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Vertical Price Transmission in Serbian Wheat-to-Bread Supply Chain during the Global Commodity Price Peaks 2007/2008 and 2010/2011

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Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August, 2012.

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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 mills 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. We find that consumers benefitted from the governmental interventions only to a limited degree and experienced overall welfare losses. Compared with laissez-faire policy, the bread price increase was dampened by the governmental market interventions only at the beginning of the crisis. The additional strong bread price increase in April 2008 indirectly resulted from the governmental wheat purchases from the Serbian market.

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

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.

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, some of the largest grain producers in the world heavily intervened on their wheat markets during the global commodity price peaks (GÖTZ *et al.,* 2010). Also Serbia, a small wheat exporting country, was faced with soaring international wheat prices especially during the global commodity price peaks 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. During both commodity price peaks the government intervened mainly by posing export restrictions on wheat and flour markets (e.g. wheat export ban and flour export quota).

Most of the policy interventions taken worldwide, during the commodity price peaks, were referring to the export restrictions which were imposed by some of the world biggest commodity exporters (e.g. Russia, Ukraine and India). Thus, export restrictions have received substantial attention in the literature where majority of the study recognize policy interventions as one of the

most important factors influencing global commodity price peaks (MARTIN and ANDERSON, 2012; ABOTT, 2012; BAFFES and HANIOTIS 2010; BOUËT and LABORDE 2010; VON BRAUN and TORERO 2008).

The effects of export restrictions on the price transmission along the supply chain have not yet been investigated comprehensively. An exemption are just several studies, such as the study of VON CRAMON and RAISER (2006) who investigate the Ukrainian wheat export quota introduced in 2006. They find that the export quota is a costly tax on producers and investors in the agricultural sector that may have increased poverty while benefitting only millers and feed producers. Later on, GRUENINGER and VON CRAMON-TAUBADEL (2008) calculate foregone farm revenues due to export quotas in Ukraine amount to 1.6 billion US$ in 2007/2008 in the case of wheat. It is noted that the milling industry took advantage of the situation on wheat markets and increased the wheat-flour margin with the export quota system. NOGUÉS (2008) investigate the domestic impact of export taxes and export quotas on various agricultural products prevailing in Argentina in mid-2007. Hi argues, based on a World Bank general equilibrium model, that the elimination of export barriers would increase the respective consumer prices. For example, the removal of a 32.5% export tax on wheat would increase bread prices by 3.5%. He also argues that the export quotas on beef reduce farmers' prices more than consumers' prices. He suggests that export taxes should be eliminated since they reduce GDP and increase poverty. Additionally, OXFAM RESEARCH REPORT (2011) finds that the 2010/2011 wheat export ban did not reduce food prices in Russia which had the strongest effect on Russia‘s poor people.

Concerning literature it becomes evident that implementation of any kind of export restriction will lead to the consumers' and net economic welfare loss followed by the increased number of poor people within the country. Thus, the issue about the implementation of the export restrictions as the primary crisis policy is highly questionable, where the attention of policy makers arises concerning possible alternatives. Additionally, extensive literature about the crisis policy interventions and their impact on the domestic agricultural markets is mainly focused on the large country cases, regardless of whether it is about export or import of certain commodities (e.g. MITRA and JOSLING (2009); ABBOTT (2011)). Thus, the main contribution of this paper is that it provides a detailed research approach for analyzing the effects of the crisis policy measures on the specific agricultural market in the case of a small export oriented country. Additional contribution is achieved through comprehensive analysis about the effects of the crisis policy on each member of the supply chain of the selected commodity which is important for the policy makers in their evaluation of certain policy measures and their alternatives.

The main objective of this paper is to identify the effects of Serbia's crisis policy on domestic wheat-to-bread supply chain during the global commodity price peaks and food crisis in 2007/08 and 2010/2011. We hypothesize that the state of the Serbian wheat-to-bread supply chain changed due to the comprehensive governmental market interventions during the observed crisis periods. Additionally, we assume that consumers bear the biggest burden caused by the crisis and governmental interventions. Thus, our research questions are: by which crisis policies did the government intervene on domestic wheat, flour and bread markets and how were they sequenced? How did crisis policy affect domestic wheat and flour markets particularly market prices and trade volumes? Were consumers protected, did they really benefit? Who benefited and who lost from the governmental interventions?

In order to identify who, from the wheat-to-bread supply chain members, benefited and who lost we made a two steps estimation approach. A first step refers to the analysis at the level of milling and baking industry. We conduct the vertical price transmission analysis by using Markov Switching Vector Error Correction Model (MSVECM) 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. A 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 development scenarios.

This paper is structured as follows. Section 2 describes the decisive factors influencing domestic wheat, flour and bread prices during the global commodity price peaks. Section 3 briefly descries the theoretical backgrounds. Section 4 explains the methodology and data. Section 5 provides empirical results. Section 6 summarizes and provides conclusions.

2 Decisive factors influencing domestic wheat, flour and bread prices

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 export and strongly increasing wheat prices on domestic, regional and world markets. The government justified its interventions by the danger to run out of wheat emergency[1] stocks, which would potentially bring Serbia into a wheat importing position, and by high food prices which would negatively affect consumers. Thus, the aim of the government was to secure domestic wheat supply and to protect consumers.

The Serbian government started to intervene on wheat market on August 4, 2007, by introducing quantitative export controls on wheat and other grains (Figure 1, WA[2]). The wheat export ban was first announced to last for 3 months until December 2007 (USDA, 2007), and it was triggered by record wheat exports in June and July 2007, which led to a sharp increase in domestic wheat prices by 21 % and the increase in domestic flour prices by 26 % (in August 2007). Since wheat export was banned, export demand for flour increased substantially pushing the flour prices to increase even stronger than wheat prices. Therefore, the price difference (margin) between flour and wheat prices even doubled in September 2007, compared to the period before the wheat export ban (Figure 1).

Though, a strong increase in domestic wheat prices could be observed again at the end of September caused by increased domestic demand and reduced supply. Demand was increasing due to significant flour export while domestic supply decrease since wheat traders did not involve much on the domestic market expecting the export ban to be lifted. Thus they could export wheat

[1] Here we refer to total wheat stocks within the country which are owned by the government and other private entities (producers, mills, bakers, cooperatives, traders, etc.). According to experts, emergency stocks are about 350,000 t which is almost equal to three months of domestic wheat consumption in Serbia. If total domestic stocks go lower then this level, it is reasonable to expect that wheat import will be necessary.

[2] W - wheat market, A – alphabetical order of implemented policy measures.

for much higher price than on the domestic market. Since domestic wheat prices reached record levels in October 2007, the Serbian government decided to extend the wheat export ban for another 125 days until March 5, 2008 (WC) on October 26, 2007. Concurrently, a flour export quota of 80,000 t was introduced for the same time period (Figure 1, FA[3]). The second 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 (FB). Finally, the wheat export ban (WG) and flour export quota system (FC) were removed on June 15, 2008. However, the flour export quota was at no time binding since 84,461 t was exported from 100,000 t quota (November 2007/May 2008)[4].

Concurrently to the export ban, the Serbian government engaged twice in the purchase of wheat from the domestic market through the Directorate of the Commodity Reserves (DCR)[5]. In order to ensure sufficient wheat stocks, the DCR announced the purchase of 60,000 t of wheat on the domestic market. The purchase period was from September 24 until October 3, 2007 (WB). The DCR again announced the purchase[6] of about 50,000 t of wheat at the beginning of March 2008 (WE) when the wheat price reached its highest historical level of 23,000 RSD[7]/t (about 438 U.S. Dollar/t). The purchase period was fixed until March 21, 2008. Both governmental purchases, in 2007 and 2008, increased the demand for wheat on the domestic market which had a significant price increasing effect. Thus, Serbian wheat prices increased even beyond than the world market prices (April/May 2008).

Finally, the wheat import tariff of 30 %[8] was abolished in the middle of-March 2008 along with the implementation of an import quota of 200,000 t (WF). Import supposed to be realized not later than April 30, 2008. According to the Statistical Office of the Republic of Serbia, there was no wheat import realized during the observed period which indicates that sufficient amount of wheat was present on the domestic market.

The Serbian government again intervened on the domestic wheat and flour markets at the beginning of 2011. The wheat and flour export ban was introduced on March 17, 2011 by the new agricultural minister who 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 wheat exports and high domestic, regional and world wheat prices.

Two weeks later, the government announced the introduction of an export quota for flour of 33,000 t on March 31 (FE) starting from April 1, 2011. As it was the case in 2007/2008, quota

[3] F – flour market, A – alphabetical order of implemented policy measures.

[4] From the first export quota of 80,000 t, about 55,000 t of flour was exported in the period November 2007/February 2008.

[5] The DCR is the official governmental institution responsible for national commodity reserves. Serbian Ministry of Trade and Services (MTS) had the direct control over this institution until 2011. After 2011, the MTS was merged with the MAFWM and the new Ministry of Agriculture, Trade, Forestry and Water Management (MATFWM) was formed. All the responsibilities of the MTS were transferred to the MATFWM.

