Impacts of Export Controls on Wheat Markets During the Food Crisis 2007/2008 in Russia and Ukraine

Linde Götz [a], Thomas Glauben [a] and Bernhard Brümmer [b]

[a] Leibniz-Institute of Agricultural Development in Central and Eastern Europe (IAMO), Halle (Saale), [b] Georg-August-Universität Göttingen, Dept. of Agricultural Economics and Rural Development, Göttingen

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Abstract

This paper investigates the impacts of export controls in Russia and Ukraine on wheat world market price transmission during the 2007/2008 global food crisis. Russia and Ukraine aimed to reduce wheat exports induced by extraordinarily high world market prices to secure sufficient wheat supply on the domestic markets. Utilizing a Markov-Switching vector error correction model (MSVECM), we find that the temporary export restrictions induced negative effects on wheat markets in Russia and Ukraine. Although instability increased on the world markets itself, we have shown that the increase in the market instability was particularly pronounced in Russia and Ukraine. Also, the export restrictions dampened price transmission to the farmers' prices, which pushed the growers' prices below their long-run equilibrium level. Thus, investment incentives in wheat production which could result from high world market prices were foregone.

Keywords

International price transmission, wheat market, food crisis, Markov switching error correction model, Russia, Ukraine

1 Introduction

Russia, particularly the Central and Southern regions, and Ukraine have high wheat production potentials due to highly fertile soil and the availability of land. However, Russia's and Ukraine's wheat production has decreased since the beginning of the transformation in the nineties. This was caused by the decrease of arable land used for wheat production and the decline in yields. Thus, Russia and Ukraine have significant unrealized wheat production potentials and are seen as two important countries which could contribute significantly to the increase in global wheat production, thereby counteracting a next food crisis and contributing to global food security (EBRD/FAO, 2008).

To mobilize Russia's and Ukraine's production potential, it is decisive that wheat prices are adequately transmitted from the world market to the domestic markets of these countries. Especially high wheat prices provide incentives to invest in new agricultural technology, to utilize certified planting seed and to increase fertilizer application which increases yield.

The degree to which prices are transmitted from the world market is significantly influenced by national policies. Russia and Ukraine have heavily intervened in their wheat export markets in the food crisis 2007/2008. They aimed to reduce wheat exports induced by extraordinarily high world market prices to secure sufficient wheat supply on the domestic markets. Therefore, it seems unlikely that the high world market prices were fully transmitted to wheat producers in Russia and Ukraine. In contrast, it can be expected that the national markets were at least partially isolated from the price developments on the world markets so that exports were reduced.

This paper investigates the degree to which price changes on the world wheat market were transmitted to farmers in Russia and Ukraine during the food crisis 2007/2008. We utilize world market and grower wheat prices as our data base. Also, we account for the possible impact of the export restrictions on the world market price transmission during the food crisis 2007/2008 in Russia and Ukraine.

World market price transmission during the food crisis has been addressed by several studies to assess poverty and welfare impacts of the food crisis, mainly for Sub-Saharan Africa (e.g. Simler (2009), Cudjoe et al. (2009), Ulimwengu et al. (2009), Benson et al. (2008)), Latin America (Robles and Torero, forthcoming) and Asia (Dawe, 2008). Though, to the best of our knowledge, there is not any study which covers wheat world market price transmission for Russia or Ukraine, which are net exporters of wheat to the world markets. Also, we are not aware of any study which analyzes world wheat market price transmission to farmers during the food crisis based on grower price data. The only exception is Dawe (2008) who compares cumulative percentage changes and absolute changes of world market prices with producer and consumer prices. Studies which utilize the net benefit ratio tracing back to Deaton (1989) to assess welfare impacts of rising food prices only utilize consumer prices as their data base and assume that producer prices increase to the same degree as consumer prices (e.g. Simler, 2009). This approach may overstate welfare effects for producers since price transmission along the supply chain may be asymmetric due to e.g. the exertion of market power by traders or producers might face higher production costs. Therefore, consumer prices might be over proportionately higher than the prices farmers receive.

