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Analysis of the Asymmetric Price Transmission in the Ukrainian Wheat Supply Chain

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1. Introduction

Analysis of price transmission along the supply chain has become a frequently used method by economists to study the efficiency of markets and identify price response rigidity in the marketing system. The purpose of such analysis is the determination of the price linkages across different marketing levels (i.e. exporter-producer-consumer), as well as the extent and the speed at which a price change that occurs at one stage is also reflected at other stages. If price transmission is not perfect, this implies that the markets may convey inaccurate information to producers and consumers, thus leading to misallocation of resources in the economy.

This paper aims to identify potential market and policy failures in the Ukrainian soft wheat supply chain that might inhibit its efficiency. Ukraine constitutes a particularly interesting case. It has recently emerged into becoming one of the largest world grain exporters. In the 2012/13 marketing year, according to USDA (2013) Ukraine was among the top ten global suppliers of corn (13.5 mln tons), wheat (7 mln. tons), and barley (2.2 mln tons). The expansion into the world markets, however, did not come with a similar openness in the approach of the Ukrainian government to policy implementation. Until recently it has been characterized by frequent and rather ad hoc policy interventions into the Ukrainian grain exports. For example, during the financial crisis in 2006-08, the Ukrainian government changed its decisions on wheat export restrictions at least eight times. In 2010, Ukrainian policy makers could not come up with a stable wheat export policy for more than a year, again changing the legislation several times. Such an unstable policy environment both distorts farmers' incentives locally and restrains the attraction of foreign direct investments. Also, as previous research shows (Goychuk and Meyers 2013), it affected cointegration of Black Sea prices with the prices of other exporters. However, policy makers justify the abovementioned controls as the ones that protect Ukrainian consumers from the high and volatile world grain prices.

More specifically, the goal of this paper is to investigate the price transmission between the world wheat prices and Ukrainian domestic wheat prices at both producer (farm) and consumer (flour) levels. First, we analyze the transmission of the world prices into the Ukrainian domestic wheat market under different policy restrictions and identify potential losers in the marketing chain. The hypothesis is that there is a lack of transmission between these two series that could be caused by a number of factors, such as, transaction costs, market power, policy interventions, exchange rates, quality differences, etc.

Second, we investigate the price transmission patterns from wheat producers to flour millers. Two hypotheses are to be tested in this case. The first one is that there is a lack of transmission between these two series. Second, we test the hypothesis that the responses of millers to the change in wheat farm price is of the same magnitude regardless of the direction of change (i.e. the price transmission is symmetric). According to economic theory, if a shock arises in a market, its adjustment towards a long-run equilibrium happens via the chain of demand and supply interactions. In a competitive market the rate at which discrepancies from the equilibrium are eliminated is expected to be the same regardless of whether the initial shock was positive or negative. This would be the case of symmetric price transmission. However, a growing body of literature suggests that the responses of different economic agents to a change in price might be of different magnitude (i.e. asymmetric) between different levels in the supply chain with regards to the direction of change. For example, Peltzman (2000) while analyzing data for 77 consumer and 165 producer goods, concluded that positive asymmetric behavior is the rule rather than the exception. The primary reasons for this are adjustment costs, such as menu costs, or strategic behavior of the intermediaries (Simioni et al. 2013). It would be interesting to see if the same tendency occurs in the Ukrainian wheat supply chain.

Thus, to summarize, five aspects of price transmission are assessed in this paper:

1) The magnitude of price transmission, i.e. how much of the price change at one stage of the chain is transmitted to the downwards stage;

2) The speed of price adjustment, i.e. the pace at which changes in prices at one level of the chain are transmitted to the other levels;

3) The asymmetry of the price adjustment, i.e. the extent to which price increases and decreases are transmitted differently in terms of magnitude and speed to other levels;

4) The presence of the structural breaks in the long-run relationship between French export price and Ukrainian wheat farm price;

5) The discussion of the factors that could negatively affect magnitude or speed of price transmission in the Ukrainian supply chain with a more detailed focus on export policies.

Analysis of price transmission has become very popular in the agricultural economics literature and has been applied to a number of markets around the globe (for example, see Simioni et al. 2013, Boetel and Liu 2010, Abdulai 2002). Two of these studies analyze vertical price transmission in the Ukrainian wheat markets. The most recent one is by Gotz et al. (2013) investigates the effects of the wheat export restrictions implemented by the Ukrainian government on the transmission from the world wheat price to the Ukrainian farm level prices during the commodity spike of 2007-08. The study shows that while the series remained cointegrated during the whole period that was analyzed, the magnitude of the price transmission to the growers did change in the 2007-08 crop year. An earlier study by Brummer et al. (2009) studied the price transmission between farm wheat and wheat flour prices in Ukraine from 2000 till 2004. Both of these studies use Markov-switching vector error-correction model in their analysis.

This paper builds on the previous analysis in several ways. First, the data span used in this analysis extends from 2005 till 2012, and looks at the effects of two commodity price spikes (2007-08 and 2010-11) as well as effects of various policy instruments (after a long history of export quotas, in 2011, the Ukrainian government switched to less distorting mechanisms of export tariffs) on the price transmission from the world wheat market into the Ukrainian one. Second, this is the first study that looks into the symmetry of price transmission in the Ukrainian wheat supply chain. Third, the uniqueness of this study in that it tests for the structural breaks in the long-run relationship between world and domestic wheat prices across the entire analyzed period, which was characterized by a variety of events that could have potentially induced such breaks. This, in turn, could provide insights in the causes of structural breaks in the Ukrainian markets, and be used by policy makers in their future decision making process. Finally, in this paper a different set of econometric methods is employed to compare to those previously used to study this market. This could by itself add to the pool of literature that compares the effectiveness of different cointegration techniques.

2. Background

a. The marketing chain in Ukraine

The major players in the Ukrainian wheat industry are wheat farmers, processors, exporters and retailers. The simplified structure of the Ukrainian wheat supply chain is provided in figure 4.1. Once harvested, most of the wheat is stored at the elevators. From the elevators the wheat can follow the "food path", i.e. being processed for flour and further into wheat products, the "feed path", or the "export path". The leftover of the wheat harvest in a given year is stored in the form of stocks or used for seed in the next year. In 2011/2012, 26 percent of produced wheat was used for exports, 17 percent for domestic feed, and about 52 percent for food and seed (USDA, 2013).

According to the Ukrainian State Statistics Bureau (2013), about seventy eight percent of grain is produced by agricultural enterprises; the rest is produced by the household farms[1]. Those agricultural enterprises of the size less than 2,000 ha produced eighty five percent of total wheat production in 2011. In the majority of cases farmers, elevators, food/feed processers, and traders are entities independent from each other. However, there are instances when some parts of the supply chain are integrated. Larger farms can have their own storage facilities, or farmers who have their production facilities close to the ports in the South of the country can sell their grain directly to the traders to eliminate the middlemen cost. For example, during the past decade Ukraine (along with Russia and Kazakhstan) has seen an emergence of mega farms, known as agriholdings. These are the large farms (sometimes larger than 100,000 ha) that are often vertically integrated with processors and/or exporters. According to the Ukrainian Agribusiness Club, in 2011 there were 79 agriholdings in Ukraine with the total land use of 5 million hectares (Gagalyuk, 2011), which is an equivalent of about 25 percent of country's total sown area. Such mega farms account for about nine percent[2] of the total wheat production in the country (Ukrainian State Statistics Bureau, 2013). However, the majority of this wheat is used as fodder for the livestock and poultry produced by the same farms that control about 28% of total animal production in the country (Kobuta et al. 2012).

[1] Household plots constitute small plots of land (typically less than 0.5 ha), which are used by families for subsidiary farming.
[2] The estimate is for the farms of the size 3,000 ha or more.