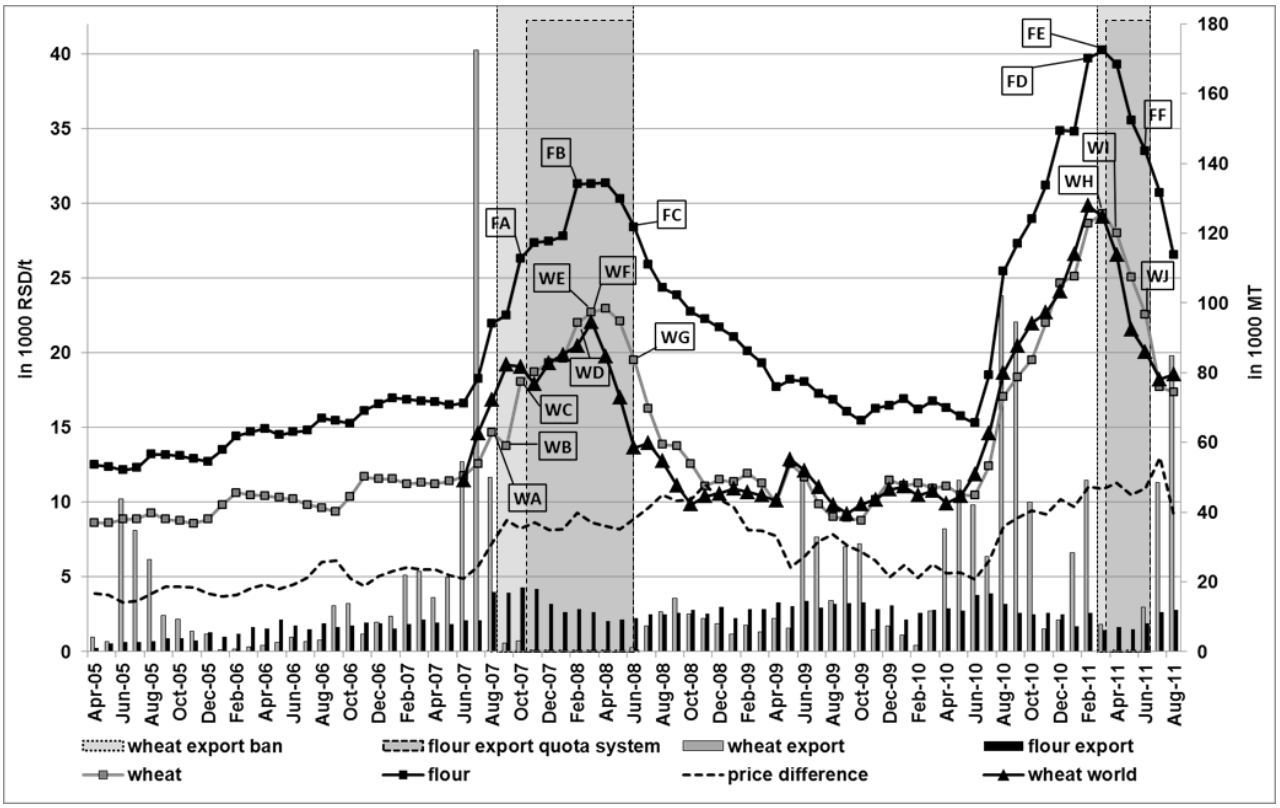
[6] According to experts, wheat traders offered about 40,000 t of wheat to the DCR.

[7] Republic of Serbia Dinar (Serbian Dinar) – official currency in the Republic of Serbia.

[8] Under the normal circumstances wheat import tariff is 30%. The level of import tariff varies depending on the different bilateral agreements.

was not binding since 21,378 t of 33,000 t quota was exported (April/Jun 2011). On the same day, a wheat import quota with tariff exemption of 100,000 t 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. Finally, the wheat export ban and flour export quota system were cancelled on June 15, 2011 (WJ and FF).

Figure 1: Governmental interventions on wheat and flour markets 2007/2008 and 2011



Source: Serbia's Grain Fund (wheat prices) and GEA Info Center (flour prices), own illustration.
Note: Labels in Figure 1 are explained within the text. World wheat market price starts from June 2007.

Besides wheat and flour markets, the Serbian government intervened indirectly (2007/2008) and directly (2010/2011) on the bread market[9]. The main reason was the significant increase in bread prices, which bakers were justifying by rapidly increasing wheat and flour prices on the domestic spot market.

Bread prices changed three times in 2007/2008. The bread price was first increased at the end of August 2007 as a result of an unofficial agreement between the MTS, Serbian Bakery Union[10], and the largest representatives of the milling industry (Figure 2, BA[11]). Bread prices increased again in the middle of November 2007, justified by bakeries and retailers with increasing wheat and flour spot market prices in the media (BB). The third substantial bread price increase was

[9] Here we refer to the specific type of bread, the so called "social bread", which is produced from flour type 500 and one loaf weights about 500 g. This is the cheapest and the most consumed bread in Serbia.

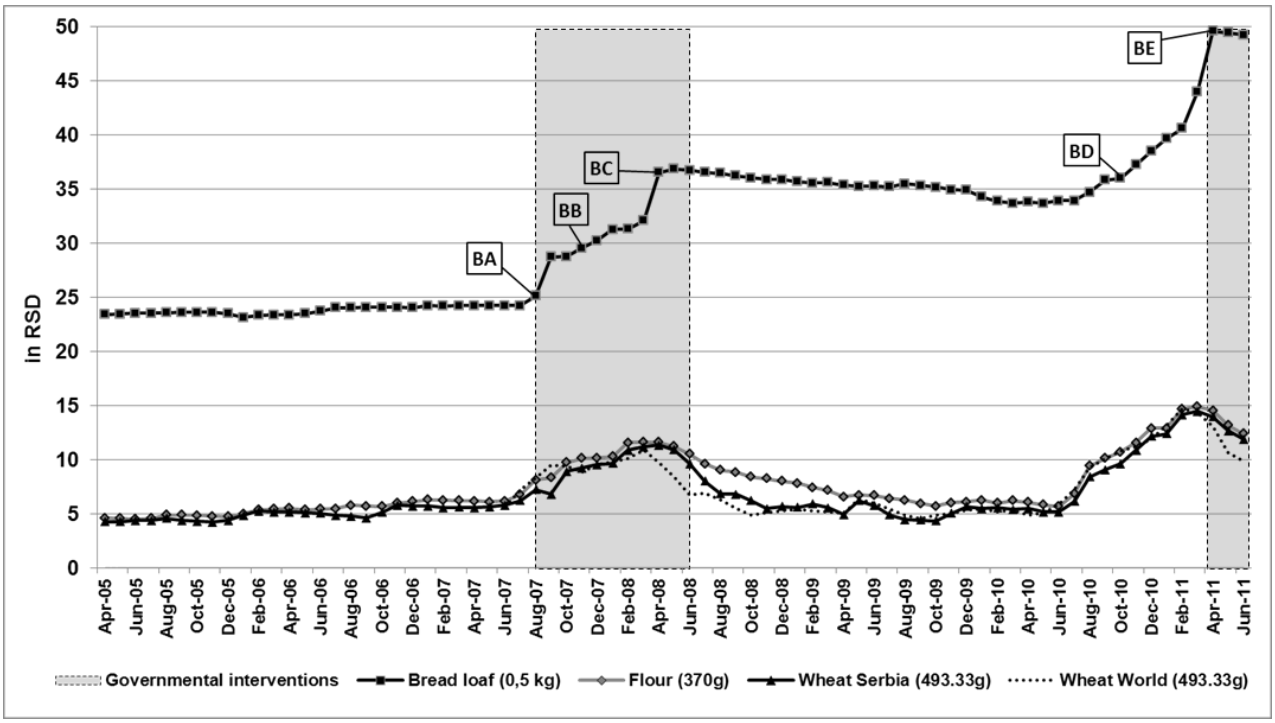
[10] Serbian Bakery Union has more than 7,000 members which employ about 70,000 workers.

[11] B – bread market, A – alphabetical order of the described event/policy measure.

realized in April 2008, again justified by bakers and retailers with historically high wheat and flour spot market prices (BC).

In 2010 the MTS directly intervene on the bread market by obligating bread producers to produce at least 40 % of bread (of their total bread production) from wheat flour type 500 (BD). Concurrently, the wholesale bread trade margin was fixed to at most 2 % and the retail trade margin to at most 7 %. Thus, the total trade margin (including bakers' and retailers' margin, rebate, cash discounts, etc.) should not exceed 9.14 % of the bread producer price. These measures were prolonged in 2011 and additionally the price of a bread loaf was fixed to 54.22 RSD (BE).

Figure 2: Important events and policy measures influencing bread prices



Source: Serbia's Grain Fund (wheat prices), GEA Info Center (flour prices), Statistical Office of the Republic of Serbia (bread prices), own illustration.

Note: Labels in Figure 2 are explained within the text.

