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GLOBAL COMMODITY PRICE PEAKS AND GOVERNMENTAL INTERVENTIONS: THE CASE OF THE WHEAT-TO-BREAD SUPPLY CHAIN IN SERBIA – DID CONSUMERS REALLY BENEFIT?

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GLOBAL COMMODITY PRICE PEAKS AND GOVERNMENTAL INTERVENTIONS: THE CASE OF THE WHEAT-TO-BREAD SUPPLY CHAIN IN SERBIA – DID CONSUMERS REALLY BENEFIT?

GLOBALE PREISSPITZEN VON AGRARROHSTOFFEN UND STAATLICHE INTERVENTIONEN: DIE WEIZEN-BROT WERTSCHÖPFUNGSKETTE IN SERBIEN – HABEN DIE KONSUMENTEN WIRKLICH DAVON PROFITIERT?

Abstract

We analyze how the governmental market interventions, during the commodity price peaks 2007/2008 and 2010/2011, have affected the transmission of price changes along the wheat-to-bread supply chain in Serbia. We aim to investigate if consumers benefitted from the wheat and flour export restrictions or if other members along the supply chain were able to gain advantage. Our analysis of price dynamics between wheat and flour prices within a Markov Switching Vector Error Correction Model suggests that the millers increased their margin and thus profits in the aftermath of the food crisis. The simulation of bread production costs makes evident that bakeries and even more retailers profited substantially from the crisis policy. Compared with laissez-faire policy case, the significant wheat, flour and bread price increase was dampened by the governmental market interventions only at the beginning of the crisis. Additional market interventions, mainly wheat purchases, caused significant price increase on the domestic market which pushed consumers into unfavorable position. Consumers' expenditure for food was increasing followed by the increased governmental expenditures for market interventions. Overall market situation, characterized by ad-hoc policy interventions and uncertainty, was leading to the net welfare loss for the whole Serbian economy.

Keywords: Markov-Switching Vector Error Correction Model, export ban, Serbia, vertical price transmission, wheat-to-bread supply chain

Zusammenfassung

Wir analysieren wie die politischen Marktinterventionen während der Agrarpreisspitzen 2007/2008 und 2010/2011 die Transmission von Preisveränderungen entlang der Weizen-Mehl-Brot Wertschöpfungskette in Serbien beeinflusst haben. Im Mittelpunkt steht die Frage ob die Endkonsumenten von den Exportrestriktionen für Weizen und Mehl, welche von Marktaufkäufen seitens der Regierung ergänzt wurden, profitiert haben, oder ob andere Akteure der Wertschöpfungskette davon profitiert haben. Unsere Analyse der Preisdynamiken zwischen Weizen und Mehlpreisen in einem Markov-Switching Fehlerkorrekturmodell zeigt, dass die Getreidemühlen ihre Marge und damit Profite im Anschluß an die Krise erhöht haben. Die Simulationen der Produktionskosten von Brot verdeutlichen dass die Bäckereien zusammen mit den Supermarktketten erfolgreich die Brotendkonsumentenpreise erhöht haben, ungerechtfertigterweise begründet mit dem Anstieg der Weizen- und Mehlpreise auf dem Spotmarkt. Somit haben großen Bäckereien und Supermärkte von der Krisenpolitik stark profitiert. Fernen zeigen unsere Analysen dass die Endkonsumenten von den staatlichen Markteingriffen nur in beschränktem Umfang profitiert haben und insgesamt Wohlstandsverluste

erlitten haben. Verglichen mit einer Laissez-faire Politik wurde der Anstieg der Brotpreise nur zu Beginn der Krise durch die Marktinterventionen gedämpft. Die zusätzlichen starken Ansteige der Brotpreise im April 2008 sind das Ergebnis der staatlichen Weizenaufkäufe im inländischen Markt.

Schlüsselbegriffe: Markov-Switching Fehlerkorrekturmodell, Exportverbot, Serbien, Vertikale Preistransmission, Weizen-Bot Wertschöpfungskette

1 Introduction

In recent years significant commodity price increases were observed on world markets which impacted end consumer prices and had severe consequences for poor people, particularly in developing countries. By implementing a wide range of short run policy measures, many governments of importing as well as exporting countries tried to mitigate the impact of the global food crisis on their local markets. Nevertheless, the outcome was not always as intended. In the case of Serbia, which is studied in this paper, the governmental interventions on the wheat market led to local wheat prices which even exceeded world market prices.

The majority of the worldwide governmental interventions were trade oriented and based on controlling export or import flows of a country's primary commodities (DEMEKE *et al*., 2011). Even Russia and Ukraine, one of the largest grain producers in the world heavily intervened on their wheat markets during the food crisis (GÖTZ et al., 2010).

Faced with soaring international wheat prices, especially in 2007/2008 and 2010/2011, the Serbian government intensively intervened on wheat, flour and bread markets with the official aim to secure sufficient stocks for domestic utilization and to mitigate the significant increase of bread prices. Both in 2007/2008 and 2010/2011 the government intervened on wheat market in various ways 1) by posing export ban, 2) buying-out wheat from the market (only 2007/2008) and 3) removing the import tariff. This was supplemented by implementing an export quota system on the flour market.

In this paper we analyze how prices are transmitted from the farms, via the mills, to the end consumers in the Serbian wheat-to-bread supply chain. We account for the possible impact of the governmental policy measures implemented on wheat, flour and bread markets in Serbia during the periods of high commodity prices peaks in 2007/2008 and 2010/2011. Our research questions are: How fast and to which extend are wheat price changes transmitted to flour and bread prices? Are the price increase of wheat and/or flour of major impact for bread prices? We aim to investigate if consumers benefitted from the wheat export restrictions or if other members along the wheat-to-bread supply chain were able to gain advantage. Welfare economic analysis suggests that consumers benefit from an export ban or export quota by the decrease in domestic prices, whereas producers loose from the price decrease. However, a governmental buy-out from the domestic market increases domestic demand and thus increases a domestic price which leads to consumer welfare losses.

To the best of our knowledge, the effects of export restrictions on the price transmission along the supply chain have not yet been investigated comprehensively. An exemption is the WORLD BANK (2008) which finds that the margin between milling wheat prices and flour prices rose

significantly with the implementation of the wheat export system in Ukraine. VON CRAMON and RAISER (2006) find that flour and feed producers and not consumers gain from the grain export quota in Ukraine.

Our analysis consists of two parts. First we analyze price dynamics between wheat and flour prices within a Markov Switching Vector Error Correction Model (Krolzig, 1997; Brümmer et al. 2009). In addition, we simulate flour production costs and the mills' profits for two scenarios. Since data on bread wholesale prices is not available, we calculate bread production costs for different scenarios. We include the bread production costs based on the world market wheat price as our reference case. Based on our empirical results we identify who benefitted and who lost from the governmental market interventions on the wheat and flour market.

2 Chronology of the governmental policy interventions on the wheat, flour and bread markets

The Serbian government was radically intervening on the wheat and flour markets by numerous ad hoc policy measures through the Ministry of Agriculture, Forestry and Water Management (MAFWM) during the price peaks in 2007/2008 and 2010/2011. The governmental interventions were triggered by rapidly increasing wheat exports and strongly increasing wheat prices on domestic, regional and world markets. The government justified its interventions by the danger to run out of wheat and flour stocks for domestic consumption and by high food prices which would negatively affect consumers.

The Serbian government started to intervene on wheat and flour markets during their price peaks in 2007/2008. On August 4, 2007, quantitative export controls on wheat and other grains were introduced (Figure 1, WA[1]). The export quota was first announced to last for 3 months until December 2007. Although the MAFWM had announced the introduction of export quotas for wheat, export quotas were actually not issued. Thus, the wheat export was de facto completely banned (USDA, 2007).

The export restriction was triggered by record wheat exports in June and July 2007, which led to a sharp increase in domestic wheat prices by 21 % and an increase in domestic flour prices also. Since export demand for flour increased substantially, flour prices increased even stronger than wheat prices. Therefore, the price difference (margin) between flour and wheat prices even doubled (Figure 1).

Though, a strong increase in domestic wheat prices could be observed again at the end of September caused by almost doubled flour exports. Since wheat prices reached record levels in October 2007, the Serbian government decided on October 26, 2007 to extend the wheat export ban for another 125 days until March 5, 2008 (WC). Concurrently a flour export quota of 80,000 t was introduced for the same period (Figure 1, FA[2]). Dampened wheat and flour prices remained until January 2008. During the same period, the price difference between flour and wheat prices was oscillating at a very high level. The extension of the export ban until June 15, 2008 was decided on February 29, 2008 (WD). In addition, a flour export quota of 20,000 t was issued

[1] Description of labels presented in Figure 1. W - policy measures that refer directly to wheat market, A – alphabetical order of implemented policy measures.