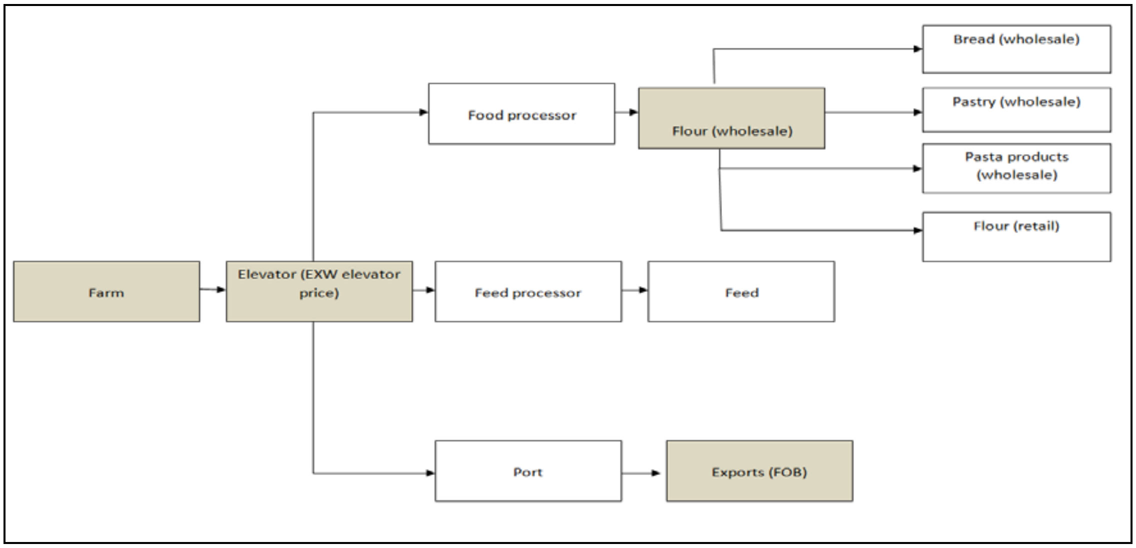

Figure 4.1 Simplified Ukrainian wheat supply chain (without the retail level, except for flour)

Source: Canadian International Development Agency, 2007

The quality of wheat production is dominated by the feed wheat. In accordance with a new adopted standard, feed wheat accounted for 67% in total production in 2009-2010 (Kobuta et al. 2012). Unlike the European wheat quality standards, in the Ukrainian internal market till very recently the quality and class of wheat were determined by gluten content; while in the ports the assessment was based on the protein content of the product. As a result, food wheat (2nd or 3rd class) for the internal market was often classified as feed wheat on world markets.

With regards to the flour production in Ukraine, in 2012 there are about 1500 millers (2012 est.) that are divided into three major categories – industrial (from 100tons/day); agricultural millers (30-100 tons/day), and small miller enterprises (less than 30 tons/day). Seventy percent of the market is controlled by 60-70 large flour producers with the top twenty ones controlling half of the market. Industrial millers produce 70% of the total flour, agricultural millers – 23% and small millers – about 7 percent. Overall, the tendency towards decrease in number and increase in size is persisting in the market (Ukrselko 2013).

The Ukrainian government intervenes in the market by buying grain to support domestic producers; however, the role of state procurement agencies has decreased over time. In 2008-2010 only 5 percent of all grain was sold to them (Kobuta et al. 2012).

Bread prices are controlled by the government. Local administrations can control flour to bread margins and are allowed to set maximum profit margins for bakeries in the country. Such a profit margin usually averages at 5 percent and cannot exceed 10 percent. At the same time, the local administration often provides subsidies to the bakeries to purchase grain and/or flour. Overall, from 2005 until 2012 the real bread price on average increased by 0.7 percent with some fluctuations from year to year. For example, in 2008, the bread price went up by 6 percent compared to 2007, but in 2009 it decreased by 12 percent compared to 2008 (Ukrainian State Statistics Bureau 2013).

b. Export policy environment (2006-2012)

As was mentioned in the introduction, the Ukrainian government is prone to intervene in the wheat export market in a rather ad hoc manner. This section offers a chronology on officially implemented export restrictions in the analyzed period (table 4.1).

In October 2006 in response to rising global grain prices, Ukraine introduced wheat export quota that ranged from 3,000 tons to 1.2 million tons between 2006 and May 2008, when export quotas were abolished in light of an expected extraordinary large harvest. In August 2010, following the Russian ban on wheat exports, Ukraine implemented a new export quota in the amount of 500,000 tons which was increased to 1 million tons in December 2010. In March 2011, the government announced the extension of the 1 million quotas till July 2011. However, in May 2011, export quotas were substituted with export tariffs that remained in place till October 2011.

Table 4.1 Chronology of grain export restrictions starting from 2006, 1000 MT

Decision date	Period	Wheat	Barley	Corn
10/11/2006	10/17/2006-12/31/2006	400	600	600
12/08/2006	12/14/2006-06/30/2007	3	600	500
02/13/2007	02/15/2007-06/30/2007	3	606	30
02/22/2007	02/26/2007-06/07/2007	3	Quotas cancelled	Quotas cancelled
05/22/2007	05/22/2007	Quotas cancelled	-	-
06/20/2007	07/01/2007-10/31/2007	3	3	3
09/26/2007	01/01/2008-03/31/2008	200	400	600
03/28/2008	04/01/2008 – 04/30/2008	200	400	Automatic licensing
04/23/2008	04/2008-07/01/2008	1,200	900	Automatic licensing
05/21/2008	05/21/2008	Quotas and licenses are cancelled		
10/06/2010	10/20/2010-12/2010	500	200	2,000
12/08/2010	12/2010 – 02/2011	1,000	200	3,000
03/30/2011	04/04/2011 – 07/01/2011	1,000	200	5,000
05/2011	05/2011	Quotas are cancelled		
05/2011	05/2011-01/2012	Tariffs are introduced		
10/2011	10/2011	Tariffs cancelled, except for barley (01/01/2012)		
10/10/2011	07/01/2011 – 06/30/2012	Ministry of Agricultural Policy and Food of Ukraine signed a Memorandum of Understanding with the grain exporters; amount of allowed exports established at 24.761 mln. tons of grain		
07/2012	07/01/2012 – 06/30/2013	Memorandum of Understanding was extended for 2012-13 marketing year; amount of allowed exports established at 24.761 mln. tons of grain		
11/2012	11/2012 – 06/30/2013	Export amounts under the Memorandum of Understanding were increased by 1.5 mln. tons (for corn only)		
06/2013	07/01/2013 – 06/30/2014	Memorandum of Understanding was extended for 2013-14 marketing year		

Source: UkrAgroConsult 2013, Kobuta et al. 2012, FAO and EBRD, 2010

3. Methods

Economists have developed a variety of empirical methods to study price transmission (see Fackler and Goodwin 2011), that initially focused on estimating simple correlations between price series and were further developed into much more complex models. In the first step of this analysis, traditional cointegration models, such as the Engle and Granger (1987) procedure (primary one) and the Johansen Maximum Likelihood method (1988) to check for the robustness of the results are used to test for the presence of the long-run cointegration relationship between the analyzed pairs of price series. For the pairs of prices that are found to be cointegrated we use an error correction model, described further in the text to study the short-run dynamics of these prices.

The major limitation of the above methods, however, is that they assume linearity and symmetric adjustment of the price to the long run equilibrium. This might not be an adequate representation of reality and might lead to erroneous conclusions about the price relationships. Therefore, we employ threshold autoregressive (TAR) and momentum threshold autoregressive (M-TAR) models to account for possible asymmetries in the transmission of the analyzed prices, as well as the Bai and Perron (2003) structural break test to investigate the series for the presence of structural breaks in the long-run relationship.