To summarize, the Serbian government intervened on the domestic wheat and flour markets during the commodity price peak in 2007/2008 by implementing a wheat export ban, twice announcing the significant purchase of wheat from the domestic market, cancelling the wheat import tariff for the quota of 200,000 t, and by introducing a flour export quota system (which was not binding). In 2011 the government first introduced a wheat and flour export ban. Later on, the flour export ban was changed to an export quota system. Concurrently, the government cancelled the wheat import tariff for the quota of 100,000 t. Also, the government directly intervened on the bread market by regulating the bakers' and retailers' margin and fixing the price of bread.

3 Theoretical backgrounds

In order to identify the impact of wheat and flour export restrictions on wheat-to-bread supply chain our theoretical framework consists of two aspects. First aspect refers to the theoretical concept of vertical price transmission while the second aspect refers to the welfare economic theory.

Concerning price transmission, the adjustment of price shocks from wheat producers to flour producers, and vice versa, can give us the insights into the functioning of these markets. The process of price transmission within the wheat-to-bread supply chain in Serbia is of great interest for policy makers especially during the periods of high price peaks, such as in 2007/2008 and 2010/2011, characterized with extremely high commodity prices which are commonly associated as the main cause of the high food prices. The common concern of policy makers is that due to the imperfect price transmission, a price reduction at the producer level (e.g. wheat producers) is not fully transmitted to through the supply chain. On the other hand, price increase at the producer level is thought to be passed more quickly on to final consumer (Vavra and Goodwin 2005).

Concerning theory, vertical price transmission is characterized by the magnitude, speed, nature and direction of the adjustments through the supply chain to market shocks that are generated at different levels of the supply chain. Magnitude refers to the size of the response at each level of the supply chain caused by the certain size of the shock at another level. It is one of the central concerns when analyzing vertical price transmission. Beside the size of the response speed of adjustment has an important role and it refers to the time lag needed for the price shock from one level of the supply chain to be transmitted (partially or fully) to another level of the supply chain. The speed of the adjustment to the shock mainly depends on the actions taken by the market agents at different levels of the supply chain. If some of constrains are present, the transmission of shocks may take place only with certain time delay or, in the extreme case, they can be completely prohibited. Nature of price transmission refers to the fact if price adjustment is following positive or negative shocks, or in other words if there is symmetrical or asymmetrical price adjustment. Asymmetrical price adjustment can occur in any of vertical price transmission aspects (magnitude, speed and direction). According to Peltzman (2000), asymmetric price transmission is the rule, rather than exception. Further, Mayer and von-Cramon Taubadel (2004) are pointing out the importance of the asymmetric price transmission for the welfare and policy implications, arguing that asymmetric price adjustments can cause that consumers are not benefiting from the reduced prices on the producers' level of the supply chain, or that producers might not benefit from the price increase on the retailers' level of the supply chain. They conclude that distribution of welfare effect across different levels of the supply chain will be altered relative to the case of the asymmetric price transmission. Finally, direction is showing weather the price shock is transmitted upwards or downwards within the supply chain.

Beside the analysis concerning the transmission of price signal through the wheat-to-bread supply chain we also aim to identify the welfare effects of the wheat export ban for consumers and other members of the supply chain. To judge if consumers really benefitted from the wheat export restrictions, or if other members along the wheat-to-bread supply chain were able to gain advantage, we analyze the laissez-faire policy case without any governmental crisis interventions in comparison.

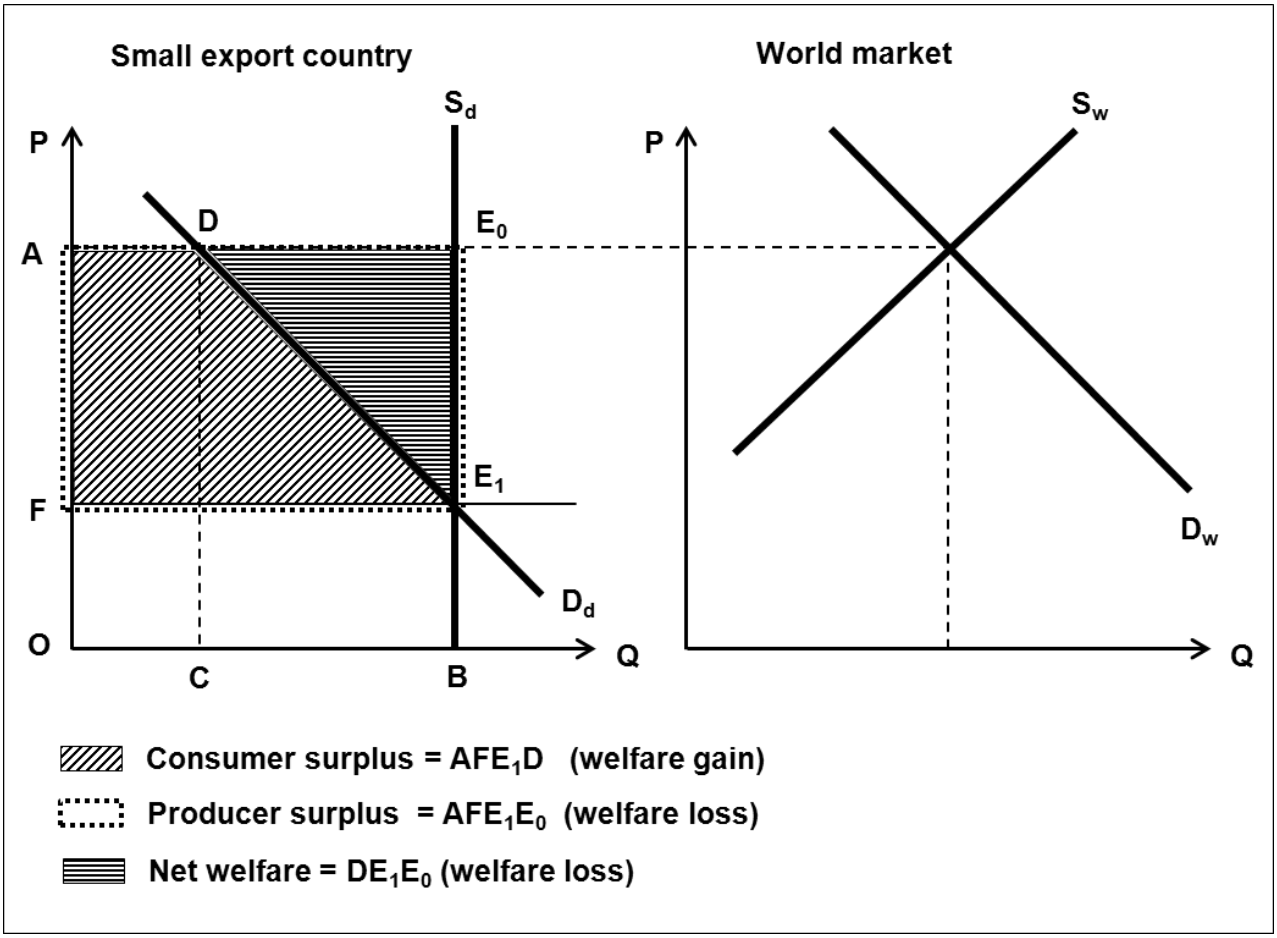
Figure 3 shows the short-run welfare effects of the wheat export ban implemented in a small wheat exporting country.

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. 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), and that domestic wheat supply (S_d) is completely inelastic in the short- run. OB represents the quantity of wheat produced domestically. OC is quantity of wheat demanded domestically at the world market price (OA), and CB is amount of wheat exported.

Second, we introduce the case of an export ban. 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 loose 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 in Figure 3.

Figure 3: Short-run welfare effects: export ban (small country)