Our model framework is unique in explicitly accounting for the influence of the food crisis on world market price transmission by choosing a Markov switching vector error correction model (MSVECM), which allows the price transmission regime to change. This is particularly relevant for Russia and Ukraine since world market price transmission might have changed through the governmental interventions on wheat export markets during the food crisis.

We also include Germany and the USA, two countries which did not intervene in their wheat export markets, in our analysis, since world market price transmission might have changed during the food crisis 2007/2008 even without governmental market interventions. This should facilitate to identify the price transmission effects resulting from the export restrictions.

This paper also adds to the strand of literature analyzing world market price transmission regarding wheat in general utilizing more sophisticated model approaches (Barassi and Goshray (2007), Goshray (2002), Thompson et al. (2002), Thompson et al. (2000)). Though, none of these studies applies a MSVECM. A further distinguishing feature of our approach is that we utilize high-frequency, weekly data. Since wheat prices on world markets, particularly during the food crisis, change with a higher than monthly, quarterly or even yearly frequency, the analyses based on low-frequency data cover prices changes only partially which may imply biased estimation results (maybe refer to Stephan's paper).

Russia and Ukraine are already today among the major wheat exporting countries in the world. In 2008/2009 Russia ranked second with wheat net exports amounting to 18.2 million t, corresponding to 13.1% of world wheat exports. Ukraine ranked sixth with wheat net exports of 12.9 million t and a 9.3% share in world wheat exports (USDA PSD online, 2010).

Though, since a high share of the abandoned land is marginal agricultural land with low profitability and recovery costs are prohibitively high in some cases, it can be expected that Russia's and Ukraine's unrealized wheat potential might result more from an increase in production efficiency through a technology-driven increase in yields than by the expansion of the arable land (USDA, 2008; OECD/FAO, 2009). The amount of abandoned land which is not marginal land and might be recovered profitably is estimated to amount for Russia 6 million ha by FAO/EBRD (2008) and at most 10 million ha by USDA (2008) and 3 million ha for Ukraine by FAO/EBRD (2008). Wheat yields are expected (FAO/EBRD, 2008) to be increased for Russia from 2.1 t/ha (2008/09) to a yield level similar to Canada (2.34 t/ha) and for Ukraine from 2.8 t/ha to a yield level similar to France (6.26 t/ha).

In this paper we proceed as follows. Section 2 provides an overview on the relevant literature. Section 3 outlines the governmental wheat market interventions during the food crisis 2007/8 in Russia and Ukraine. Section 4 explains the methodological approach and data base. This is followed by the presentation of the empirical results in section 5. Finally the results are discussed and conclusions are drawn in section 6.