Consider the Engle and Granger (1987) procedure which consists of two steps. First, the long run relationship between the pairs of analyzed log-prices is estimated[3]:

$$\mathrm{P_t^{FL}} = \beta_0 + \beta_1 \mathrm{P_t^{FW}} + \varepsilon_t \qquad (1),$$

where $\mathrm{P_t^{FL}}$, P_t^{FW} are prices of flour and farm wheat prices respectively. β_0 is an intercept, β_1 stands for the price transmission elasticity, and ε_t is the error term.

In the second step, we use an Augmented Dickey Fuller (ADF) test to check if the null hypothesis that $\gamma_1 = 0$ holds in the following regression:

$$\Delta\overline{\varepsilon_t} = \gamma_1 \bar{\varepsilon}_{t-1} + \sum_{i=1}^{p} \gamma_{i+1} \Delta\, \bar{\varepsilon}_{t-i} + \omega_t \qquad (2),$$

where ω_t is the white noise term, and $\overline{\varepsilon_t}$ is the residual obtained from the long-run equilibrium equation (1). The number of lags is selected by minimizing the Akaike Information

[3] From here forward we use an example of the relationship between Ukrainian farm wheat and flour prices. Also for simplicity from this point on Ukrainian wheat farm prices is denoted in the text as “Farm”, while Ukrainian flour price is referred to as “Flour”. French wheat FOB price is referred to as “FrenchFOB”

Criterion (AIC) and making sure that errors are not serially correlated. Rejecting the null would mean that analyzed wheat prices are cointegrated, i.e. they move together in the long-run.

While the coefficient β_1 is super-consistent if a pair of prices is cointegrated, it might still be biased for a number of reasons. One of them, described by Stock (1987) and Philips and Loretan (1991), suggests that β_1 is asymptotically biased when two prices are found to be cointegrated because of their correlations in a static equation. Second, if the dynamics of the data-generating process is ignored, it could further lead to the bias in β_1 (Banerjee et al. 1993; Boetel and Liu, 2010).

To correct for the above biases, Stock and Watson (1993) offered a Dynamic OLS technique that adds leads and lags of first differences of the independent variable to the equation (1) that now takes the following form:

$$P_t^{FL} = \theta_0 + \theta_1 P_t^{FW} + \sum_{i=-m}^{+m} \Delta P_{t-i}^{FW} + u_t \qquad (3),$$

where P_t^{FL}, P_t^{FW} are prices of flour and farm wheat prices respectively. θ_0 accounts for the transfer costs, θ_1 is a super consistent unbiased coefficient of price transmission elasticity, $\sum_{i=-m}^{+m} \Delta P_{t-i}^{FW}$ is the sum of lags and leads of first-differenced price of wheat, and u_t is the error term. These first differences allow controlling for possible endogeneity and simultaneity problems. Selection of the number of leads and lags in this analysis was based on the AIC. The Newey-West heteroskedasticity and autocorrelation robust standard errors need to be used to assess the significance of the coefficients (Cushman 2000).

a. Asymmetric price transmission

Enders and Granger (1998) argue that the ADF test in equation (2) would be misspecified if price adjustment towards equilibrium is asymmetric. Therefore, they suggested a modification to equation (2) to test for the asymmetric price transmission, which is known as the threshold autoregressive (TAR) model:

$$\Delta\bar{\varepsilon}_t = I_t\gamma_1\bar{\varepsilon}_{t-1} + (1 - I_t)\gamma_2\bar{\varepsilon}_{t-1} + \sum_{i=1}^{p}\gamma_{i+1}\Delta\,\bar{\varepsilon}_{t-i} + \varphi_t, \qquad (4),$$

where $\Delta\bar{\varepsilon}_t$ is the first difference of the error term from (1),

$\bar{\varepsilon}_{t-1}$ is lagged error term from (1) lagged for one time period,

γ_1 and γ_2 are the adjustment rates,

I_t is the Heaviside indicator function, such that

$$I_t = \begin{cases} 1\ if \quad \bar{\varepsilon}_{t-1} \geq 0 \\ 0\ if \quad \bar{\varepsilon}_{t-1} < 0 \end{cases} \qquad (5),$$

and $\sum_{i=1}^{p}\gamma_{i+1}\Delta\,\bar{\varepsilon}_{t-i}$ is lagged differenced error term. An AIC is used to determine the optimal lag length.

Alternatively, it is also possible that the process of adjustment to the long run equilibrium may depend on the change in $\bar{\varepsilon}_{t-1}$ instead of the level of $\bar{\varepsilon}_{t-1}$ and, therefore, exhibiting more momentum in one direction than another. For such cases, Enders and Siklos (2001) suggested an alternative momentum threshold autoregressive (M-TAR) model in which Heaviside indicator function is modified in the following way:

$$I_t = \begin{cases} 1\ if\ \Delta\bar{\varepsilon}_{t-1} \geq 0 \\ 0\ if\ \Delta\bar{\varepsilon}_{t-1} < 0 \end{cases} \qquad (6).$$

To summarize, TAR and M-TAR models correspond to “deep” and “steep” asymmetric processes, respectively (Sichel 1993). Deepness corresponds to skewed price series in levels, while steepness represents skewed first-differenced series. However, in either model, $|\gamma_1| < |\gamma_2|$ would suggest that increases in the price of the independent variable tend to persist, while the decreases are transmitted back to the long run equilibrium. The choice of the model is selected based on the AIC or BIC criterion (Enders and Granger 1998). Moreover, several studies (Enders 2001; Enders and Siklos 2001) suggest that the M-TAR model has a greater power in detecting a cointegration relationship than the TAR model.

For both TAR and M-TAR models, the first step is to check (and in case of our paper, to verify) that analyzed series are cointegrated. To do so, the null hypothesis H_0: $\gamma_1 = \gamma_2 = 0$ of no cointegration is tested. Since the F statistic for the above null hypothesis has a non-standard distribution, the Φ-statistic is used instead (see Enders and Granger 2001). If the null that $\gamma_1 = \gamma_2 = 0$ is rejected, we can conclude that the series are cointegrated and proceed with the test for the symmetric price adjustment. To do so, the null hypothesis of symmetric adjustment H_0: $\gamma_1 = \gamma_2$ is tested. Standard F-statistics can be used to test this hypothesis. If we fail to reject the null, we can conclude that the price adjustment is symmetric. Rejecting the null, however, would suggest that the series respond differently to whether the departure from the long-run equilibrium is increasing or decreasing.

b. Short-run dynamics

Short-run cointegration tests serve to verify if analyzed prices in different markets respond immediately to the long-run relationship. Error-correction models (ECM) are used to analyze such short-run dynamics. However, their specifications, as in the case of the long-run dynamics analysis, depend on whether price adjustment is symmetric or not.

Symmetric ECM takes the following form:

$$\Delta P_t^{FL} = a_0 + a_1 \bar{\varepsilon}_{t-1} + \sum_{i=1}^{p} \delta_i \Delta P_{t-i}^{FL} + \sum_{j=1}^{n} \theta_j \Delta P_{t-j}^{FW} + \vartheta_t \quad (7),$$

where ΔP_t^{FL} and ΔP_t^{FW} are vectors of the first differences of log prices for flour and wheat at the farm level, $\bar{\varepsilon}_{t-1}$ is the lagged residual from (1), ϑ_t is the error term, and the scalar a_1 represents the short-run adjustment speed of the dependent variable to the long-run steady state (Baffes 2003).

If, however, series respond with different magnitude towards positive and negative changes (i.e. null hypothesis that H_0: $\gamma_1 = \gamma_2$ is rejected in (4)), ECM model is modified into a threshold ECM (TECM) as follows:

$$\Delta P_t^{FL} = a_0 + \rho_1 I_t \bar{\varepsilon}_{t-1} + \rho_2 (1 - I_t) \bar{\varepsilon}_{t-1} + \sum_{i=1}^{p} \delta_i \Delta P_{t-i}^{FL} + \sum_{j=1}^{n} \theta_j \Delta P_{t-j}^{FW} + \mu_t \qquad (8),$$

where ρ_1 and ρ_2 represent the speed of adjustment depending on whether $\bar{\varepsilon}_{t-1}$ or $\Delta\varepsilon_{t-1}$ is above or below the threshold[4].