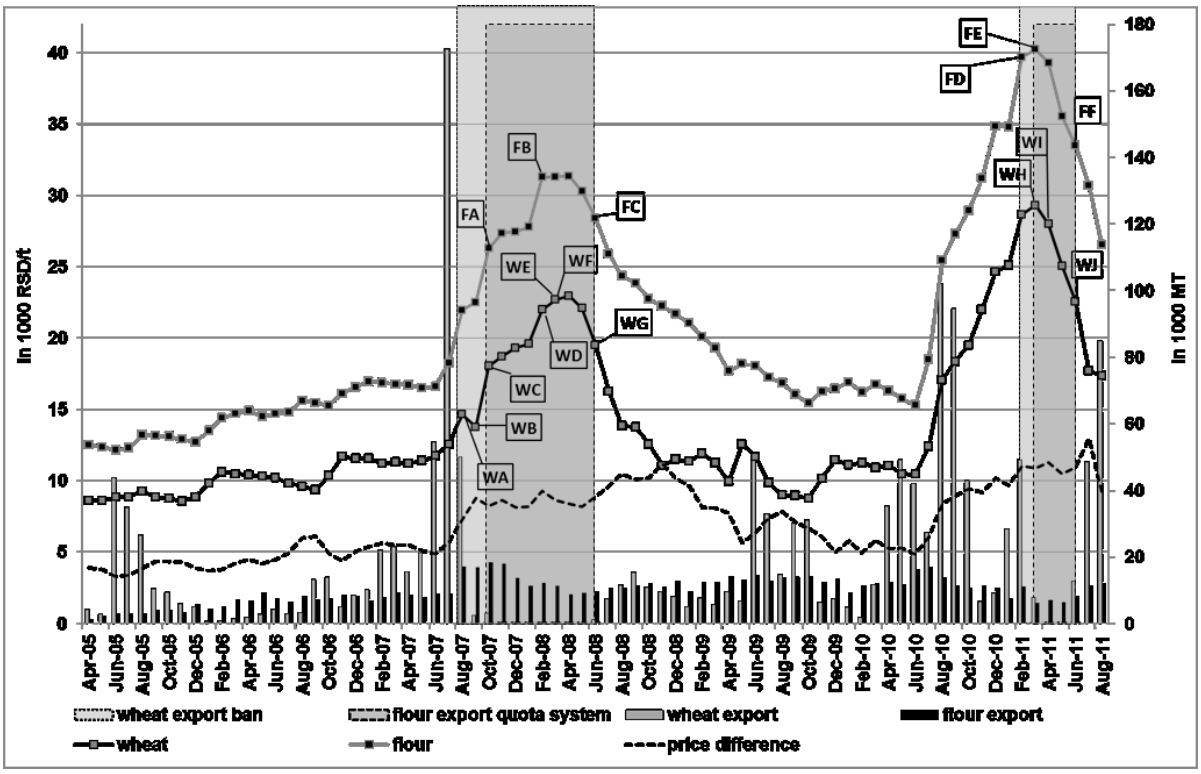
[2] Label FA refers to the policy measures introduced on flour market: F – flour market, A – alphabetical order of implemented policy measures.

(FB). Finally, the grain export ban (WG) and flour export quota system (FC) were removed on June 15, 2008.

Concurrently to the export ban, the Serbian government engaged twice in the purchase of wheat from the domestic market. In September 2007, the government announced the purchase of 60,000 t of wheat from the domestic market in order to ensure sufficient wheat stocks (WB). This induced an increase in wheat prices by about 33 % until the end of October 2007. The government again purchased about 40,000 t of wheat in March 2008 (WE) when the wheat price reached its highest historical level of 23,000 RSD[3]/t (about 438 U.S. Dollar/t).

Finally, the wheat import tariff of 30 % was abolished in March 2008 along with the implementation of an import quota of 200,000 t (WF). During the observed period, September 2007 until June 2008, flour prices were following wheat prices at almost the same % of increase.

Figure 1: Governmental policy interventions on wheat and flour markets in 2007/2011



Source: Serbia's Grain Fund (wheat prices) and GEA Information System (flour prices), own illustration
Note: Labels in Figure 1 are explained within the text

The Serbian government again intervened on the domestic wheat and flour markets at the beginning of 2011. The wheat and flour export ban4 was introduced on March 17, 2011 by the new agricultural minister who just came into office on March 14, 2011. The export ban was announced to last for 90 days for wheat as well as for flour, which was not the case during the 2007/2008 grain export ban (WH and FD). Similar to 2007/2008, the market interventions were justified by the strong increase in exports and high domestic, regional and world wheat prices.

[3] Republic of Serbia Dinar (Serbian Dinar) – official currency in the Republic of Serbia.
[4] Serbian official Gazette No. 18/11.

Two weeks later, the government announced the introduction of an export quota for flour of 33,000 t on March 31 (FE) lasting until April 1, 2011. On April 8, 2011 an import quota of 100,000 t and with tariff exemption was implemented and supposed to be valid until June 15, 2001 (WI). Though, Serbian flour exporters who had signed contracts with foreign partners before March 16, 2011 were allowed to fulfill their contracts on April 12, 2011. Finally, both wheat export ban and flour export quota system were cancelled on June 15, 2011 (WJ and FF).

Beside wheat and flour markets, the Serbian government was also trying indirectly (2007/2008) and directly (2010/2011) to intervene on bread market. The main reason was the significant increase in bread prices, which bakers were justifying by rapidly increasing wheat and flour prices on domestic market. According to our data analysis we identify three periods, between 2007 and 2008, when the bread prices were changed with indirect or no influence of the government. First price increase was at the end of August 2007. This was an unofficial agreement between the Ministry of Trade and Services (MTS), Serbian Bakery Union, and the biggest representatives of milling industry in Serbia. Second price increase was in mid-November 2007, justified by increasing wheat and flour prices. Finally, the third significant bread price increase was in April 2008. In 2010/2011 the MTS obligated the bread producers to produce at least 40 % of bread (of their total bread production) from wheat flour type 500 Also, this measure was fixing the wholesale bread trade margin on max 2 % and retail trade margin on max 7 %. This means that total trade margin should not be more than 9.14 %. In 2011, the MTS prolonged the same measure and additionally fixed the price of bread loaf to 54.22 RSD.

3 Theoretical background

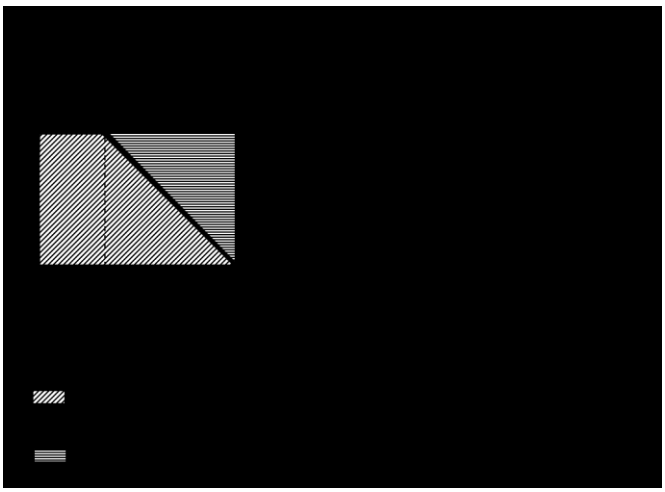
In this section we aim to provide the simple theoretical framework which enables the understanding of the effects of export restrictions (particularly export ban) on domestic agricultural markets. Here we present the impact of the export ban imposed by a small wheat exporting country (e.g. Serbia) which defers from the impact of the export ban imposed by a big exporting country by not influencing the net wheat supply on the world market, and thus there is no influence on the world wheat market price.

First, we observe the situation in the case of a free trade, meaning that there are no constrains affecting wheat exports from a small exporting country to the world market (Figure 2). In this case we assume that the world wheat market price is determined according to the equilibrium between the world market supply (S_w) and world demand for wheat (D_w). Also, we assume that domestic wheat supply (S_d) is completely inelastic in the short- run, and that OB represents the quantity of wheat produced domestically. Since there is no barrier for trade, world wheat market price will be transmitted completely to the domestic market at the level of OA. According to this price level quantity of wheat demanded domestically is equal to OC, and CB is the amount of wheat that will be exported.

Second, we introduce the case of an export ban (Figure 2). In this case the amount of wheat previously exported to the world market (CB) is shifted to the domestic market. Thus, the domestic wheat price will be reduced. Consequently, the quantity of wheat demanded domestically will increase from OC to OB. Finally, new equilibrium between domestic supply (S_d) and domestic demand (D_d) is reached in E_1.

Concerning welfare effects, the implementation of the export ban will increase the consumers' surplus (AFE_1D) in the short-run which represents the welfare gain for the consumers. On the contrary, since the domestic wheat price is reduced (from OA to OF), growers need to sell their wheat on the domestic market at a lower price. Due to the domestic price decrease and the forgone exports to the world market at a price exceeding the domestic market price, growers lose from this policy measure in the short-run. This welfare loss is presented by the area AFE_1E_0. Consequently, since the welfare loss of the producers is greater than the welfare gain of the consumers, the overall net welfare effect of the wheat export ban is negative in the short-run. The net welfare loss is shown as the area DE_1E_0.

Figure 2: Short-run welfare effects: export ban (small country)



Source: own illustration.