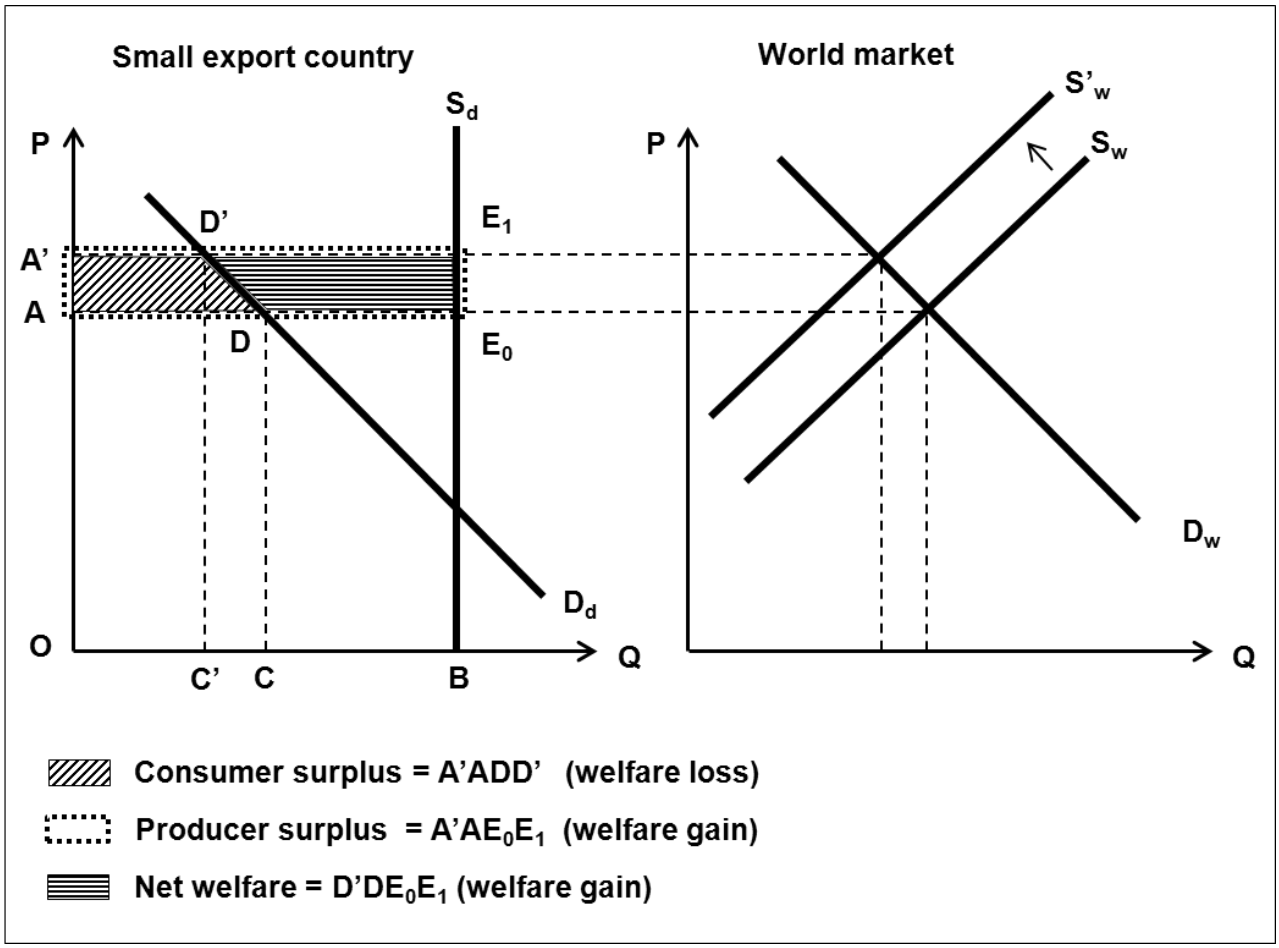
Source: own illustration

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 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 4. 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.

Figure 4: Laissez-Faire Policy



Source: own illustration

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.

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 wheat price changes along the wheat-to-bread supply chain in times of comprehensive governmental market interventions by analyzing the transmission of domestic wheat price changes to the flour price.

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. A characteristic of the Markov-Switching model is that the parameter changes are governed by a Markov Chain. 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 model framework for our price transmission analysis:

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

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 $S_t = 1,\ldots,M$. 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

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

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

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, our second step is to estimate the flour production cost and millers' profit in order to identify if mills 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:

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

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

$M \in \{1, \dots, k\}$ and $\sigma \in \{1, \dots, n\}$ depend on the flour extraction technology. Thus, 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 T500, M=2 to flour type T400 and so on.

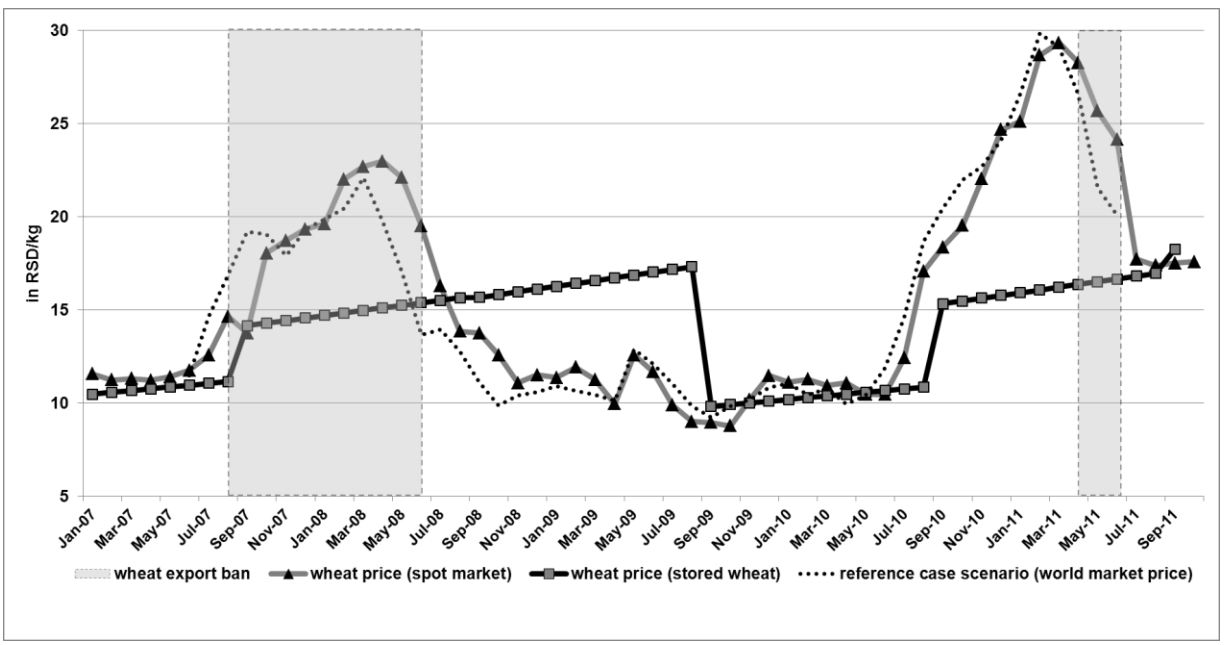
By deducting respective costs, from the miller's revenue, we are able to calculate the potential millers' profit (π_t) which is presented in the following equation:

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

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 5).

Figure 5: Monthly wheat spot and storage prices in Serbia, 2007/2011



Source: Serbia's Grain Fund

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 price (Figure 5). 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. Wheat prices which accounts for certain storage costs is calculated by the following formula:

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

where $p_{S_{t+i}}^{w}$ represents the price of the 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). γ 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).

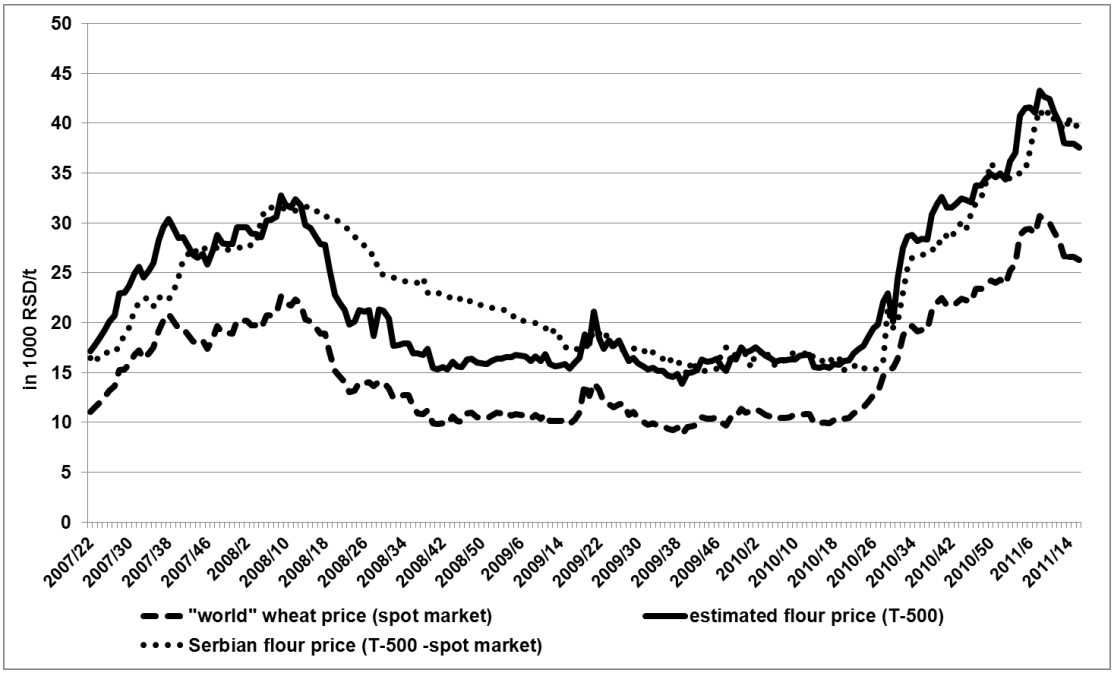
Scenario 3 is a hypothetical reference case scenario which is used in order to reflect the situation if the Serbian government did not react on the market (laissez-faire policy case). In order to present the most realistic situation the Hungarian[12] wheat spot market prices have been used since Hungary 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:

$$ln\ p_i^f = \beta_0 + \beta_1 ln\ p_i^w \qquad (8)$$

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 transmission parameter) are retrieved from the MSVECM for each regime. The results of the estimated flour price are presented in Figure 6.