The signs of the short-run adjustment coefficients are expected to be negative. Both equations (7) and (8) can be specified with additional lags ($\sum_{j=1}^{n} \theta_j \Delta P_{t-j}^{FW}$ and $\sum_{i=1}^{p} \delta_i \Delta P_{t-i}^{FL}$) to deal with autocorrelation which might be present in the error term.

Additionally, following the procedure used by Ghoshray (2002) we can estimate the number of months (n) it takes flour price series to adjust back to the equilibrium after the change in the farm wheat prices. The formula to use is the following:

$$n = \frac{\log(1-p)}{\log(1-a_1)} \qquad (9),$$

where p is a given proportion of the disequlibrium to be corrected, and a_1 is the short-run adjustment speed coefficient from (7) given the symmetric adjustment. If TECM is used, then instead of a_1 in (9), we use ρ_1 and ρ_2 to differentiate between the speed of adjustment to the equilibrium after positive and negative changes.

c. Structural breaks

[4] In this study we focus on testing long run asymmetry only, however, one should note that the model in (10) could further be modified to incorporate short run asymmetries

Since French FOB-Farm and Farm-Flour series are cointegrated, the results of the regressions that analyze the relationships between them are consistent (see equation 3). Thus, β_1 can be considered as the long-run price transmission elasticity. However, such an interpretation of the parameter is grounded in the assumption that the long-run relationship between the series is constant over time, which might necessarily be realistic, especially given the sporadic changes in the Ukrainian grain export policies or two large price commodity spikes in the analyzed period. Thus, we use Bai and Perron (2003) procedure to test the null hypothesis that there is at least one structural break in the relationship of the French FOB – Farm wheat price pair[5] over the analyzed period.

The pioneer of the structural break tests is considered to be Chow who in 1960 introduced the first test to check for the presence of structural break in the series. The major limitation of his test, however, is that the break date needs to be known *a priori*. This is hard to do in the case of this analysis due to a variety of different events and factors that could have potentially affected the relationship of the analyzed series. By contrast, the Bai and Perron (1998) test (which was further improved in 2003) provides two important advantages over the Chow test and, thus, is suitable for this analysis. First, it allows for searching for more than one break, and, second, there is no requirement for a researcher to know the timing of the break(s) in advance.

The Bai and Perron (1998) procedure is sequential and uses a dynamic programming approach to identify the optimal number of breaks. To do so, at first, a specification of the minimum allowable segment length needs to be estimated. In their 2003 study, Bai and Perron

[5] In this analysis, we test for the presence of structural breaks in the FrenchFOB-Farm relationship only. The reason is that it seems to constitute a more interesting case than a Farm-Flour relationship due to a number of policy interventions in the Ukrainian export market as well as various events in the world grain markets that could have caused such breaks.

discuss size distortions associated with heteroskedasticity and the autocorrelation consistent covariance matrix estimator when the trimming rate is set at a low level. They suggest a rate at 20 percent for a sample size of 120 observations, yet acknowledge that this rate could be reduced with a smaller sample. It is also not unusual in the literature to set the trimming rate at 0.1 or 0.15 level (Dahl et al.; Jin and Miljkovic). This would imply that each segment tested for the presence of structural break cannot contain less than 10 or 15 percent of total observations. In our case, 10 percent of the sample would equal to about 42 observations, and 15 percent would account for 63 observations.

Once the trimming parameter is set, the Bai and Perron algorithm evaluates each segment for the presence of structural breaks by carrying out a sequence of F-statistics test for the null hypothesis of no breaks. The optimal number of breaks was selected based on minimizing two criteria - BIC and Residual Sum of Squares. When any extra break is added to the model, its statistical fit improves even if no break was present. Therefore, it is important to focus only on those breaks that improve the model in statistically significant way.

If structural breaks are found in the long-run relationship, the next step would be to re-estimate equation (3) by inserting relevant break dummies in the equation to obtain a consistent estimate of the long-run price transmission elasticity.

$$\mathrm{P}_{\mathrm{t}}^{\mathrm{FL}} = \partial_0 + \partial_1 \mathrm{P}_{\mathrm{t}}^{\mathrm{FW}} + \sum_{\mathrm{i}=-\mathrm{m}}^{+\mathrm{m}} \Delta \mathrm{P}_{\mathrm{t-i}}^{\mathrm{FW}} + \mathbf{X}_{\mathrm{t}} + \varphi_{\mathrm{t}} \qquad (10),$$

where $\mathrm{P}_{\mathrm{t}}^{\mathrm{FL}}$, P_t^{FW} are prices of flour and farm wheat prices respectively. ∂_0 accounts for the transfer costs, ∂_1 is a super consistent unbiased coefficient of price transmission elasticity, $\sum_{\mathrm{i}=-\mathrm{m}}^{+\mathrm{m}} \Delta \mathrm{P}_{\mathrm{t-i}}^{\mathrm{FW}}$ is the sum of lags and leads of the first-differenced price of wheat, $\mathbf{X}_{\mathrm{t}}$ represents regime dummies (here indicated with $\mathbf{X}_{\mathrm{t}}$ for the sake of simplicity), and φ_{t} is the error term.

4. Application to the Ukrainian grain market

a. Data and stationarity tests

The data used in this analysis consists of weekly nominal French soft wheat FOB prices (Rouen ports), Ukrainian ex-warehouse wheat prices and top grade flour prices. All prices are expressed in logs. The analyzed period spans from January 2005 till December 2012, accounting for a total of 416 observations. The data was obtained from the Ukrainian analytical agency APK-inform and HGCA. From visual inspection of the series (Figure 4.2), we can conclude that in general all farm wheat and flour price series tend to move together.

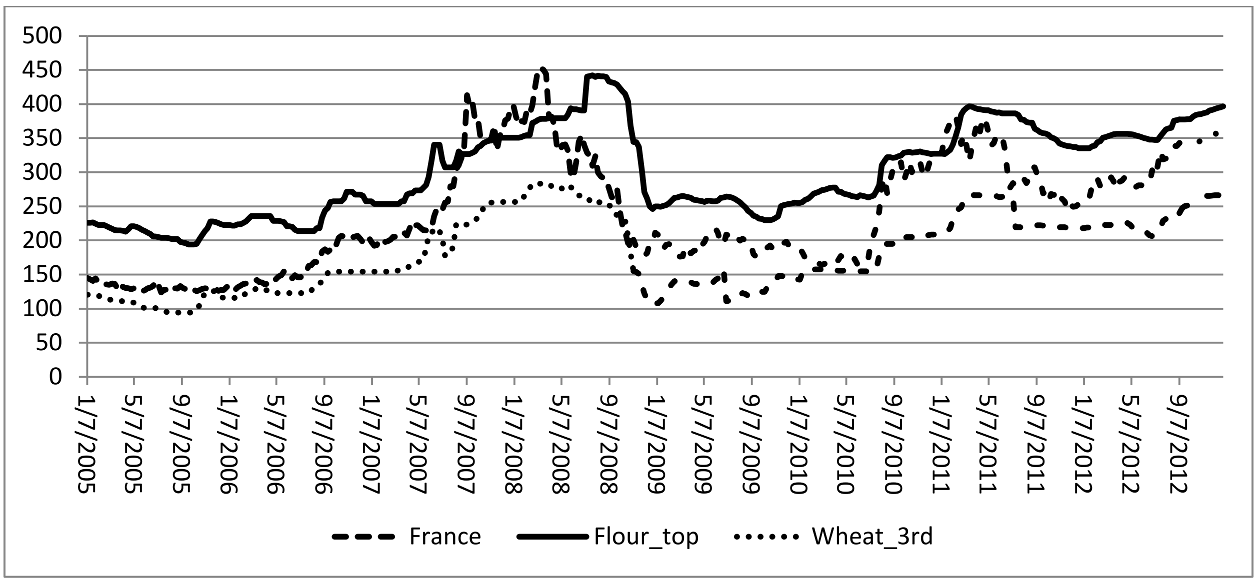

Figure 4.2 Development of the domestic wheat price and wheat exports of Ukraine compared to the world market

Source: APK-Inform (2013), HCGA (2012)

However, it can be observed that the domestic prices, even though they share the overall dynamics with the French export prices, do deviate from those at times of the global commodity price spikes of 2007-08 and 2010-11. These periods also coincide with an increased intervention of the Ukrainian government into its wheat exports.