2 Wheat export restrictions during the food crisis in Russia and Ukraine

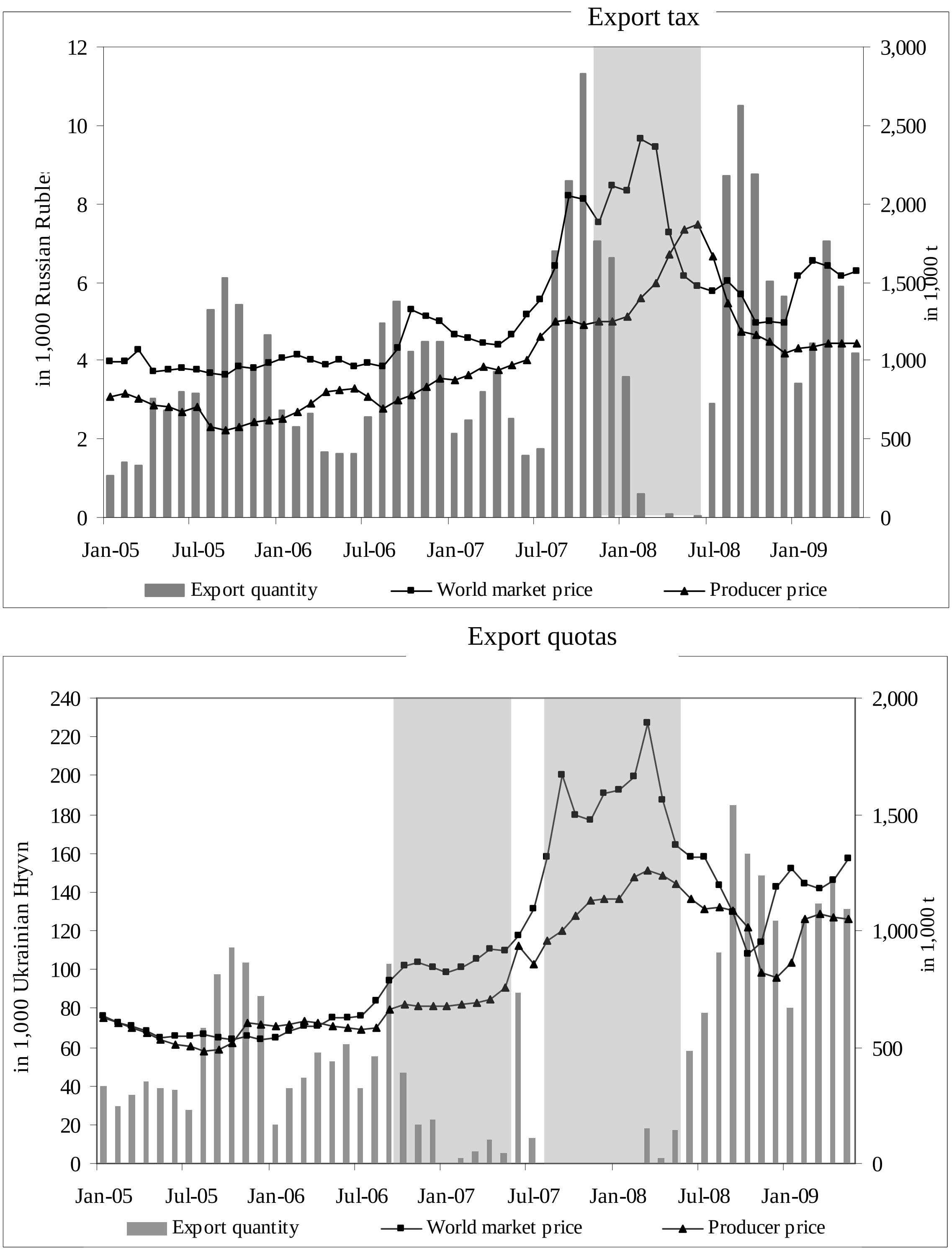
In Russia and even more in Ukraine, wheat market policy is characterized by discretionary, ad hoc market interventions which change quite often.

Russia and Ukraine have both restricted wheat exports during the food crisis 2007/2008. They aimed to reduce wheat exports induced by extraordinarily high world market prices to secure sufficient wheat supply on the domestic markets.

In particular, Russia implemented export taxes initially of 10% in November 2007 which were increased to 40% in December 2007, and maintained until May 2008. Ukraine established export quotas varying between 3,000 t and 1.2 million t from October 2006 until July 2008. The export quotas were abandoned in May 2007 and reintroduced in July 2007. For about 12 months the wheat export quota was as low as 3,000 t thus wheat exports were quasi banned.

Figure 1 shows that the export taxes of 40% in Russia and the export quotas in Ukraine successfully restricted wheat exports to the world market. It also becomes evident that the difference between the world market price and the grower price increased when the export restrictions were effective. Though, it is striking that the difference between the world wheat market price and the grower price increased even in the months directly before the export restrictions were introduced in Russia and Ukraine. In particular, the price difference increased from August to October 2007 for Russia and from August to September 2006 for Ukraine (see Figure 1). This decline in price transmission could result from the exertion of market power by wheat traders over the growers.