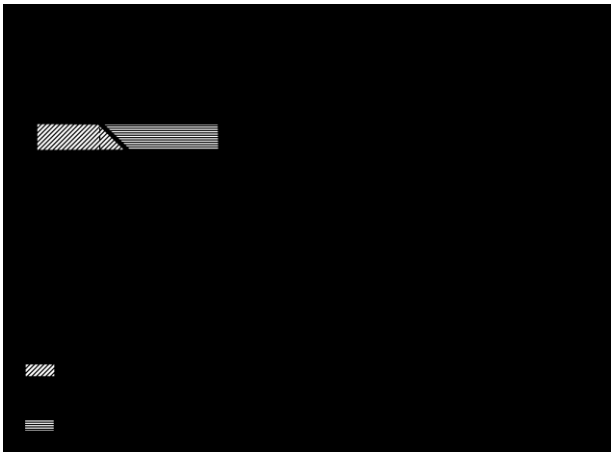
Price decreasing effects on the domestic market can be expected from a flour export quota as well. This supposes that the export quota is binding, meaning that the quota is filled and exports are reduced. However, the flour export quota in Serbia 2007/2008 was not binding, and thus flour exports were actually not completely restricted. For comparison, assume that the Serbian government would not intervene on the market and wheat trade would be fully liberalized (laissez-faire policy case). This situation is presented in Figure 3. If we assume that the world wheat supply is reduced, this shock on the market will cause world supply curve (S_w) to shift to the left (S'_w). Consequently, world wheat market price (OA) will increase to the new level (OA').

Given perfectly competitive and efficient markets, the price increase on the world market will be transmitted completely to the domestic wheat market and thus the domestic wheat price would increase to the world market price level. The quantity of wheat demanded on the domestic market will decrease from OC to OC', whereas producers would increase export from CB to C'B. Therefore, Serbian consumers would experience short-run welfare losses (A'ADD'), whereas producers would realize welfare benefits ($A'AE_0E_1$). Under the assumption of fully inelastic domestic supply, the overall net welfare will be positive ($D'DE_0E_1$) since the welfare gain of the producers is greater than the welfare loss of the consumers.

Summarizing, from theory we can see that the implementation of the wheat export ban has a negative welfare effect for the whole economy in the short-run, although the consumers might benefit due to temporarily reduced prices on the domestic market. In laissez-faire policy case, and

under the assumptions of perfectly competitive and efficient markets and completely inelastic domestic supply, full transmission of prices from the world market to domestic market should result with positive net welfare effects for the whole economy. In the case of increasing world market price, welfare gains of the producers will be greater than the welfare loss of the consumers, and vice versa in the case of the reduced world market price.

Figure 3: Laissez-Faire Policy



Source: own illustration.

4 Methodology and data

In order to identify the impact of the policy measures on individual wheat-to-bread supply chain members we divided our estimation approach in two steps.

First step refers to the analysis at the level of milling and baking industry. We conduct the vertical price transmission analysis in order to identify the transmission of price signals from domestic wheat market to the domestic flour market. Further on, we estimate the profit of millers for the entire observed period. Additionally, we simulate the millers' profit for the laissez-faire policy case in order to compare the results with our previous estimations.

Second step refers to the analysis at the level of baking industry, retailers and end consumers. Here we estimate bread production cost according to the different wheat price development scenarios. Additionally, we simulated the distributable bread margin also depending on different wheat price developments.

4.1 Estimation approaches at the level of milling and baking industry

We start investigating the transmission of price signals along the wheat-to-bread supply chain, in times of comprehensive governmental market interventions, by analyzing the transmission of price signals from wheat to flour prices.

We choose a regime-switching model framework to analyze price transmission. We assume that the price transmission regime might alter due to the manifold changes in wheat and flour market policy, as explained in section 2. Even though the exact dates of the implementation of the policy measures, as e.g. the grain export ban, are known, market participants might react at different

points of time. Market actors can change their behavior according to their expectations before the new policy measure is introduced or abolished, or may react with a certain delay. Therefore, we choose a Markov-Switching price transmission model which can be applied even when the state of the market changes and several price transmission regimes prevail. It allows distinguishing different price transmission regimes even if the state variable, which governs the regime switches, cannot or can only incompletely be observed.

The Markov-Switching model is tracing back to HAMILTON (1989) who extended the approach of GOLDFELD and QUANDT (1973) about the switching regression model. KROLZIG (1997) developed the MSVECM as a special case of the more general Markov-Switching Vector Autoregression Model. The MSVECM is widely used in the analysis of business cycles and financial research. Recently BRÜMMER *et al.* (2009) introduced this model in price transmission analysis.

We choose the unrestricted Markov-Switching Vector Error Correction Model as a model framework for our price transmission analysis:

$$\Delta p_t^f = \nu(S_t) + \alpha(S_t) p_{t-1}^f + \delta(S_t) p_{t-1}^w + \varepsilon_t \tag{1}$$

where Δ is the first difference operator, p_t^f gives the price of flour, p_t^w represents the price of wheat, ν is the intercept terms, α and δ are the speeds of adjustments, i.e. the speed with which deviations from the long-run equilibrium between flour and wheat prices are corrected by the price adjustments of the flour or wheat prices, respectively. The core element of the MSVECM specification is the state variable $S_t = 1,....,M$. This is an unobserved variable indicating which of the M possible regimes governs the MSVECM at time *t*. Terms $\nu(S_t)$, $\alpha(S_t)$ and $\delta(S_t)$ show the dependence of these parameters on the state variable S_t .

The intercept of the long-run equilibrium (β_0) and the long-run price transmission parameter (β_1) are estimated indirectly according to following formulas:

$$\beta_0 = -\frac{\nu}{\alpha} \tag{2}$$

$$\beta_1 = -\frac{\delta}{\alpha} \tag{3}$$

The level of statistical significance of these coefficients is estimated by delta method (PATTERSON, 2010). The basic assumption of the Markov-Switching model is that the data generating process underlying the state variable (S_t) follows a Markov-chain implying that the probability of switching to a new state (S_{t+1}) only depends on the state of the proceeding period (S_t) and thus is independent of the regime's history.

The estimation of a MSVECM is based on maximizing the likelihood function with the Expectation-Maximization algorithm developed by DEMPSTER *et al.* (1977). Later, this algorithm was significantly improved by HAMILTON (1990) and KIM (1994). A detailed explanation of the solution algorithm is given by KROLZIG (1997).

In general, the estimation procedure is divided in two steps. First, the parameters characterizing the unobserved state variable and transition probabilities are estimated conditional on the starting

values of the coefficients being estimated. In the second step the starting values are updated based on the estimated parameters in the first step within an iterative procedure. The procedure is stopped when the estimated parameters of two consecutive estimations do not differ significantly. The estimation procedure is available in the MSVAR package (KROLZIG, 2006) for the matrix programming language Ox (DOORNIK, 2002).

After conducting vertical price transmission, the second step is to estimate the flour production cost and millers' profit in order to identify if millers benefited or loss during the governmental interventions.

The flour production costs and the millers' profits strongly depend on the flour extraction technology. According to PRPA (2004), more than 30 different flour production technologies are used in Serbia, differing in the type of the extracted flour and the generated by-products. The primary flour types are T 500 and T 400, which are mainly used for the production of bread and confectionary products, respectively. Therefore, our calculations are based on the flour extraction technology which extracts 53 % flour type T 500, 15 % of flour type T 400, 10 % of flour type 850, 20 % of fodder flour and 2 % other by-products.

We calculate the millers' revenue (R_t) at each point of time (t) as the sum of the five kinds of extracted flour valued by the respective weekly spot market prices by the following formula:

$$R_t = \sum_{M=1}^{k} \sigma(M) p_t^f \tag{4}$$

$$\sigma(M) = \begin{cases} \sigma_1 \; if \; M = 1 \\ \vdots \\ \sigma_n \; if \; M = k \end{cases} \tag{5}$$

where $M \in \{1, \dots, k\}$ and $\sigma \in \{1, \dots, n\}$ depend on the flour extraction technology. Thus, in our case σ_1 = 0.53, σ_2=0.15, σ_3=0.1, σ_4=0.2, and σ_5=0.02. Also, in this case M=1 corresponds to flour type T 500, M=2 to flour type T 400 and so on.

By deducting respective costs, from the miller's revenue, we are able to calculate the potential millers' profit (π_t) which is presented by the following equation:

$$\pi_t = R_t - p_t^w - C_t \tag{6}$$

Where p_t^w stands for the wheat prices and C_t stands for other costs (in our case we account for packaging cost which we assume to be fixed at the level of 0.5 RSD/kg).

In our calculations we use three different wheat prices in order to simulate three different scenarios (Figure 4).

Scenario 1 refers to mills which do not have access to large silos and continuously buy wheat on the spot market. Thus, the flour production costs and millers' profit are simulated based on the wheat spot market prices. This scenario is relevant for the numerous of small mills which are dominant in villages in the rural areas of Serbia.