The hypothesis that the price series are non-stationary time series over the whole period were tested by using ADF, PP and KPSS unit root tests. The results suggested that all series are I(1) at conventional significance levels (see table 4.2 and table 4.3).

Table 4.2 Results of the unit root tests in levels[a]

			ADF		PP		KPSS	
	# of lags	AIC	w/ drift	w/ drift and trend	w/ drift	w/ drift and trend	w/ drift	w/ trend
FrenchFOB	1	-1532.5	-1.35	-1.66	-1.23	-1.53	2.93**	0.56**
Flour	1	-2270.9	-1.42	-2.02	-0.92	-1.39	3.24**	0.49**
Farm	1	-1986.0	-1.51	-2.11	-0.97	-1.46	2.90**	0.49**

[a]Asterisks denote levels of significance (* for 10 percent , ** for 5 percent). The 5% and 10% critical values for ADF and PP tests with a drift are -2.90 and -2.59 respectively; for the tests with a drift and a trend are -3.47 and -3.16 respectively. Critical values were obtained from MacKinnon (1991). The 5% and 10% critical values for the KPSS test in levels are 0.463 and 0.347 respectively; for the KPSS tests with a trend they are 0.146 and 0.119 respectively.

Table 4.3 Results of the unit root tests in differences[b]

			ADF		PP		KPSS	
	# of lags	AIC	w/ drift	w/ drift and trend	w/ drift	w/ drift and trend	w/ drift	w/ trend
FrenchFOB	1	-1526	-13.29**	-13.27**	-17.61**	-17.59**	0.09	0.09
Flour	1	-2264	-9.30**	-9.29**	-11.33**	-11.32**	0.07	0.08
Farm	1	-1978	-9.68**	-9.67**	-11.51**	-11.49**	0.07	0.07

,[b]Asterisks denote levels of significance (* for 10 percent , ** for 5 percent). The 5% and 10% critical values for ADF and PP tests with a drift are -2.90 and -2.59 respectively; for the tests with a drift and a trend are -3.47 and -3.16 respectively. Critical values were obtained from MacKinnon (1991). The 5% and 10% critical values for the KPSS test in levels are 0.463 and 0.347 respectively; for the KPSS tests with a trend they are 0.146 and 0.119 respectively.

b. Cointegration and asymmetric estimations

To test for the presence of the statistically significant long-run relationship between French and farm prices as well as between farm and flour prices, we use the Engle and Granger (1987) two-step procedure. Results provided in table 4.4 show that both pairs of prices are cointegrated[6]. The number of lags in equation (1) was selected by using AIC .

Table 4.4 Engle and Granger cointegration tests for the wheat price series of interest[c]

	# of lags	AIC	ADF w/ drift and trend	PP w/ drift and trend	KPSS w/ trend
France-Farm	1	-1648.7	-4.85**	-4.04**	0.113*
Farm-Flour	1	-2203.6	-3.41**	-3.45**	0.09**

[c]Asterisks denote levels of significance (* for 10 percent, ** for 5 percent). The 5% and 10% critical values for tests with a drift are -3.37 and -3.07 respectively. Critical values were obtained from MacKinnon (1991). The 5% and 10% critical values for the KPSS test in levels are 0.463 and 0.347 respectively; for the KPSS tests with a trend they are 0.146 and 0.119 respectively.

For the consistency check of cointeration, a Johansen ML model was also estimated (see Johansen 1988). Its results confirmed a statistically significant long-run relationship between the series of interest (table 4.5).

Table 4.5 Johansen ML Pairwise cointegration tests for the wheat price series of interest[d]

Pairs of series	Ho(H1)	p	Trace	5%CV
France-Farm	r=0((r>0)	2	44.8**	19.99
	r=1(r>1)		2.90	9.13
Farm– Flour	r=0((r>0)	2	30.55**	19.99
	r=1(r>1)		4.64	9.13

[d]Asterisks denote levels of significance (* for 10 percent, ** for 5 percent).

According to the results of equation (1), the long-run price transmission elasticities are equal to 0.69 for the French FOB-Farm pair of prices and to 0.74 for the Farm-Flour pair of prices. The price transmission elasticity indicates the percentage change in the price of wheat at one of the stages in the supply chain in response to a one-percent change at another stage.

To assess the robustness of the parameters of the cointegration vector, a DOLS model was specified (see equation (6)). The results are similar to those obtained from equation (1) for

[6] We included trend in equation (1) when specifying long-run equilibrium relationship between analyzed pairs of prices. This increased the consistency of the ADF and PP tests' results. KPSS results are significant at 10 percent level in case of FrenchFOB-Farm pair and 10 percent for Farm-Flour pair. However, we conclude that the series are cointegrated since three tests (ADF, PP and Johansen ML) support cointegration presence.

each pair of analyzed prices. The long run price transmission elasticity is equal to 0.71 for French FOB-Farm price and to 0.70 for Farm-Wheat pair. Another benefit of the DOLS model is that the extracted residuals need not to be free from autocorrelation if Newey-West errors are employed.

c. Structural break test results

To check for the presence of structural breaks in the French FOB-Farm long-run price relationship, we employ the Bai and Perron (2003) dynamic programming algorithm. We first used a trimming rate set at 10 percent. This resulted in seven breaks according to BIC and RSS, with many of them being quite minor (according to the SupF plot). Also, since the goal is to further include structural breaks in equation (12), with seven breaks the number of observations per each regime would be quite low, and, thus, might lead to inconsistent results. Therefore, the Bai and Perron (1998) technique was re-run using 15-percent trimming parameter[7].

Figure 4.3 shows BIC and RSS values that correspond to different number of breakpoints shown on the horizontal axis. The optimal number of breaks is selected by minimizing both criteria. As can be seen from this figure, a BIC criterion has its lowest value at three structural breaks, while RSS is minimized at five breaks. To account for both criteria, we select a middle point of four breaks.

[7] We re-ran the model varying the trimming rate between 0.20 and 0.30. Interestingly enough, as the number of breaks decreases with the larger trimming parameter, two breaks are always present – the one in November 2008 and the one in March 2011. However, four breaks allowed us to divide the analyzed period into the regimes with more and with fewer government interventions, and, thus, are more insightful for the purposes of this analysis.