[12] See section 4.3 (data description).

Figure 6: Estimated flour price (laissez-faire policy case)



Source: own illustration

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.

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[13].

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

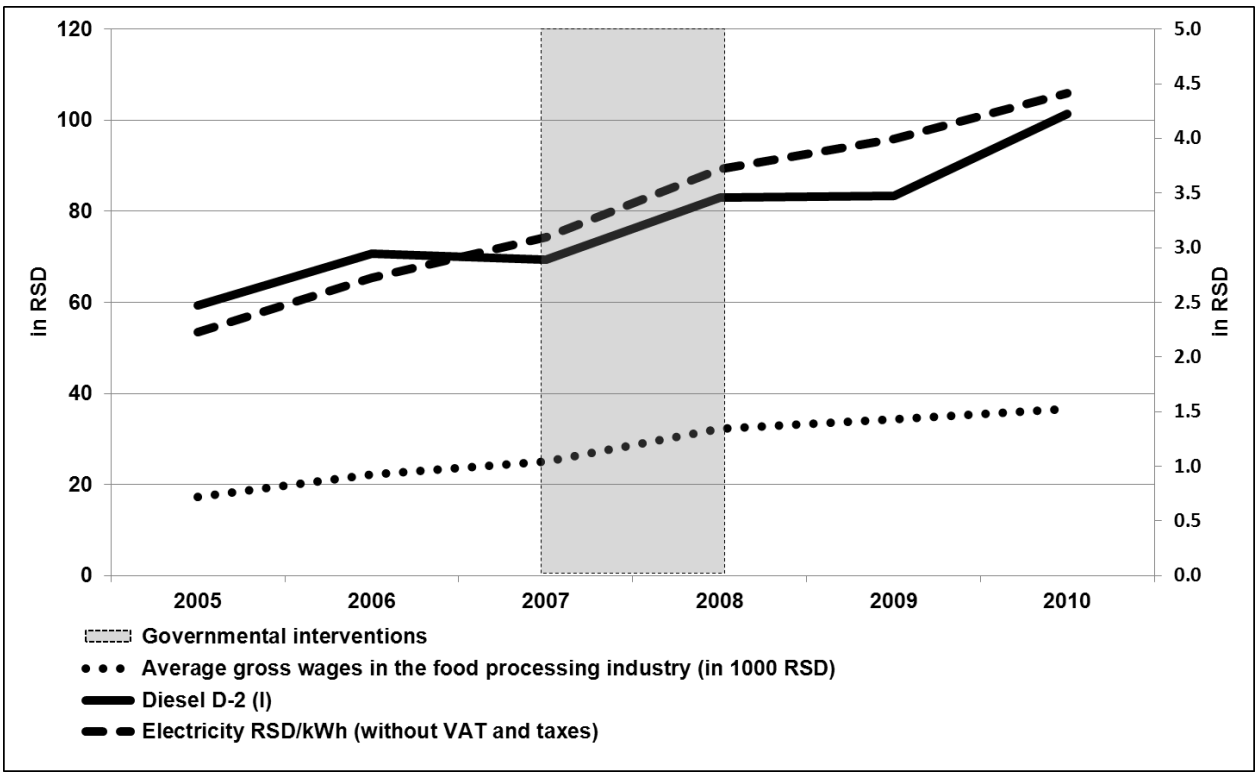
Table 1: Average bread production cost structure

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

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. Figure is showing the price development of electricity and fuel and the development of gross wages within the food processing industry for the observed period. The general costs, amortization, costs of bread return and other costs were assumed to be constant during the simulation period.

Figure 7: Average annual electricity, diesel prices and gross wages in the food processing sector in Serbia, 2005/2010



Source: AERS and Statistical Office of the Republic of Serbia , own illustration

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[14] 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 (retailers' profit) 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.

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.[15] silo selling price, obtained from Serbia's Grain Fund, and weekly F.C.A. wheat flour[16] mill selling prices as a measure for the flour wholesale price obtained from GEA Information System (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 (Figure 8).

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

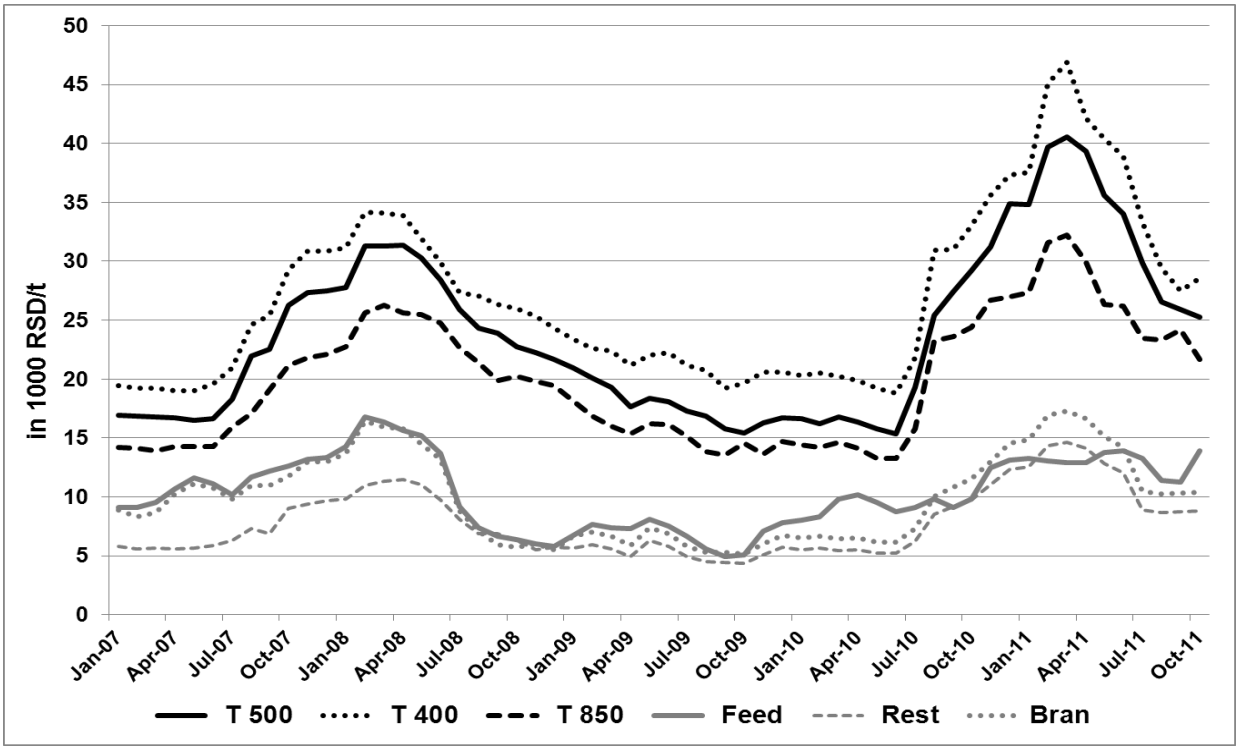
[15] F.C.A. – Free Carrier – (named place) – The seller hands over the goods, cleared for export, into the custody of the first carrier (named by the buyer) at the named place (INCOTERMS, 2010).

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

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[17] 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[18] 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.

Figure 8: Monthly flour prices (different flour types)



Source: GEA Info Center, own illustration

[17] One bread loaf has 500 g.

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

5 Empirical Results

5.1 Estimation 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 (Table 2). 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[19], suggests that the wheat and flour price series are co-integrated (Table 3) 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.

Table 2: Unit root tests

Series	Augmented Dickey-Fuller test			KPSS test		
	Test statistic	Specification	5 % critical value	Test statistic	Specification	5 % critical value
$\ln p_t^f$	-2.1881	10 lags, constant	-2.86	1.3806	10 lags	0.463
$\ln p_t^w$	-1.5517	1 lag, constant		1.0498	10 lags	
$\Delta \ln p_t^f$	-3.7139	9 lags	-1.94	0.1025	10 lags	
$\Delta \ln p_t^w$	-12.1708	1 lag		0.0793	10 lags	

Note: 5 % critical value in KPSS test is the same for levels and first differences
Source: own calculation

Table 3: Co-integration test results

Johansen's co-integration test					
Number of co-integrating vectors		Specification	Rank test	p-value	5 % critical value
H_0	H_1				
0	1	2 lags, constant	28.83	0.0020	20.16
1	2		2.85	0.6160	9.14

Source: own calculation

[19] 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.

The results of VECM estimation are given in Table 4. 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 $\chi^2(2)=12.62$ (ρ=0.01), as well as non-normality of disturbances (ρ=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[20] was used in order to calculate the empirical ρ-values for different breakpoints[21] 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 citating 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[22] 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.

[20] We account for 1000 bootstrap replications.