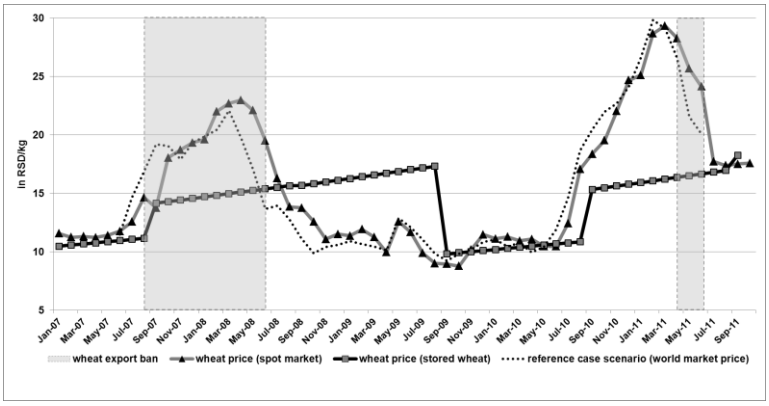
Scenario 2 is based on the wheat spot market price prevailing during the previous harvest (July/August) and the relevant wheat storage costs. This scenario refers to large industrial mills in

urban areas, particularly in Belgrade[5]. Wheat prices which accounts for certain storage costs is calculated by the following formula:

$$p_{S_{t+i}}^{w} = \left[\left(\overline{p_t^w p_{t+1}^w}\right)\gamma\right]\omega_i \tag{7}$$

where $p_{S_{t+i}}^{w}$ represents the price of wheat stored until *i* period of time (in the presented calculations wheat can be stored maximum for 12 months starting from September). p_t^w is the wheat spot market price during the first month of the harvest (wheat harvest in Serbia usually starts in July). p_{t+1}^{w} is spot market price in the second month of the harvest (harvest can rarely be extended to the first days of August). □ stands for the silo handling costs which includes quality control costs and the costs for the physical transfer of wheat into the silo (this costs are usually about 3 % of the wheat purchase price). Parameter ω_i represents monthly storage costs (1 % per month).

Figure 4: Monthly wheat spot and storage prices in Serbia, 2007/2011



Source: SERBIA'S GRAIN FUND.

Scenario 3 is a hypothetical reference case scenario which is used in order to reflect the situation if the Serbian government did not react on the market (laissez-faire policy case). In order to present the most realistic situation the Hungarian[6] wheat spot market prices have been used since Hungary is the biggest regional wheat export competitor of Serbia, and its government did not intervene on the wheat market during the global commodity price peaks in 2007/2008 and 2010/2011. Thus, Hungarian wheat prices are reflecting the most possible prediction of wheat price development on the Serbian market. In order to simulate the millers' profit, under the laissez-faire policy case, we needed to estimate the flour spot prices in the case that Hungarian wheat price level ("world" price level) was prevailing on the Serbian market. In order to do so we used the results from the price transmission analysis. Namely, we used the following formula:

$$ln\ p_i^f = \beta_0 + \beta_1 ln\ p_i^w \tag{8}$$

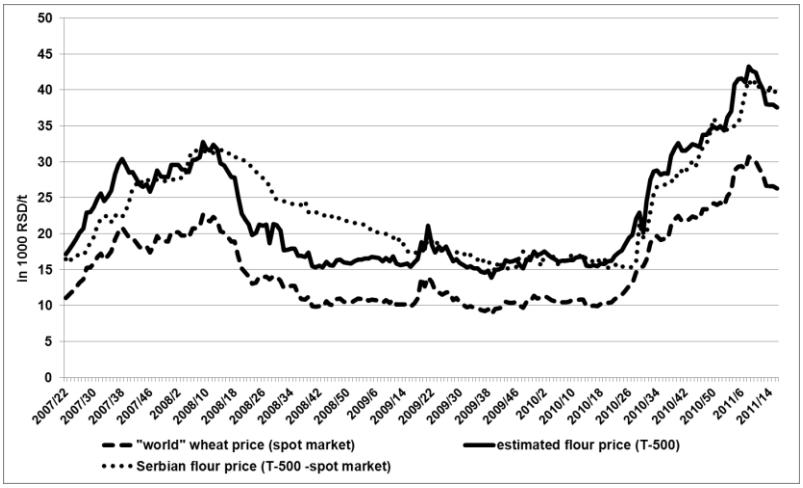
where p_i^f refers to the estimated flour prices (for flour type 500) depending on the respective "world" wheat spot market price p_i^w. Coefficients β_0 (constant) and β_1 (long-run price

[5] The capital city of the Republic of Serbia. Population: approximately 1.6 million people.
[6] See section 4.3 (data description).

transmission parameter) are retrieved from the MSVECM for each regime. The results of the estimated flour price are presented in Figure 5.

After estimating the spot market prices for flour type 500 we estimated the price of other flour types by multiplying it with the % of price difference between Serbian flour type 500 and other flour types which are used in previous scenarios. By estimating the spot market prices for all types of flour, under the laissez-faire policy case, we are able to simulate the millers' profit by deducting the spot "world" wheat prices from the estimated millers' revenue as it is previously explained.

Figure 5: Estimated flour prices (laissez-faire policy case)



Source: own illustration.

4.2 Estimation approaches at the level of baking industry, retailers and end consumers

Simulations of bread production costs and retailers' profit have been conducted according to the structure of the average production costs of bread loaf presented in (Table 1). All presented costs are average costs of the big industrial bread producers in Serbia. Thus, they are not presenting the exact cost of bread production for one specific bakery. This cost structure would significantly vary if it is observed for small artisanal bakeries. The results of the simulations (bread producer price and bread wholesale price) were compared with the end consumer bread prices in order to estimate the retailers' profit for the observed time period[7].

Table 1: Average bread production cost structure

No.	A) bread producer price (production costs)	No.	B) bread wholesale price (A+)	No.	C) end consumer bread price (B+)
1	flour (370 g)	6	transport	10	retailers margin
2	gross wages	7	cost of bread return	11	VAT
3	energy	8	other costs		
4	general costs	9	wholesale margin		
5	amortization				

Source: ZITOVOJVODINA, own illustration.

[7] Because of the lack of data, simulations are only referring to the time period 2007/2008.

Concerning bread production costs simulations certain assumptions have been made. Thus, cots of flour are allowed to vary according to the change in the monthly price of wheat. The costs of gross wages are allowed to change according to annual percentage change in gross wages within the food processing sector. Energy costs (mainly electricity) were adjusted according to the known annual price increase. Transport costs (mainly fuel prices) were allowed to change according to the percentage change in monthly diesel prices. The general costs, amortization, costs of bread return and other costs were assumed to be constant during the simulation period.

The estimated bread producer price is the first result of the simulation. It is calculated by summing up the costs of flour (370 g), gross wages, energy and other common costs (general costs and amortization). The second result is the estimated wholesale bread price. It is calculated by adding the transport costs, other costs and bakers margin on the producer bread price. For the purpose of this simulation the bakers' margin[8] is set to be a constant value of about 1 RSD/bread loaf which is about 4 % of the wholesale bread price in average.

In order to identify the distributable surplus coming from selling bread, the additional simulations have been made. Namely, the potential distributable surplus has been simulated by deducting the wholesale bread price from the end consumer bread price (without VAT).

All bread production cost simulations are conducted for three possible scenarios, differing in the underlying wheat price. Scenario 1 refers to large industrial bread producers which buy wheat during the harvest, have access to silos, and produce flour, which can only be stored for about 4 weeks, in their own mills. In this scenario, flour is produced from stored wheat according to the bakery's production plan. Therefore, additional monthly wheat storage costs (September 2007 until August 2008) are added to the wheat spot market price prevailing during harvest of the particular marketing year, respectively.

Scenario 2 is a hypothetical scenario based on a bread production cost structure as given in scenario 1. However, we assume that flour is produced from the actual wheat spot market price. We estimate this scenario since large bakeries in Serbia generally justify bred price increases, particularly those in August 2007 and April 2008, by increases in the wheat spot market price.

Scenario 3 is a hypothetical scenario for the average bread production costs which is based on the world wheat market price. Again, as it was the previous case of flour production costs, we choose the Hungarian wheat market price as the relevant world market price. This scenario serves as our reference case representing bread production costs in the laissez-faire policy case, thus without any policy interventions in the wheat and flour market.

Concerning consumers, we mainly concentrate on estimating the food expenditure (especially for bread and cereals). We focus on a very poor part of the population which is the most vulnerable concerning significant food price changes.

4.3 Data

For the first step in our empirical approach, we use weekly wheat grower prices (milling quality) measured as the F.C.A.[9] silo selling price, obtained from SERBIA'S GRAIN FUND, and weekly

[8] According to experts, bakers' margin is usually less than 6 % of the wholesale bread price.

[9] F.C.A. – Free Carrier – (named place) – The seller hands over the goods, cleared for export, into the custody of the first carrier (named by the buyer) at the named place (INCOTERMS, 2010).

F.C.A. wheat flour[10] mill selling prices as a measure for the flour wholesale price obtained from GEA INFO CENTER (Figure 1). Prices are presented in RSD/t since we are observing vertical price transmission on the Serbian domestic market. For the analysis we use both price pairs in natural logarithms. Our dataset covers 335 observations from April 2005 until August 2011.