Figure 1: Development of world market price, producer price and exports of wheat for Russia (1a) and Ukraine (1b), January 2005-May 2009



Sources: GTIS (2009), APK-INFORM (2009), HGCA (2009), own illustration based on DJURIC ET AL. (forthcoming)

3 Methodological Approach and Data

This study investigates to which degree the large price increases during the food crisis 2007/2008 have been transmitted to the farmers in Russia and Ukraine. We expect that price transmission was dampened temporarily when wheat exports were restricted by governmental market interventions. Therefore, we expect that the price transmission regime prevailing before the food crisis started differs from the price transmission regime during the food crisis. Also, it is not compelling that the price transmission regime changed back to the regime prevailing before in the aftermath of the food crisis. Thus, it seems likely that up to three different price transmission regimes are observed.

Besides, the dramatic changes on the world markets during the food crisis might have influenced the transmission of world market prices to the grower prices even for countries which did not intervene in the wheat export markets during the crisis as e.g. Germany and the USA. For example, it is possible that world market price transmission increased since the traders were better informed about the actual world market price level and price increases were easier for the growers to enforce because global supply was particularly low.

Therefore, we also include Germany and the USA as further cases in our analysis. This should provide us with reference cases which should facilitate to identify the effects on price transmission resulting from the export restrictions.

We conduct this analysis within the framework of a Markov-switching vector error correction model (MSVECM) tracing back to HAMILTON (1989). A MSVECM was first designed by KROLZIG et al. (2002) to analyze business cycles and was recently introduced in the analysis of price transmission by BRÜMMER et al. (2009). In contrast to a linear vector error correction model (VECM), which is a time-series model adequate to analyze a market in a time period when the market prevails in one particular state which is characterized by one price transmission regime, a MSVECM can be applied even when the state of the market changes and several price transmission regimes prevail in the market. For Russia and Ukraine

we hypothesize that up to 3 price transmission regimes might be observed during the time period underlying this analysis.

A further advantage of the MSVECM is that it allows distinguishing different price transmission regimes even if the state variable, which governs the regime switches, can not or only incompletely be observed. The state variable determines the probability with which a particular regime prevails in the market at a given point of time. The MSVECM is based on the assumption that the data generating process underlying the state variable is following a Markov-chain. This implies that the state of the market of tomorrow is determined only by the state of the market of today but not of yesterday. Equation (1) shows the notation of a general unrestricted MSVECM, with regime-dependent behaviour in all short-run parameters, including the intercept, and the error variances.

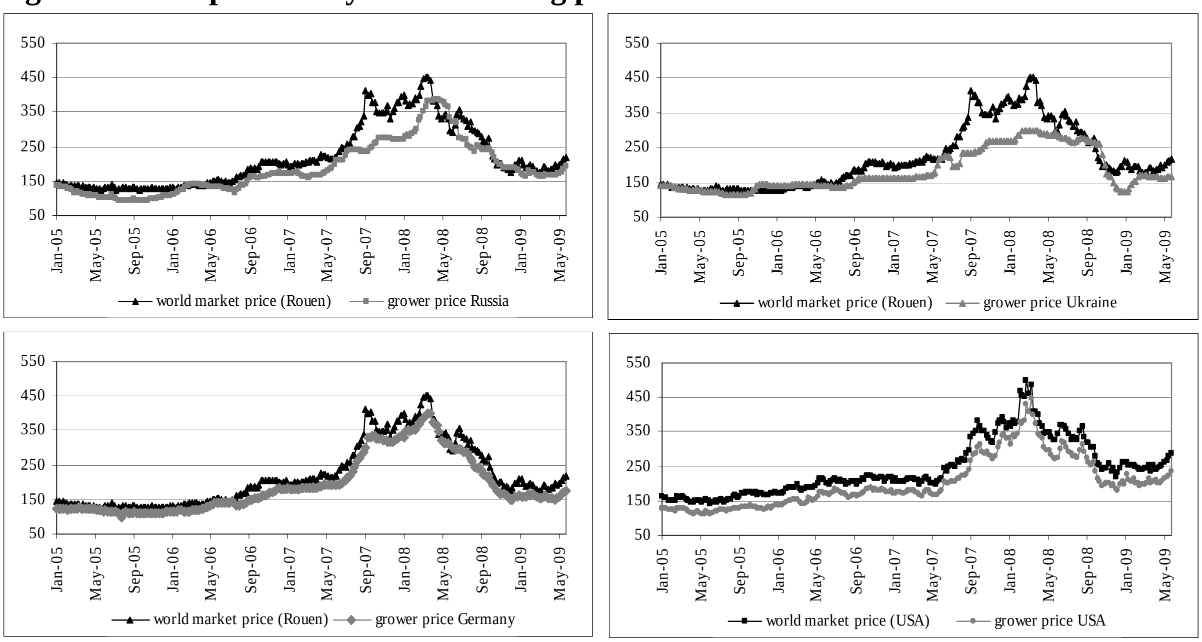
$$\Delta p_t = v(s_t) + \alpha(s_t)(\beta(s_t)' p_{t-1}) + \sum_{i=1}^{k} A_i(s_t)\Delta p_{t-i} + u_t \qquad (1)$$