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

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

Table 4: Estimated coefficients of the long-run equilibrium regression (VECM)

Coefficient	Estimated value	t-value	P-value	Standard deviation
Intercept				
β_0	-0.677	-1.223	0.221	0.553
Loading coefficients				
α_{p^f}	-0.070	-3.366	0.001	0.021
α_{p^w}	0.046	1.733	0.083	0.027
Estimated co-integration relation				
β_1	-0.974	-16.698	0.000	0.058
Lagged endogenous terms				
Δp^f_{t-1}	-0.119	-2.145	0.032	0.055
Δp^w_{t-1}	0.166	3.666	0.000	0.045
Δp^f_{t-2}	-0.062	-1.121	0.262	0.055
Δp^w_{t-2}	0.082	1.836	0.066	0.045

Source: own calculation

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 optimal model is of the type MSIAH[23] 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 9. 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 "market power" 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 "market power" regime comprising 54 observations with a regime probability of 16 % and an average duration of almost 3 weeks.

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 5). Also, the speed of adjustment in the normal regime is statistically significant and it has the correct negative sign. This suggests that the wheat

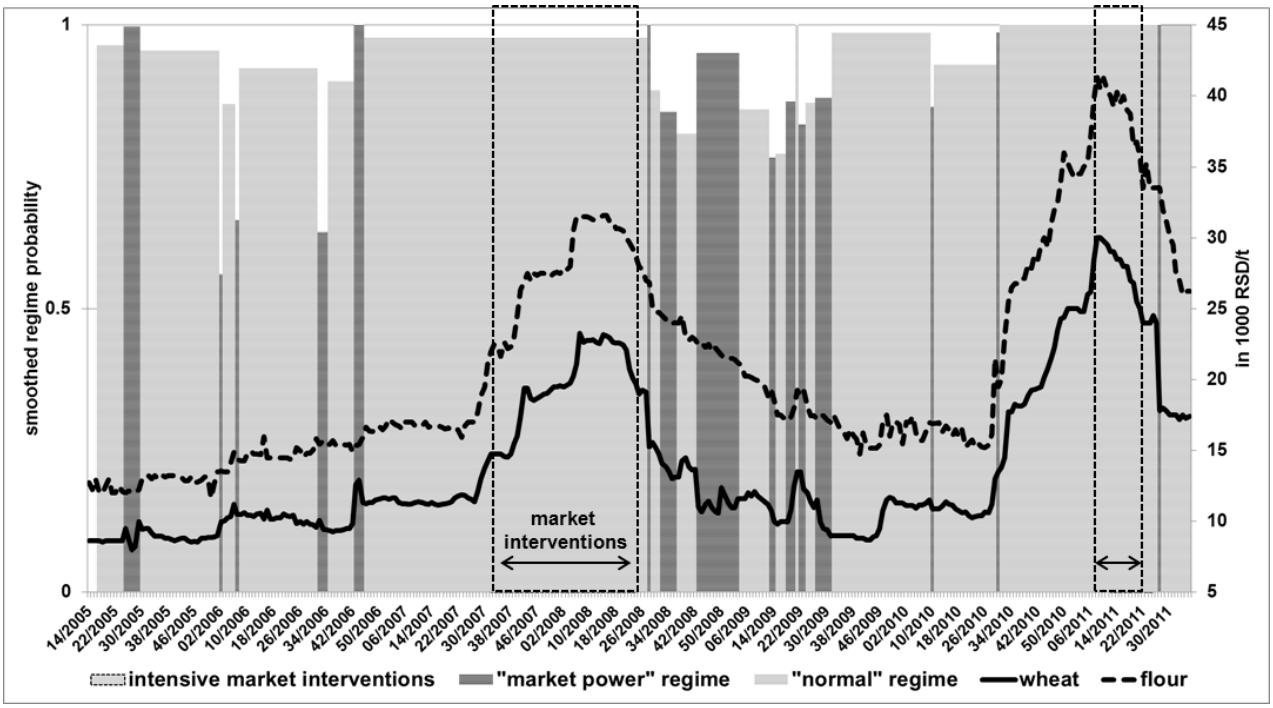
[23] This means that we allow the intercept (I), the short-run price transmission, the autoregressive parameters (A), and the variances/heterogeneity (H) to switch between the regimes.

and flour market are integrated, and that the equilibrium errors are adjusted in the expected direction.

Figure 9 shows that the “normal” regime prevails in times of the intensive governmental interventions in 2007/2008 and 2011. Thus, 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 “market power” regime is smaller than in the “normal” regime with a long-run price transmission parameter of about 0.6 (Table 5). Also, the speed of adjustment in this regime is not statistically significant indicating that the integration between wheat and flour market is disrupted. The “market power” 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.

Figure 9: Regime classification



Source: own illustration based on the model specification

Table 5: Selected parameter estimates of the MS(2)-VECM(2)

Market	Indicator	"normal" regime	"market power" 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 1%.
Source: own illustration

Since price transmission results suggests that the mills 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.

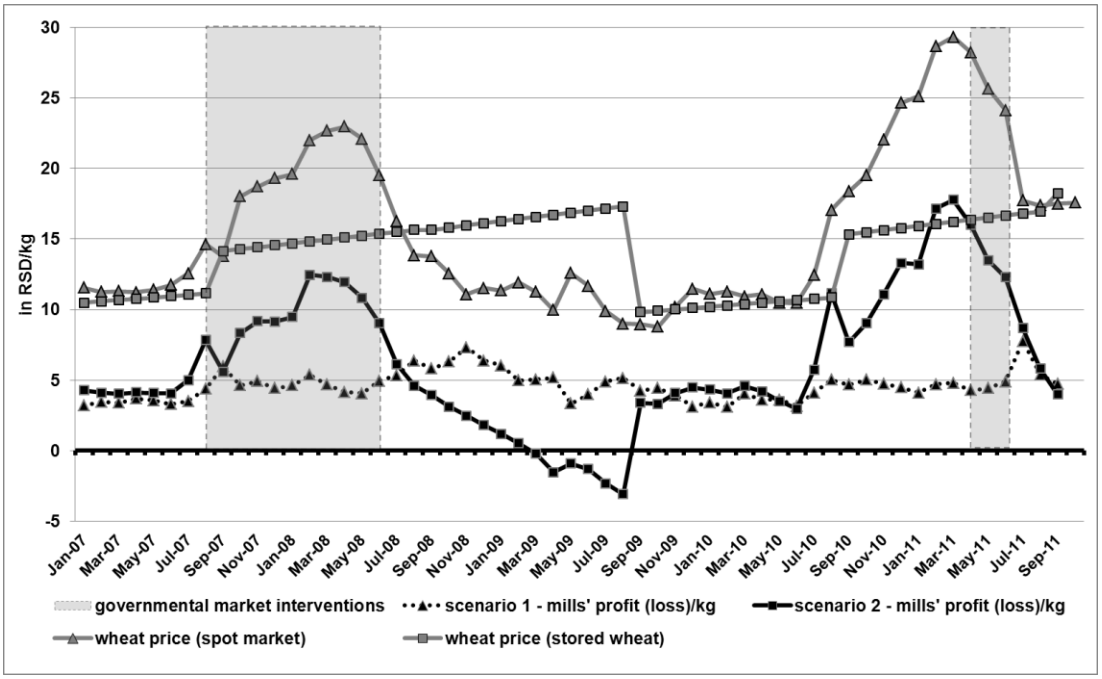
Figure 10 shows the simulated millers' profits for scenario 1 and 2. It becomes evident that the profits in scenario 2 are substantially higher than in scenario 1 in times of governmental market interventions. Particularly, the millers' average profit was up to more than 2 times higher at some points 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 11 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.

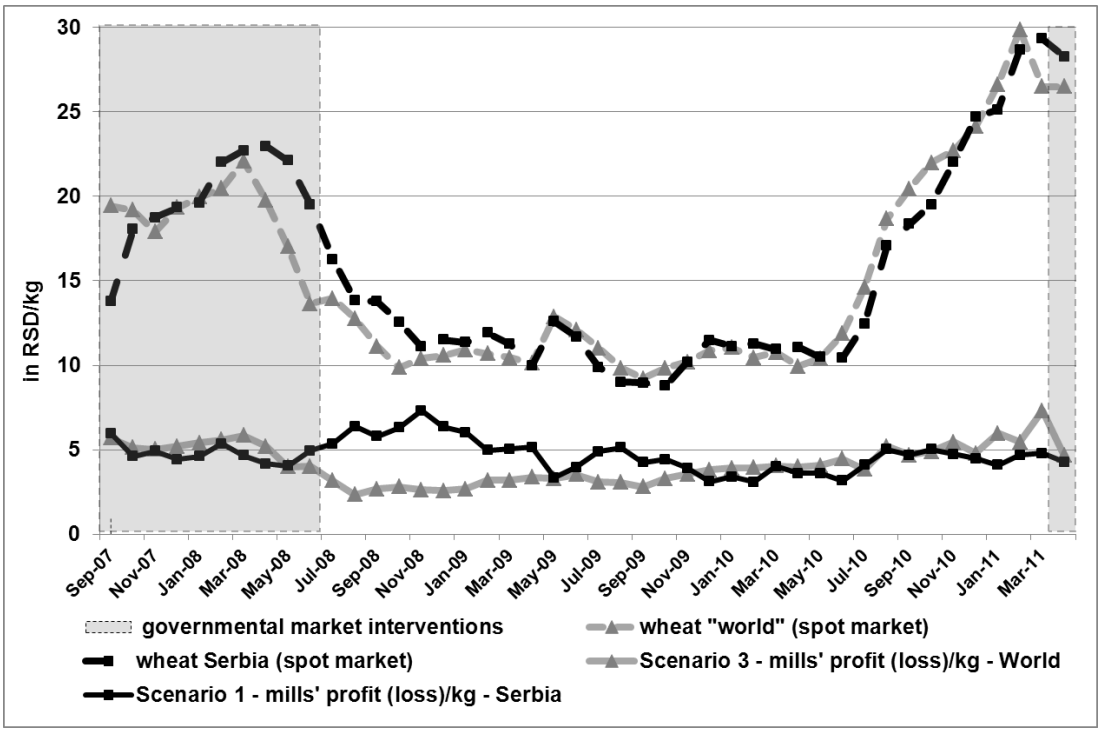
Concerning the comparison between scenario 2 and scenario 3 (Figure 12), it is clear that millers in scenario 2 benefited from the governmental market interventions and especially in the period before the cancellation of policy measures.