Additional to the main data set used for the price transmission analysis, we use two more datasets in order to investigate the impact of policy interventions on the members of the wheat-to-bread supply chain. Thus, we use average monthly F.C.A. spot market prices for the flour types: T 450, T 850, fodder flour, bran and other flour types provided by the GEA INFO CENTER. This dataset covers 58 observations from January 2007 until October 2011. All prices are expressed in RSD/t. Also, we use average monthly end consumer bread prices obtained from the STATISTICAL OFFICE OF THE REPUBLIC OF SERBIA for the period April 2005/ July 2011 covering 75 observations. Bread prices are expressed in RSD/bread loaf[11] and they refer to the bread produced from wheat flour type T 500 (Figure 2).

In order to simulate the hypothetical case scenario (laissez-faire policy case) we use Hungarian weekly wheat EXW[12] silo selling prices provided from the Serbia's Grain Fund. Data are covering period from June 2007 until December 2011 (Figure 1). All prices are recalculated to the RSD/kg. Exchange rate is obtained from the NATIONAL BANK OF SERBIA.

5 Empirical Results

5.1 Empirical results at the level of milling and baking industry

Prior to the co-integration analysis and model estimation we conducted the Augmented Dickey Fuller (ADF) test (DICKEY and FULLER, 1979) and KPSS test (KWIATKOWSKI *et al.,* 1992) in order to identify the order of integration of the price series. For selecting the proper lag length of the autoregressive process we used Akaike Information Criterion (AIC) as well as Schwarz Criterion (SC). Both, ADF and KPSS, tests are indicating the presence of a unit root in wheat and flour prices in levels since we could neither reject the null hypothesis of a unit root (ADF-test) or the null hypothesis of level stationarity (KPSS test). Thus, using the first differences of price series both tests provide us with strong evidence of stationarity. Hence, both series are found to be integrated of order 1.

Further on we test time series for co-integration. We used Johansen's test (JOHANSEN, 1995) on co-integration, based on a reduced rank regression of the vector autoregressive representation with two lags[13], suggests that the wheat and flour price series are co-integrated. This can be interpreted economically that a long-run equilibrium between the wheat and the flour market exists, and that the markets are integrated. Thus, the preconditions for utilizing a Vector Error Correction Model (VECM) are given.

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[10] Wheat flour type T 500 mainly used for bread production.

[11] One bread loaf has 500 g.

[12] EXW – Ex Works (named place of delivery) – The seller makes the goods available at its premises (INCOTERMS, 2010).

[13] Number of lag length is selected according to Schwarz Criterion (SC).

We used the following VECM formulation:

$$\Delta p_t = \alpha\beta' p_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta p_{t-i} + \varepsilon_t \quad (9)$$

where p_t represent a vector of prices of products at the different level of the supply chain. Δ donates the first difference operator $(\Delta p_t = p_t - p_{t-1})$. The matrix β contains the coefficients of linear combinations of the prices p_t interpreted as stationary long-run relationships between the prices. Thus, β donates the co-integration vector. Term $\beta' p_{t-1}$ is equal to ect_{t-1} which quantifies the equilibrium errors of each co-integration relationship for each point in time. α donates the matrix containing the rates at which the price differences Δp_t react on the deviations from the long run equilibrium which are quantified by $\beta' p_{t-1}$. Thus α presents the speed of adjustment which means the time lag needed for a shock at one stage of the supply chain to be transmitted (partially or fully) to another stage. Matrices Γ_i contain the short-run reactions of the price differences on past differences and ε_t donates an error term.

We conducted the diagnostic tests for the linear VECM by performing Lagrange-multiplier (LM) test for residual autocorrelation and Jarque-Bera test for normal distribution of disturbances. The presence of serial correlation was identified $\chi^2(2)=12.62$ ($\rho=0.01$), as well as non-normality of disturbances ($\rho=0.00$). Thus, we checked the system for the stability by using a Chow breakpoint test (CHOW, 1960). The null hypothesis assumes that all parameters in the system remain constant over the entire time period. Contrary, alternative hypothesis assumes that all coefficients except β and residual covariance matrix change. The bootstrapped procedure[14] was used in order to calculate the empirical ρ-values for different breakpoints[15] since the Chow test statistic is asymptotically distributed as χ^2, whereas the actual distribution under the null hypothesis is non-standard (BRÜMMER *et al*., 2009; CANDELON and LÜTKEPOL, 2001). Since some of the ρ-values of the breakpoints lie below 0.05 it indicates that there might be several structural breaks in the linear VECM. Additional to the Chow test we conduct the τ-Test (HANSEN and JOHANSEN, 1999) which is used for testing the stability[16] in the co-integrating vector. The test results are suggesting that the long-run equilibrium relationship is at the border of stability (at 5 % critical level) throughout the whole time period underlying our analysis.

Since all previously described tests are indicating that the linear VECM is not an appropriate representation for our data, we decided to use a regime-switching model framework. Thus, we decided to estimate a MSVECM within an unrestricted framework, which allows not only the short-run price transmission parameters but also the parameters specifying the long-run equilibrium to change during the observed time period.

We select the final specification of the MSVECM according to the Akaike Information Criterion (AIC), Schwarz Criteria (SC) and Hannan and Quinn (HQ) model selection criteria. All three criteria suggest a model with 2 regimes and 2 autoregressive parameters (MS(2)VECM(2)). Our

[14] We account for 1000 bootstrap replications.

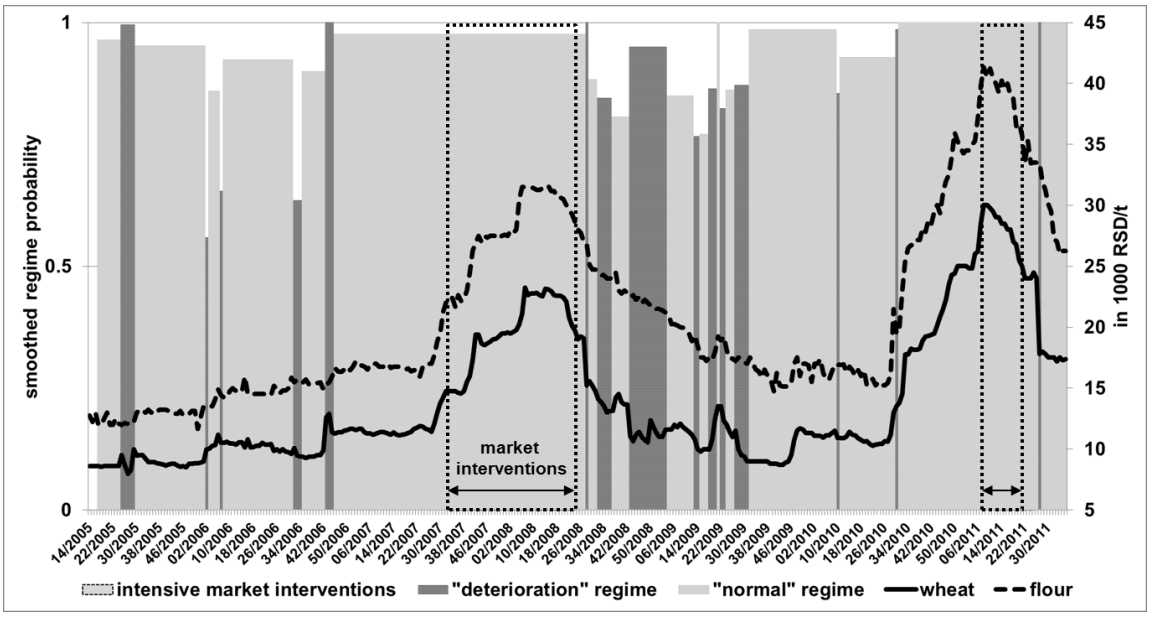
[15] We used every week as a possible breakpoint.

[16] Potential instability could originate from the speed of adjustment α, the slope coefficient β, or both (BRÜMMER *et al*., 2009).

optimal model is of the type MSIAH[17] which allows all model parameters to switch between the regimes. The model diagnostics indicate that autocorrelation and heteroscedasticity are not present. Nevertheless, non-normality of the residuals prevails.

Our model results are illustrated by Figure 6. It shows the smoothed regime probabilities and indicates the probability of the most likely regime to which one observation is attributed. Our model identifies 2 regimes. We call one regime "normal" regime, and the second regime "deterioration" regime. Our model is in the "normal" regime with a probability of 84 % during the observed period. The model attributes 278 observations to this regime with an average duration of 15 weeks. In certain periods, the "normal" regime is supplemented by the "deterioration" regime comprising 54 observations with a regime probability of 16 % and an average duration of almost 3 weeks. This indicates that "deterioration" regime appears very rare and lasts for a very short time.

Figure 6: Regime classification



Source: own illustration based on the model specification.

The "normal" regime prevails during the entire time period underlying our analysis and is characterized by an estimated long-run price transmission parameter (elasticity) of flour prices with respect to wheat prices of 0.908 (Table 2). Also, the speed of adjustment in the normal regime is statistically significant and it has the correct negative sign. This suggests that the wheat and flour market are integrated, and that the equilibrium errors are adjusted in the expected direction. Since the "normal" regime prevails in times of the intensive governmental interventions in 2007/2008 and 2011 as well, our results indicate that the governmental market interventions did not affect price transmission between wheat and flour markets.