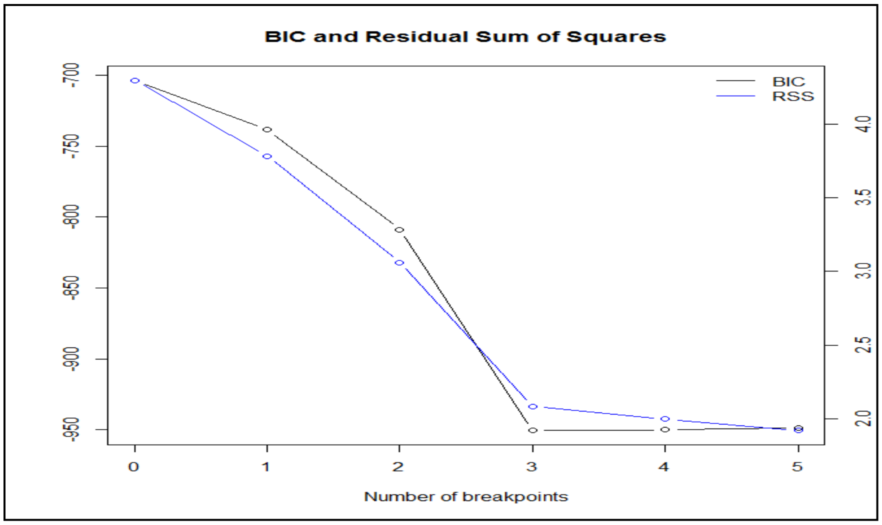

Figure 4.3 BIC and RSS models for m break points

The SupF graph in figure 4.4 supports this choice as F statistics crosses its boundary[8] four times. This can be interpreted as an evidence of four structural breaks at 5 percent significance level.

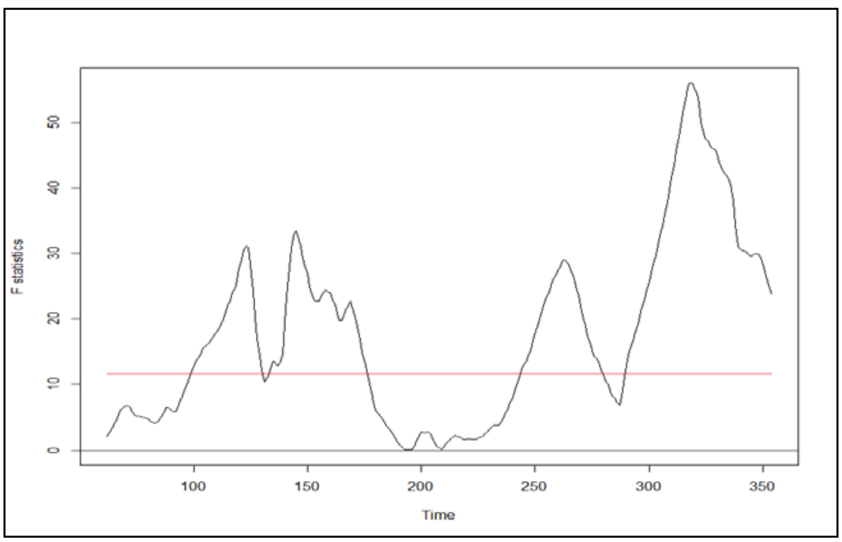

Figure 4.4 SupF test plot for FrenchFOB-Farm pair

Table 4.6 displays the estimates of optimal break dates and their confidence intervals. While it is impossible to be sure what caused these breaks based on the above results, there are several events that coincided with each break and could possibly explain them.

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[8] Under the null hypothesis, boundary is computed in such a way that the asymptotic probability that the mean of F statistics exceeds its boundary is equal to 5 percent.

Table 4.6 Estimated break dates[9]

	Break date	Confidence interval	BIC	RSS
Break 1	August 2007	07/2007 – 08/2007	2.03	-947.44
Break 2	November 2008	10/2008 –11/2008		
Break 3	January 2010	12/2009 – 02/2010		
Break 4	March 2011	11/2011 – 04/2011		

<u>Break 1:</u> Figure 4.5 displays the chronology of government interventions in the wheat market over the analyzed period. As can be seen in, in July 2007 Ukrainian government introduced a restrictive quota in the amount of 3,000 tons of wheat due to the severe drought. These months also fall on the first half of the first commodity price bubble of 2007/08.

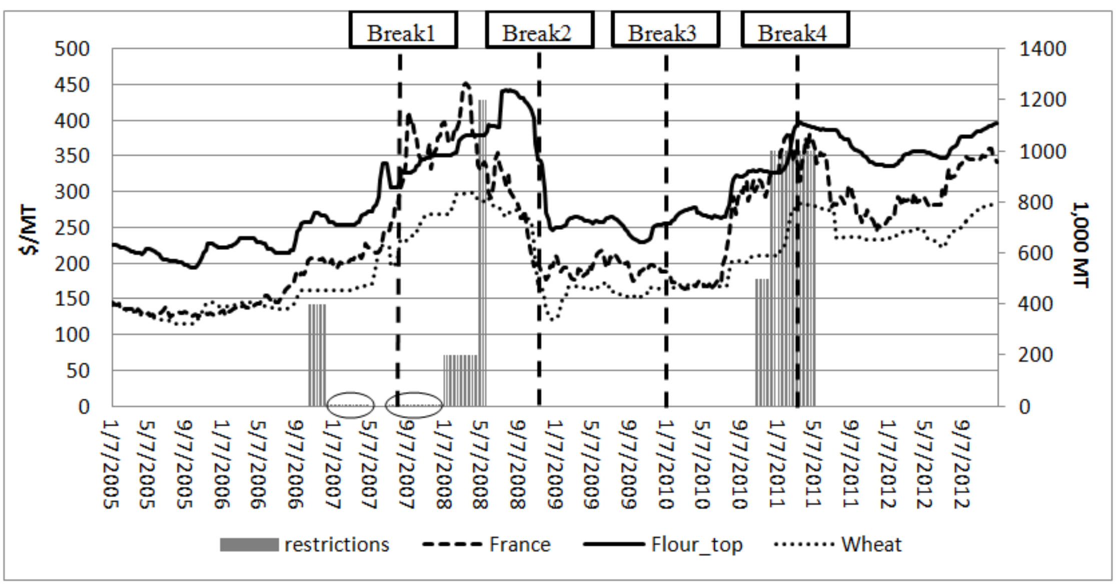

Figure 4.5 Chronology of the export restrictions and structural breaks

<u>Break 2:</u> Towards the end of 2008, Egypt, the largest importer of wheat in the world (and one of the largest importers of Ukrainian wheat) had to suspend purchases of Ukrainian product due to complaints about quality issues regarding wheat originating in Ukraine, which resulted in

[9] If three breaks were to be chosen, they would correspond to August 2007, November 2008 and March 2011.

35% reduction in Ukrainian wheat deliveries to that country as compared to the previous season (Kobuta et al. 2012).

Break 3: This break does not seem to be attributed to a direct policy intervention in the Ukrainian grain market. The exports in early fall of 2009 were among the record ones in history of Ukraine. However, as can be seen in figure 4.2, in January 2010, during the month of the 3rd break, there was almost a 50 percent drop in export amounts from about 1.1 million tons to 600 thousand. This new regime of low export amounts (with maximum export volume equaling to 800 thousand in June and September 2011) remained in the market till the summer of 2012. There are numerous reasons for such a development in Ukrainian wheat export dynamics. Among the major ones are winter kill in early 2010 and persistent heat in the summer of the same year that negatively affected the production of wheat in the country. Such weather conditions were also the major causes for the introduction of the export restrictions in the fall of 2010. Additionally, the president of the Agrarian Chamber of Ukraine named a number of other reasons that caused this decrease in export volumes in 2010. Among them are problems with the VAT repayment, ineffective activities of the Agrarian Fund with grain purchases, and, the most important one – the establishment of the new system of gain classification (APK-Inform 2013).

Break 4: In March 2011, Ukrainian government for the second time in the past three months announced an increase in export quota to 1 mln tons (from previous 500,000 tons). This was also the first time that the government of Ukraine started discussing the imposition of export duties (9% for wheat, 14% for barley and 12% for corn). Later, in May 2011, the quota was, actually, abandoned, and export tariffs were introduced instead till October 2011. Finally, in July 2011, Egypt announces that it considers allowing wheat originating in Ukraine to be included in the next wheat tender (after it has been off the list for 3 years).