Figure 10: Estimated mills' profit per kg of flour, scenario 1 and 2



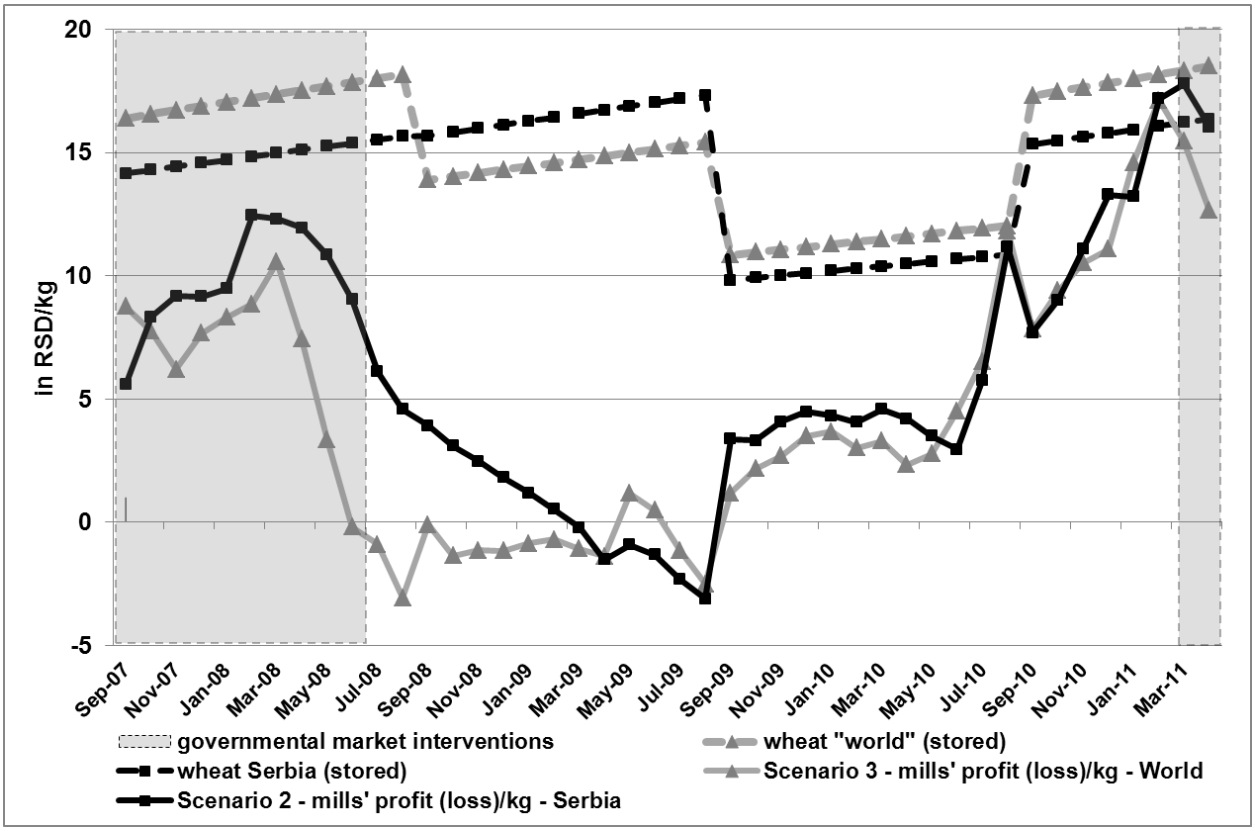
Source: GEA Info Center and Serbia's Grain Fund, own illustration

Figure 11: Estimated mills' profit, scenario 1 and 3 (laissez-faire)



Source: GEA Info Center and Serbia's Grain Fund, own illustration

Figure 12: Estimated mills' profit, scenario 2 and 3 (laissez-faire)



Source: GEA Info Center and Serbia's Grain Fund, own illustration

Though, our simulations suggest that mills profited overall from the governmental crisis policy.

Finally, most of the mills in Serbia are 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 mills 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 Estimation 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 (Figure 13), it can be observed that big industrial bread producers manage to improve their situation during the governmental interventions in 2007/2008. Figure 14 shows that the bread production costs in

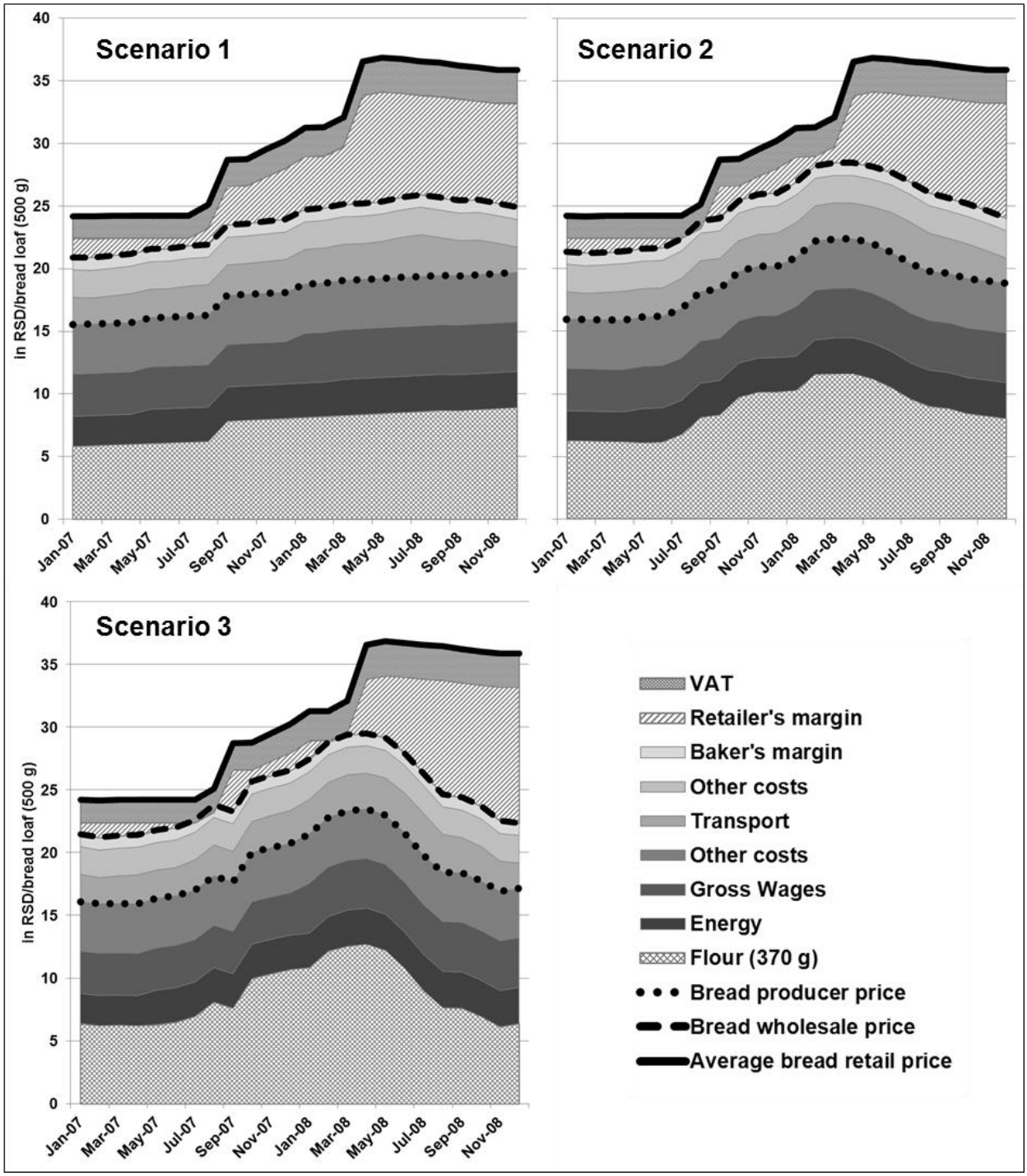
scenario 1, which represent the "actual"[24] production costs, are significantly lower than the "pretended" production costs given by scenario 2 during the whole time period of governmental interventions. The results are indicating that bread producers were affected by the significant wheat and flour price increases on the spot market only 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.