The estimated long-run price transmission parameter in the "deterioration" regime is smaller than in the "normal" regime with a long-run price transmission parameter of about 0.6 (Table 2). Also,

[17] This means that we allow the intercept (I), the short-run price transmission, the autoregressive parameters (A), and the variances/heterogeneity (H) to switch between the regimes.

the speed of adjustment in this regime is not statistically significant indicating that the integration between wheat and flour market is disrupted The "deterioration" regime mainly prevails in the aftermath of the commodity price peaks in 2007/2008 as well as 2010/2011, when wheat prices are retrieving back to their pre-crisis level. However, the downstream trend in wheat prices is obviously not transmitted to the flour prices in this regime. We suspect that the dampened transmission of wheat price decreases to flour prices might result from market power exerted by the milling industry. This is also reflected in the regime-specific average ECT term.

Table 2: Selected parameter estimates of the MS(2)-VECM(2)

Market	Indicator	"normal" regime	"deterioration" regime
Long-run price transmission	Elasticity (β_1)	0.908* (9 %) [a]	0.598 (40 %) [a]
	Constant (β_0)	1.293	4.142
Equilibrium			
Deviation from equilibrium	Regime specific Avg. ECT	-0.0179	0.1136
Adjust. dynamics	Speed of adjustment	-0.1126**	-0.0181
Stability			
Price fluctuation	Residual standard error	0.0354	0.0115

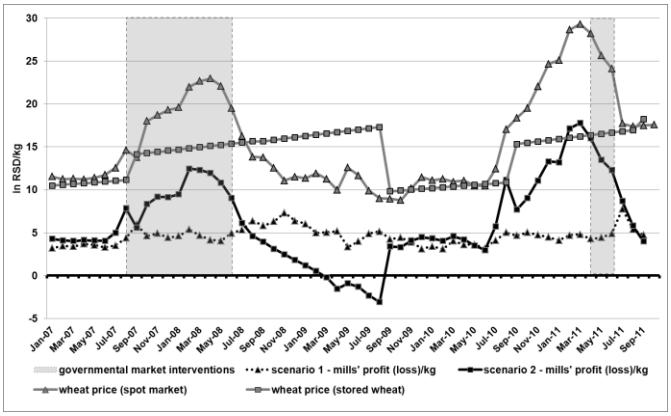
[a] difference from the perfect price transmission (β=1);
* indicates statistical significance at 5%;** indicates statistical significance at 1%.
Source: own illustration.

Since price transmission results suggests that the millers might have increased their profits in the context of the price peaks 2007/2008 and 2010/2011 we further investigate how the millers' profits developed during the observed time period.

Figure 7 shows the simulated millers' profits for scenario 1 and 2. It becomes evident that the profits in scenario 2 are substantially higher than in scenario 1 in times of governmental market interventions. Particularly, the millers' average profit was up to more than 2 times higher at some points of time during the first crisis period (August 2007 to June 2008), and up to almost 4 times higher during the second crisis period (March 2011 to June 2011). Nevertheless, the millers also experienced some losses from March to August 2009 according to scenario 2, which is relevant for the majority of the mills in Serbia.

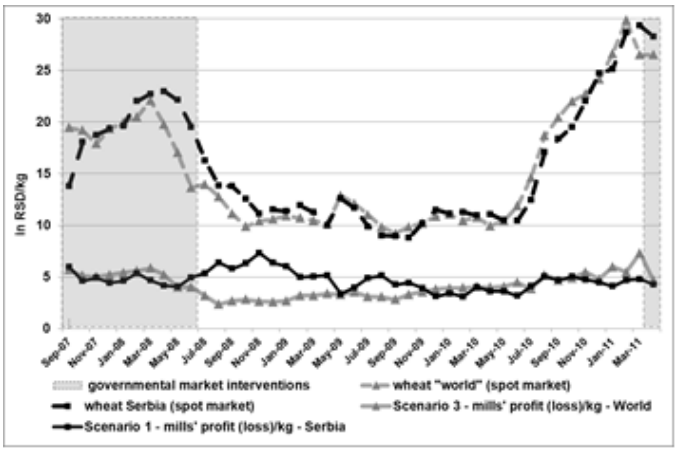
In order to identify if miller really benefited from the governmental market interventions we compared the simulated millers' profit from scenario 1 and 2 with the simulated millers' profit from scenario 3 (laissez-faire policy case). Figure 8 shows the comparison between estimated millers' profit in scenario 1 and scenario 3. We can observe that even in the situation that the Serbian government did not intervene on the market (Scenario 3) millers' profit was almost at the same level as in scenario 1. Nevertheless, it is clear that millers in scenario 1 had an opportunity to earn extra profit after the cancelation of the governmental measures since flour prices in scenario 1 were declaiming much slower than in scenario 3 which is shown in price transmission analysis. Concerning the comparison between scenario 2 and scenario 3 (Figure 9), it is clear that millers in scenario 2 benefited from the governmental market interventions and especially in the period before the cancellation of policy measures. Though, our simulations suggest that millers profited overall from the governmental crisis policy. Finally, most of the millers in Serbia are

Figure 7: Estimated mills' profit per kg of flour, scenario 1 and 2



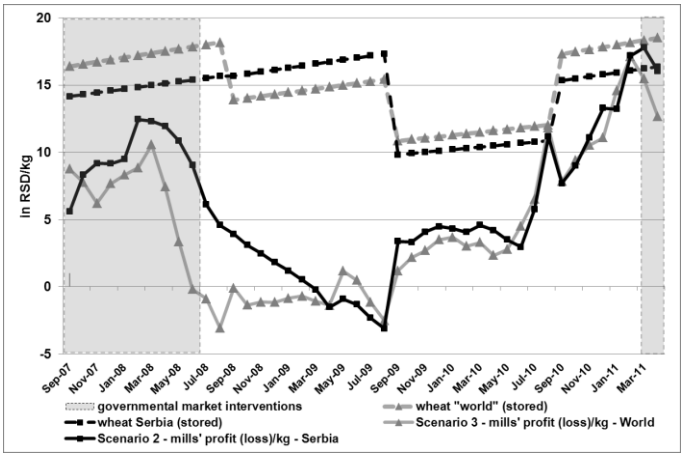
Source: GEA INFO CENTER and SERBIA'S GRAIN FUND, own illustration.

Figure 8: Estimated mills' profit, scenario 1 and 3 (laissez-faire)



Source: GEA INFO CENTER and SERBIA'S GRAIN FUND, own illustration.

Figure 9: Estimated mills' profit, scenario 2 and 3 (laissez-faire)



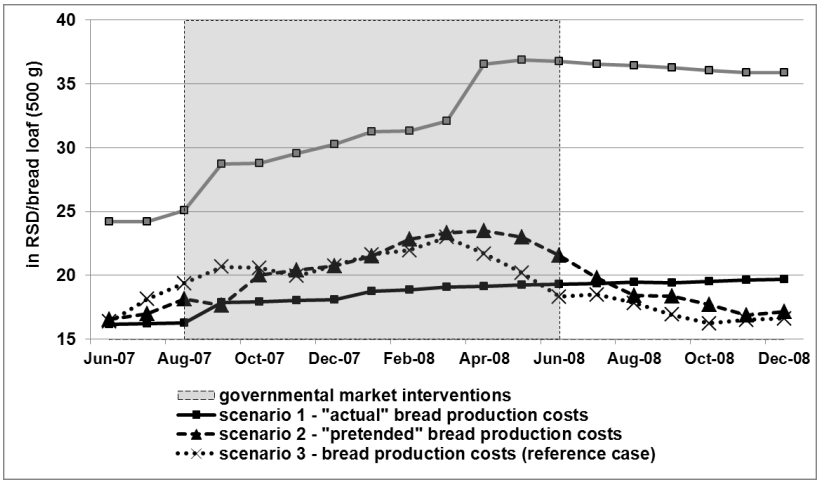
Source: GEA INFO CENTER and SERBIA'S GRAIN FUND, own illustration.

using the strategy presented in scenario 2. Market situation in 2010 had a significant impact on milling industry together with the financial crisis which is present since 2008. It is not clear which percentage of millers could actually use the opportunity to earn profit presented in scenarios 1 and 2 since they present the average estimated profit/loss of the millers according to the different milling strategies and spot market prices. Milling business is a low margin business, meaning that only big flour producers can manage to overcome the crisis periods which is not the case with small artisanal mills.

5.2 Empirical results at the level of baking industry, retailers and end consumers

Together with millers, big industrial bread producers were trying to raise the end consumer price of their products (i.e. flour and bread) according to the increase of inputs costs (i.e. wheat). According to the results obtained from the bread production costs simulations, it can be observed that big industrial bread producers manage to improve their situation during the governmental interventions in 2007/2008. Figure 10 represents the summary of three different scenarios. It shows that the bread production costs in scenario 1, which represent the "actual"[18] production costs, are significantly lower than the "pretended" production costs given by scenario 2 during the whole time period of governmental interventions. The results are indicating that bread producers were affected by the significant wheat and flour price increases on the spot market only

Figure 10: Simulated bread production costs and end consumer bread prices, 2007/2008



Source: own calculations, Zitovojvodina and SERBIA'S GRAIN FUND, own illustration.

during the harvest in July and August 2007. However the export restrictions for wheat and flour were implemented in the aftermath of the harvest 2007. Nevertheless, the bakeries (together with the retailers) were successful in increasing the end consumer price of bread wrongful justified by the increases in the wheat and flour spot market prices.