Overall, the break dates allow us to divide the entire sample into five periods:

Period 1 (January 2005 till August 2007) is characterized by a tranquil policy situation with no interventions till late 2006, when the first export quota was introduced in the Ukrainian wheat market at the amount of 400,000 tons.

Period 2 (September 2007 – October 2008) is characterized by export quotas restrictions in the market up till May 2008.

Period 3 (November 2008 – November 2010) is another period of a rather tranquil policy situation. Larger quotas (500,000 tons) were introduced in the last month of this time range. This period was, however, also characterized by the suspense of Ukrainian wheat exports to Egypt that could have potentially dampened the price transmission between French and Ukrainian wheat series, since these two countries are major competitors in the Egyptian market.

Period 4 (December 2010 – March 2011) is a short period which coincided with the second commodity bubble, and the beginning of export restrictions imposed by the Ukrainian government.

Period 5 (April 2011 – December 2012) is the period when the government of Ukraine switched to export tariffs, allowing the domestic prices to be more closely linked to the world prices. These tariffs were abolished in October 2011. Thus, this period could be categorized as the one with the least amount of market distorting interventions.

To summarize, Period 1, Period 3 and Period 5 are the periods with much fewer interventions in the wheat market compared to Periods 2 and 4. Also, the two latter periods coincide with the world commodity bubbles. Therefore, we use the DOLS model with the dummy variables that account for these different periods to test the null hypothesis that the long-run price transmission is not statistically different across different periods. The results provided in Table 4.7, however, suggest that we need to reject the null, and conclude that long-run price transmission elasticity changes significantly in the periods characterized by high governmental intervention and increase in global commodity prices (i.e. period 2 and 4) compared to the periods with lower level of intervention.

Table 4.7 Results of the Dynamic OLS model with regime dummies

Variable	Coefficient[e]
Const	2.17 (0.35)***
Trend	0.0005(0.00)***
P_t^{FR}	0.55 (0.06)***
Regime 1	0.01 (0.07)
Regime 2	-0.34 (0.08)***
Regime 3	-0.33 (0.17)*
Regime 4	-0.14 (0.07)**
Const_r1	-0.08 (0.41)
Const_r2	2.08 (0.48)***
Const_r3	1.6 (0.92)*
Const_r4	0.66 (0.38)*
ΔP_{t-1}^{FR}	-0.43(0.09)***
ΔP_{t-2}^{FR}	-0.31 (0.09)***
ΔP_{t+1}^{FR}	-0.04 (0.09)
ΔP_{t+2}^{FR}	-0.02 (0.08)
AIC	-1033.76

[e]The Newey-West heteroskedasticity and autocorrelation robust standard errors are reported in parenthesis. Asterisks denote levels of significance (* for 10 percent, ** for 5 percent, *** for 1 percent).

For example, the elasticity of price transmission is lower by 0.34 in Period 2 compared to Period 5 (the benchmark period used in the model). In Period 4 the elasticity is lower by 0.14 compared to the similar parameter in Period 5. Elasticities in periods 1 and 5 are not statistically different and equal to 0.55. The results for Period 3 are less straightforward. The coefficient for the break 3 dummy is only significant at 10 percent level. However, when a new DOLS model is re-estimated on de-seasoned series, this coefficient becomes statistically insignificant, while other coefficients remain similar in terms of magnitude and significance. Overall, with caution we conclude that there is no significant evidence to suggest that the long-run price transmission elasticity in Period 3 was statistically different from the one in Period 5.

The Ukrainian farmers seem to be the losers from the interventionist policy of the Ukrainian government. If we look at the average difference between French and Ukrainian prices (in absolute terms), it increased twofold in Period 2 and Period 4 compared to Periods 1 and 3 from about 34 USD/ton to 73 USD/ton. Figure 4.6 displays the dynamics of the FrenchFOB-to-Farm price ratios. Rectangles in the figure represent the periods of export quotas implemented by the Ukrainian government. Except for the high ratio in the late 2008 (which was probably attributed to the ban of Ukrainian exports to Egypt as mentioned earlier in the text), it is clearly seen that during the times when quotas were in place the ratio is higher comparing to the periods with no interventions.

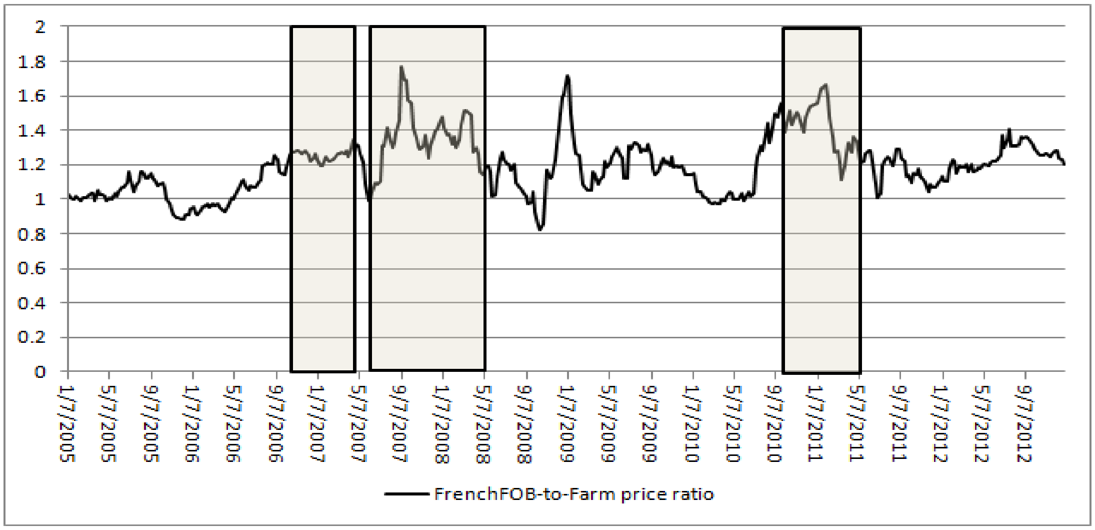

Figure 4.6 Dynamics of French to Ukrainian wheat price ratios

Since choice of the number of breaks was not a straightforward (see figure 4.3), we analyzed the dataset with the inclusion of three breaks only. This resulted in four periods instead of five: Period 1 (January 2005 till August 2007); Period 2 (September 2007 – October 2008); Period 3 (November 2008 – March 2011), and Period 4 (April 2011 – December 2012). Once the dynamic OLS was re-run with the dummies for these periods, the results were consistent with those reported in Table 4.7. Elasticities in more tranquil periods 1 and 5 were not statistically different; elasticity, however, decreased by 20 % in period 2, and by 14% in period 3 that now included export restrictions of the end of 2010, and Egyptian ban of Ukrainian wheat. However, four break division allows us to further disaggregate periods with interventions vs. periods with fewer interventions, and, for this reason, we use four breaks in this analysis.

d. Asymmetry testing

TAR and M-TAR models were estimated next for different lag length to test for the presence of asymmetric price transmission in the analyzed pairs of prices. The models were run with different lag length, with the optimal number again being selected by the AIC and SBC criterion. The results are reported in Table 4.8.

Table 4.8 TAR and M-TAR model parameter estimates[f]

	TAR model		M-TAR model	
	France – Farm	Farm - Flour	France – Farm	Farm - Flour
Variable	Parameter estimate	Parameter estimate	Parameter estimate	Parameter estimate
γ_1	-0.08 (-2.95)**	-0.06 (-2.46)**	-0.06 (-2.01)**	-0.03 (-0.99)
γ_2	-0.06 (-2.37)**	-0.07 (-2.00)**	-0.09 (-3.44)**	-0.10 (-4.33)**
$H_0: \gamma_1 = \gamma_2 = 0 (\Phi)$	7.07**	7.48**	7.72**	9.75**
$H_0: \gamma_1 = \gamma_2 \ (F)$	0.18 [0.67]	0.02 [0.89]	0.81 [0.37]	4.61 [0.03]**
AIC		-1539.70		-2044.16

[f]Asterisks denote levels of significance (* for 10 percent, ** for 5 percent). The 10% and 5% significance level critical values are 3.79 and 4.64 respectively. t-values are stated in parenthesis. The values in the square brackets denote the p-values.