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.

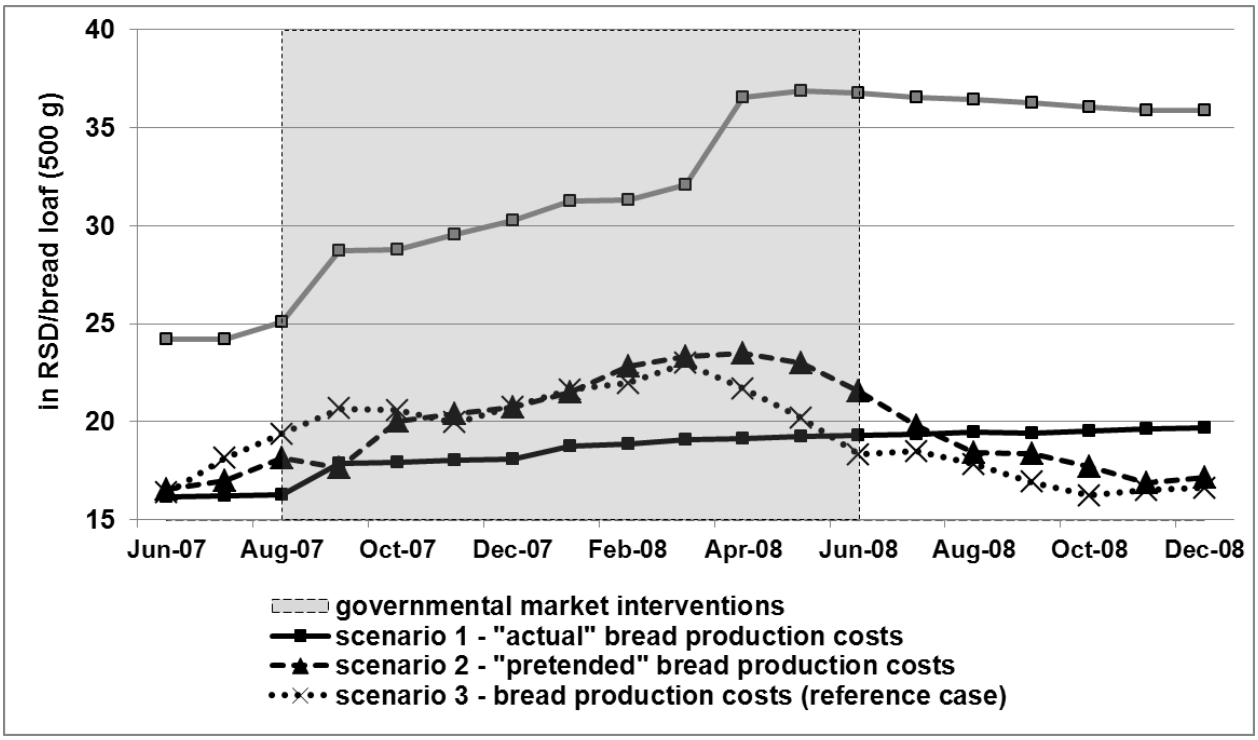
[24] The main difference between "actual" and "pretended" cost structure is in the price of wheat. Big industrial bread producers are using stored wheat (which is used for "actual" cost structure calculation) while, in the same time, they justify bread price increase with an increase in the spot market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

Figure 13: Simulated bread production costs



Source: own illustration

Figure 14: Simulated bread production costs and end consumer bread prices, 2007/2008



Source: own calculations, Zitovojvodina and Serbia's Grain Fund, own illustration.

Additionally to bread production cost simulations, we simulate the distributable surplus (potential profit) of bakers and retailers for the three possible scenarios. Figure 15 shows the maximum achievable margin[25] in all three scenarios with corresponding baker's loss[26] and distributable surplus[27]. 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 15).

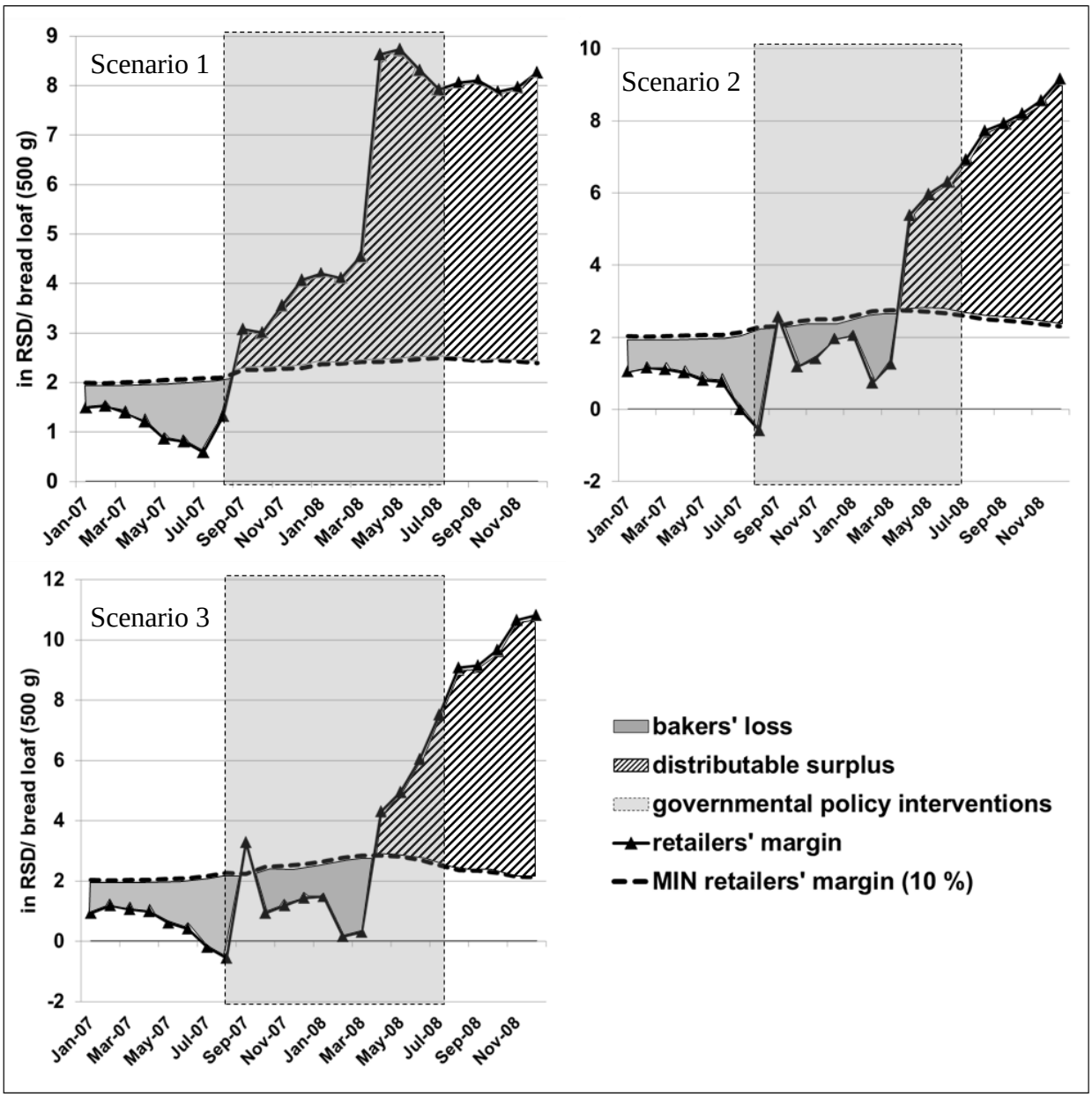
[25] Margin is calculated as the difference between the end consumer bread price (reduced by the value added tax) and the estimated wholesale bread price.

[26] 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.

[27] 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.

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 15).

Figure 15: Simulated retailer's margin



Source: own calculations, Zitovojvodina and Serbia's Grain Fund, own illustration.

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 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 %.

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(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 on, the results presented in Table 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 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.

Table 6: Governmental expenditures for buying out wheat from the market in 2007/2008

Data		2007	2008
Total Agricultural Budget (U.S. Dollar)		456,311,974	613,157,892
Average exchange rate for U.S. Dollar		57,1884 (September)	53,6491 (March)
Policy measure: Buying-out wheat from domestic market			
A	**Quantity (t)**	60,000	40,000
B	**Average wheat price (U.S. Dollar/t)**	256.40 (September)	438.03*
A x B	**Total cost per policy measure (U.S. Dollar)**	15,384,000	17,521,200
TOTAL COST	**2007/2008 (U.S. Dollar)**	**32,905,200**	

*Agreed purchasing price

Source: Ministry of Finance, Serbia's Grain Fund, National Bank, own calculation

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 2007/208 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 development 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, the 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.

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