[18] The main difference between "actual" and "pretended" cost structure is in the price of wheat. Big industrial bread producers are using stored wheat (which is used for "actual" cost structure calculation) while, in the same time, they justify bread price increase with an increase in the spot market wheat prices (which is used for "pretended" cost structure calculation).

Additional increase in profit appeared after the wheat and flour prices started to record significant downstream trend, after the cancellation of the governmental interventions in June 2008, which was not followed by the decrease of bread prices. Thus, in contrast to the bakeries' argumentation, the bread production costs of bakeries with own silos and mills were not at all affected by the wheat price changes on the Serbian spot market (September 2007/June 2008).

Without the governmental market interventions and thus with world market prices prevailing on the Serbian spot market (scenario 3 - laissez-faire policy case), the bakeries (and retailers) would not have been able to realize particularly the second dramatic bread price increase in April 2008 since the world wheat market prices were recording strong downstream trend.

Additionally to bread production cost simulations, we simulate the distributable surplus (potential profit) of bakers and retailers for the three possible scenarios. Figure 11 shows the maximum achievable margin[19] in all three scenarios with corresponding baker's loss[20] and distributable surplus[21]. The results are showing that bakers were making loss, in average, during the period of significant wheat and flour price increase (before the governmental interventions). According to experts, by producing the so called "social" bread, bakers were always at the edge of profitability. Thought, potential loss on this type of bread was covered by the profit on other bakery products. After the governmental interventions and two significant bread price increases (August and November 2007), bakers improved their situation. After the bread price increase in April 2008, bakers were able to achieve significant profit. According to experts, retailers were always making profit out of selling bread. The minimum retailers' margin is about 10 % of the bread wholesale price. Thus, after the bread price increase in April 2008 retailers were able to increase their margin and achieve up to four times higher profit (Scenario 1, Figure 11).

Even if we consider the distributable surplus in scenario 2, where we account for high spot wheat market prices as an important input cost in bread production, it becomes evident that bakers and especially retailers improved their situation after the second bread price increase in April 2008 (Scenario 2, Figure 15). Thus, arguments of bakers and retailers for increasing the end consumer bread price were not justified. This is confirmed also in scenario 3, the laissez-fare policy case, where we can drown the same conclusion (Scenario 3, Figure 11).

To summarize, big industrial bread producers, together with retailers, benefited from the export restrictions on wheat and flour markets since they manage to increase the end consumer price of bread arguing with high input costs. Additionally, they made substantial profit after the cancellation of the governmental interventions, by not reducing the end consumer price of bread according to the decrease in wheat and flour prices arguing that the other input costs increased severely. Concerning consumers, the Serbian government exerted significant pressure by the media and public to protect consumers from the increasing world and domestic food prices since the beginning of 2007. This was one of the main reasons why the government intervened on the domestic wheat and flour markets. Nevertheless, prices for wheat continued to rise sharply even

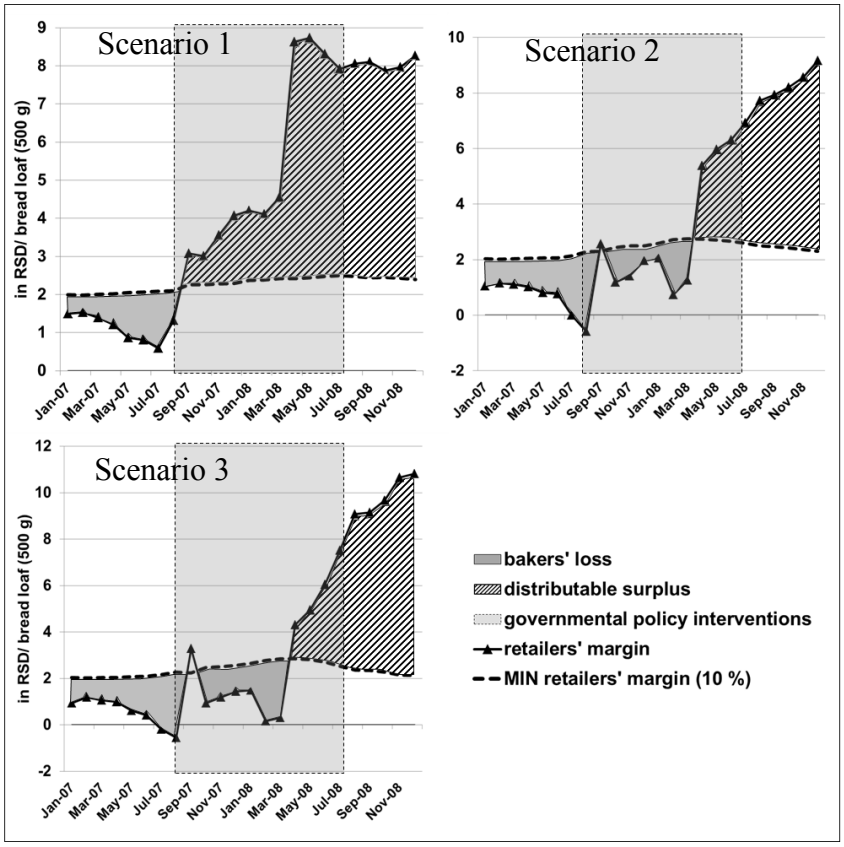
[19] Margin is calculated as the difference between the end consumer bread price (reduced by the value added tax) and the estimated wholesale bread price.

[20] According to experts, minimum retailer's margin is about 10 %. Thus, if the calculated margin is below the value of 10 %, than bakers are bearing this loss.

[21] Distributable surplus refers to the possible profit made from selling one bread loaf. According to experts this value is distributed between retailer and baker. Though, baker's margin usually is not higher than 6 % of the end consumer bread price. Thus, the biggest part of the distributable surplus is gained by retailer.

after the implementation of the export ban. This implied that the prices for flour, bread and other processed wheat products also increased significantly. According to the Statistical Office of the Republic of Serbia, retail prices for the flour type 500 (1kg) and "social" bread (0.5 kg) raised by 75 % and 52 %, respectively, from July 2007 until July 2008. During the same period, prices for goods in the consumer basket increased by 18 %.

Figure 11: Simulated retailer's margin



Source: own calculations, ZITOVOJVODINA and SERBIA'S GRAIN FUND, own illustration.

Certainly, the significant bread price increase in 2007/2008 hit the poorest population the most. According to the Study of Living Standard in Serbia for 2002-2007 (SORS, 2008) about 490,000 people were identified as poor in 2007, or about 6.6% of total population. The identification of poor people was done by setting the poverty line which was about 8,883 RSD/month in 2007. Thus, 6.6 % of Serbian population had expenditure less than the poverty line. Nevertheless, extreme poor people were not identified, which means that their expenditure was lower than the extreme poverty line of 4,138 RSD/month. If the level of monthly expenditure of poor people is compared with an average monthly expenditure for bread and cereals in 2007 (2,027 RSD), the result is indicating that poor people were spending about 23% of their total expenditure on bread and cereals. By assuming that total expenditures of poor people is fixed at the level of poverty line of 8,883 RSD/month, the increase of bread prices of 52% will increased the expenditure for bread and cereals of poor population by 31% to the level of 30% of total expenditure.

According to the results from the previously described analysis, mainly from the simulations of bread production costs and retailers margin, it becomes evident that the consumers did benefit

from the governmental interventions only to a limited degree. The results suggest that compared with the reference case scenario, the bread price increase was dampened by the governmental market interventions only at the beginning of the crisis (August and September 2007), when the Serbian wheat spot market price was lower than the world wheat market price due to the wheat and flour export restrictions. However, it induced an additional bread price increase in April 2008 due to the dramatic increase in the wheat spot market price beyond the world market price caused by the governmental purchase of wheat from the Serbian market.

Further calculations show that the consumers experienced welfare losses from the governmental crisis policy. Consumers which also pay taxes to the Serbian government had to cover the costs of the governmental wheat purchases during the crisis period, first in September 2007 (about 60,000 t) and then again in March 2008 (40,000 t). By purchasing wheat from the domestic market the Serbian government certainly made budgetary expenses. Approximated total costs were about 33 million U.S. Dollars which represent about 6 % of average agricultural budget in 2007/2008. Considering that wheat prices even increased after governmental interventions it is clear that this governmental policy measure had a negative impact on consumers.

Overall, our results suggest that the consumers experienced welfare losses from the governmental interventions in 2007/2008 although they were imposed especially with the aim to protect consumers against dramatically increasing food prices.

6 Conclusions

Welfare analytical considerations suggest that consumers benefit from an export ban in response to large increases of world market prices as observed during 2007/2008 and 2010/2011. In particular, consumers experience welfare gains from this policy measure. In contrast, theory suggests that consumers lose welfare if a world market price increase is fully transmitted to the domestic market in the case of a laissez-faire policy. This hypothesis was tested by analyzing how prices developed at different stages of the wheat to bread supply chain. Besides, we simulated flour and bread production costs, bread end consumer prices and profits of millers, bakeries and retailers for different scenarios. We assess if consumers really benefitted from this policy intervention and how the welfare gains/profits were distributed along the wheat-to bread supply chain.