From the results of the TAR test we can conclude that the price transmission between both pairs of prices is symmetric. However, the results of the M-TAR model contradict such a conclusion. The F test in the M-TAR model for the Farm-Flour pair of prices suggests the rejection of the null hypothesis of symmetry. Based on the AIC criterion for both TAR and M-TAR model, it is clear that the latter model fits the data better. Moreover, as was mentioned in the methods part of the paper, the literature suggests that the M-TAR model is better at detecting asymmetry in price transmission among series; however, we use both models for the purpose of consistency check. Based on the results, we conclude that price transmission between farm and flour prices is asymmetric. The coefficients provided in table 4.8 show the level of persistence of positive and negative discrepancies from equilibrium in the short-run. It can be concluded from these results that positive discrepancies in the profit margin of the millers (i.e. wheat price decrease) are not eliminated at all due to the insignificance of the coefficient. The negative discrepancies (i.e. wheat price increase) in the profit margin are eliminated at the rate of 10 percent per week. Therefore, the Ukrainian miller industry responds much more quickly to the shocks that squeeze its profit margins than to those that stretch them. These results are rather expected, given the structure of the flour market in Ukraine in which more than 50% of all flour production is controlled by twenty largest millers, who can possibly exert some power over the price of their final product.

These results suggest that millers can protect themselves from the increases in wheat prices, by increasing flour prices. However, as the results of the asymmetry tests suggest when the wheat farm prices go down, the millers tend not to pass this decrease onto the bakers. Since the government controls bread prices in the country, abrupt changes in the wheat prices are not necessarily transmitted to the final consumer. This implies, that the major losers in the Ukrainian wheat market are, actually, bakers, who have to deal with controlled bread prices and fluctuating prices in wheat flour or taxpayers, since as was mentioned in the introduction, local government administrations often provide the bakeries with the subsidies to purchase flour and maintain their profit margins as flour price fluctuates.

e. Short-run dynamics

Given the results of the asymmetric price transmission test, the error correction model to test for short-run dynamics for the pairs of prices that are analyzed in the study can be constructed. Since the adjustment between French and Farm prices was found to be symmetric, we proceed with the symmetric error correction model provided in equation (7). For Farm and Flour prices we employ a threshold error correction model offered in equation (8).

Table 4.9 shows the results for both models. It can be observed that the error-correction terms for French FOB prices are negatively significant. This suggests that Ukrainian wheat farm prices adjust to the long-run equilibrium of French FOB prices. Using equation (9) we estimate that it takes wheat farm price about 37 weeks or 9 months to correct 90 percent of disequilibrium after the change in French export price. This is rather low level of adjustment and could be caused by the inefficiencies present in the market, for example, those caused by the policy interventions or substantially higher (if compared to the US and EU) farm to port transport costs.

Table 4.9 Error-correction model parameter estimates[g]

Dependent variable	Independent variable	# of lags	Speed of adjustment, ρ_1	Speed of adjustment, ρ_1	Speed of adjustment, ρ_2
FrenchFOB	Farm	1;1	-0.0240 (-1.33)	-	-
Farm	FrenchFOB	2;2	-0.0638 (-5.70)**	-	-
Flour	Farm	1;1	-	-0.02 (-1.23)	-0.11(-6.08)**

[g] t-values are given in parenthesis. [f]Asterisks denote levels of significance (* for 10 percent, ** for 5 percent).

On the contrary, the error correction terms are not significant for the wheat farm price. This implies that French prices do not adjust to correct long-run disequilibria after the change in the farm price, and serves as an indication that French export prices serve is a price leader in its relationship with wheat farm series.

In case of the short-term dynamics for the Farm-Flour pair of prices, the results suggest that flour prices adjust to the long-run equilibrium after a positive change in the wheat price, and 90 percent of such adjustment happens in about 5 months. The short-run adjustment to the decreases in wheat price is found to be statistically insignificant at 5 percent level. In the case of the Farm-Flour price relationship, we assume a unidirectional flow of change from wheat farm price to the flour price. Such an assumption is not surprising given the fact that wheat price comprises about 85 percent of the cost of flour and most likely determines its price.

5. Conclusions and implications

This paper analyzes price transmission along the Ukrainian wheat supply chain from January 2005 until December 2012. The results have important implications for evaluating the performance of the Ukrainian wheat market and efficiency of resource allocation among its different players. More precisely, a number of econometric techniques (such as Engle and

Granger (1987) procedure, Johansen ML test (1998) and Error Correction Model) are employed to examine the long- and short-run relationships between French export prices and Ukrainian wheat producer prices as well as between Ukrainian wheat producer and flour prices. Additionally, the assumptions about linearity and symmetric adjustment of the analyzed price to the long run equilibrium are tested with the help of the threshold autoregressive (TAR) and the momentum-threshold autoregressive (M-TAR) models, and the Bai and Perron (2003) structural break test.

Cointegration test results suggest that Ukrainian farm wheat prices are cointegrated with French prices, while flour prices are cointegrated with the farm prices. The estimated long-run price transmission elasticity for the FrenchFOB-Farm pair is equal to 0.70, while for Farm-Flour pair – to 0.71.

The Bai and Perron (2003) procedure suggested that there are four structural breaks in the FrenchFOB-Farm relationship that occurred between 2005 and 2012. Based on these breaks the data was split into five periods. Two of these periods - Period 2 (September 2007 – October 2008) and Period 4 (December 2010 – March 2011) - to a large extent coincided with the world commodity price bubbles and implementation of the export restrictions by the Ukrainian government. Three other periods in between were characterized by a more or less tranquil policy environment with fewer (or less restrictive) interventions. The results of the Dynamic OLS model applied to the FrenchFOB-Farm pair with the incorporation of dummies for these five periods suggest that during periods 2 and 4, the long-run price transmission elasticity decreased by 0.34 and 0.14, respectively.

As to the price asymmetry tests, they suggest that in case of the Farm-Flour price relationship, increases in wheat prices that result in the reduction of the marketing margin for the millers appear to be passed to the flour consumers faster than reductions in wheat price that lead to increases in millers' profit margin. In case of the FrenchFOB-Farm pair, the price transmission was found to be symmetric.

To analyze short-run dynamics between the prices of interest, error correction models were applied. For the FrenchFOB-Farm pair a symmetric error-correction model was fit. Its results showed that Ukrainian producer prices follow those of the French prices and it takes wheat farm price about 9 months to correct 90 percent of disequilibrium after the change in French export price. If compared to the literature on short-run price adjustment in grain markets (Ghoshray 2007, Dawson et al. 2006), 9 month adjustment to the equilibrium could be considered as a slow rate of adjustment, which is a sign of inefficiencies present in the market.

To analyze the short-run relationship between farm wheat price and flour price, a threshold error-correction model was employed to account for the found asymmetries. The results suggested that in the short run, after decrease in wheat price, flour prices are irresponsive to the adjustment towards the equilibrium. Increases, however, are passed on within five months, an average adjustment rate. This further suggests that Ukrainian flour millers might exhibit market power and not pass on decreases in wheat prices to the bakers.

Based on the above results, it could be suggested that during the export restrictions, Ukrainian farmers are among the major losers in the domestic market, since the high world wheat price is not fully transmitted to them. Another category of losers are bakers, who are caught up in-between bread market controlled by the government and millers who are slow at passing on to them the decreases in wheat prices.

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