The wheat to flour price transmission analysis made evident that the millers increased their margin in the aftermath of the food crisis, after the governmental market measures were lifted in 2008 as well as in 2011. Our analysis of the flour production costs show that the margin increase cannot be justified by an increase of flour production costs. Furthermore, the analysis of the flour production costs and the millers' margin shows that the mills with own wheat storage capacities increased their profits even during the crisis when the wheat export ban and the flour export quota system were effective. In contrast, mills which had to buy wheat from the wheat spot market could not profit from this situation. Thus, although the mills experienced some losses at some points of time, the small and large mills could both benefit overall from the governmental market interventions during the food crisis.

The bread production costs simulations in the 3 scenarios show that the big industrial bread producers (scenario 1) were affected by the significant wheat and flour price increases on the spot market only during the harvest in July and August. However the export restrictions for wheat and flour were implemented in the aftermath of the harvest 2007. Nevertheless, the bakeries (together

with the retailers) were successful in increasing the end consumer price wrongful justified by the increases in the wheat and flour spot market prices. Without the governmental market interventions and thus with world market prices prevailing on the Serbian spot market, the bakeries (and retailers) would not have been able to realize particularly the second dramatic bread price increase in April 2008. Thus, the large bakeries and retailers profited substantially from the export restrictions on wheat and flour.

According to the results from the previously described analysis we can say that, in general, consumers did benefit from the governmental interventions only to a limited degree. The main reason is that bread prices rose significantly during the food crisis. Our results suggest that compared with laissez-faire policy, the bread price increase was dampened by the governmental market interventions only at the beginning of the crisis (August and September 2007), when the Serbian wheat spot market price was lower than the world wheat market price due to the wheat and flour export restrictions. However, it induced an additional bread price increase in April 2008 due to the dramatic increase in the wheat spot market price beyond the world market price caused by the governmental wheat purchase from the Serbian market. Overall, our results suggest that the consumers experienced welfare losses from the governmental crisis policy. Consumers which also pay taxes to the Serbian government had to cover the costs of the governmental purchase on the Serbian wheat market as well.

Thus, our results do not confirm the hypothesis that consumers benefit from the export ban and achieve welfare gains. In contrast consumers experience welfare losses from the wheat export ban during the world market price peaks 2007/2008 and 2011. We see the main reasons in policy failure and in the (temporary) change of market behavior of major actors along the wheat-to-bread supply chain. In particular, the Serbian wheat price increased at some points of time even stronger than the world market price which we trace back to the two governmental wheat purchases on the domestic market and in keeping up the import barriers for wheat too long. Also, wheat warehousing had a price increasing effect on the domestic wheat price. Besides, price changes were transmitted along the wheat-to-bread supply chain at differing speeds by using market power by the millers and building upon market in transparency, which was increased by the governmental market interventions, and incomplete information by bakeries and retailers.

The future research will be focused on a comparison of the costs and benefits of alternative policy measures. We will explore the alternative policy options that could be designed in order to allow the Serbian government to respond more efficiently to increasing world market prices in the future.

References

ABOTT, P. (2012): Export Restrictions as stabilization responces to food crisis. American Journal of Agricultural Economics, 94 (2), 428-434.

AERS - Energy Agency of the Republic of Serbia (2011): Unpublished data: http://www.aers.rs/

BAFFES J. and HANIOTIS, T. (2010): Placing the 2006/08 commodity price boom into perspective. Policy research working paper 5371, the World Bank.

BOUËT A. and LABORDE, D. (2010): The economics of export taxation in a context of food crisis: a theoretical and CGE-approach contribution. Discussion Paper 00994, IFPRI, Washington DC.

BRÜMMER, B., VON CRAMON-TAUBADEL, S. and ZORYA, S. (2009): The impact of market and policy instability on price transmission between wheat and flour in Ukraine. European Review of Agricultural Economics 36, 203-230.

CANDELON, B. and LÜTKEPOHL, H. (2001): On the reliability of Chow type tests for parameter constancy in multivariate dynamic models. Economics letters 73: 155–160.

CHOW, G. C. (1960): Tests of Equality between Sets of Coefficients in Two Linear Regressions. Econometrica, 28, 591-605.

DEMEKE, M., PANGRAZIO, G. and MAETZ, M. (2011): Country responses to turmoil in global food markets: The nature and preliminary implications of the policies purued in the 2006-08 episode. FAO publication: Safeguarding food security in volatile global markets. Food and Agriculture Organization of the United Nations, Rome. Chapter 10, 183-209.

DEMPSTER, A. P., LAIRD, N. M. and RUBIN, D. B. (1977): Maximum Likelihood from Incomplete Data via the EM Algorithm (with Discussion). *Journal of the Royal Statistical Society*, 1-38.

DICKEY, D. and FULLER, W. (1979): Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association, 74, 427-431.

DOORNIK, J. A. (2002): Object-Oriented Matrix Programming Using Ox. 3rd edn *London: Timberlake Consultants Press and Oxford*.

GEA I.S. – INFO CENTER (2011): Unpublished data, online databese: www.gea-is.com.

GOLDFELD, S. M. and QUANDT, R. E. (1973): A Markov Model for Switching Regressions. *Journal of Econometrics*, 3-16.

GÖTZ, L., GLAUBEN, T. and BRÜMMER, B. (2010): Impacts of Export Controls on Wheat Markets During the Food Crisis 2007/2008 in Russia and Ukraine. Selected Paper, Agricultural & Applied Economics Association 2010 AAEA, CAES, & WAEA Joint Annual Meeting. Denver, Colorado, USA.

GRUENINGER, M. and S. VON CRAMON-TAUBADEL (2008): Competitive agriculture or State control – Ukraine's response to the global crisis, World Bank Document, May 2008.

HAMILTON, J. D. (1989): A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle. *Econometrica* 57, 357-384.

HAMILTON, J. D. (1990): Analysis of Time Series Subject to Regime Changes. Journal of Econometrics, 39-70.

HANSEN, H. and JOHANSEN, S. (1999): Some Tests for Parameter Constancy in Cointegrated VAR-models. Econometrics Journal 2, 306-333.

INCOTERMS (2010): International Chamber of Commerce (ICC).

JOHANSEN, S. (1995): Likelihood-based Inference in Cointegrated Vector Autoregressive models. Oxford university Press.

KIM, C.-J. (1994): Dynamic Linear Models with Markov-switching. *Journal of Econometrics*,1-22.

KROLZIG, H. M. (1997): Markov-Switching Vector Autoregression - Modelling, Statistical Inference, and Application to Business Cycle Analysis. Berlin: Springer-verlag.

KROLZIG, H. M. (2006): MSVAR - an Ox package designed for the econometric modelling of univariate and multiple time series subject to shifts in regime.

KWIATKOWSKI, D., PHILLIPS, P.C.B., SCHIDT, P. and SHIN, Y. (1992): Testing the null stationarity against the alternative of a unit root: How sure are we that the economic time series have a unit root? Jurnal of Econometrics, 54, 159-178.

MARTIN W. and ANDERSON, K. (2012): Export Restrictions and Price Insulation during Commodity Price Booms. American Journal of Agricultural Economics, 94 (2), 422–27.

MINISTRY OF FINANCE OF THE REPUBLIC OF SERBIA - (2007/2008): Budget Law.

MITRA, S. and JOSLING, T. (2009): Agricultural export restrictions: Welfare implications and trade disciplines. International Policy Council position paper, Agricultural and Rural Development Policy Series.

NATIONAL BANK OF SERBIA, online database, www.nbs.rs

NOGUÉS, J. (2008): The Domestic Impact of Export Restrictions: The Case of Argentina. International Food & Agricultural Trade Policy Council, Washington DC.

PATTERSON, D. (2010): The Delta Method and Applications. Working paper, Department of Mathematical Sciences, the University of Montana, USA.

PRPA, DJ. (2004): Some indicators of wheat chemical composition and quality - possibilities of flour extraction.

SERBIA'S GRAIN FUND (2011): Unpublished data.

SORS - STATISTICAL OFFICE OF THE REPUBLIC OF SERBIA (2008): Living Standard in Serbia. Online report: www.stat.gov.rs

STATISTICAL OFFICE OF THE REPUBLIC OF SERBIA (2011): Online database: www.stat.gov.rs

USDA (2007): Serbia - Grain and Feed: Update for wheat and corn. http://www.fas.usda.gov/gainfiles/200711/146292966.pdf

VON BRAUN, J. and TORERO, M. (2008): Physical and virtual global food reserves to protect the poor and prevent market failure. Policy briefs 4, International Food Policy Research Institute (IFPRI).

VON CRAMON-TAUBADEL, S. AND M. REISER (2006): The Quotas on Grain Exports in Ukraine: ineffective, inefficient, and non-transparent. World Bank report.

WELTON, G. (2011): The impact of Russia's 2010 grain export ban. Oxfam Research Report, June 28, 2011.

ZITOVOJVODINA (2011): Unpublished data. Joint Sock Company for development of milling and bakary industries, trade and services.