where p_t denotes (the vector of) wheat prices, v is the vector of intercept terms, α is the vector of the speed of adjustment coefficients, and β is the long-run cointegrating vector. The A_i are matrices containing the short-run parameters of the system, capturing the autoregressive part of the price movements. The error terms u_t fulfil the usual properties. s_t is the state variable, which in our case take the values s_t=1,…,3 (at most), indicating the regime in which the system is. This state, however, is not directly observable. The probability of being in state s in period t might depend on the full history for all variables. However, the simplifying Markov assumption (2) is made in estimating the MSVECM:

$$\Pr(s_t \mid S_{t-i}, \Delta p_{t-1}, \beta' p_{t-1}) = \Pr(s_t \mid s_{t-1,} \Pi) \qquad (2)$$

where the square matrix Π contains the (row-wise) probabilities $[\pi_{ij}]$ for switching from the regime in row i to the regime in column j, conditioned on the regime in the previous period. The parameters of a MSVECM are estimated by maximizing the likelihood function with the expectation maximization algorithm (KROLZIG, 1997). Based on starting values for the parameters to be estimated, the parameters characterizing the unobserved state variable and the probability of a change of one regime to another regime (transition probability) are first estimated. In the next step, the starting values are updated based on the parameters estimated in the first step within an iterative procedure. This procedure is stopped when the parameter estimates of two consecutive estimations do not differ significantly.

Figure 2: Price pairs analyzed concerning price transmission



Sources: AMI (2009); APK-INFORM (2009); HGCA (2009), own illustration

We conduct our analysis based on 230 weekly observation for the world market price and the grower price in the time period week 1 (January) 2005 to week 22 (May) 2009 (Figure 2). We utilize as wheat grower prices ex warehouse prices of milling wheat of class III of the Southern

District of Russia and Ukraine (APK-Inform, 2009), average warehouse delivery price of bread wheat of Germany (AMI, 2009) and average elevator prices of Hard Red Winter Wheat of East Central Colorado of the USA (USDA, 2009). Hard Red Winter Wheat is the primary type of wheat which is exported by the USA (Beuerlein, 2010). As the world market price we utilize the F.O.B. price of wheat of the type Other Wheats at the harbour of Rouen in France (HGCA, 2009) since French wheat is exported to the world market primarily via this harbour[1]. As the relevant world market price for the USA we utilize F.O.B. price of Hard Red Winter Wheat at the USA Gulf port (HGCA, 2009). All prices are converted by weekly exchange rates into US$/t. The missing values are imputed based on the program Amelia in R.

4 Empirical Results

The ADF test and the Johansen cointegration test indicate that the 4 data series are I(1) and that the 4 price pairs are cointegrated[2]. Thus the preconditions for estimating a MS(V)ECM are given. The MS(V)ECM is estimated in its unrestricted form which is more flexible than the restricted model framework. It allows that not only the short-run price transmission parameters but also the parameters specifying the long-run equilibrium, in particular the long-run price transmission, might have changed in the time period underlying this analysis. The parameters characterizing the long-run equilibrium (intercept and slope coefficient) are not estimated directly but can be retrieved indirectly from the parameters of the MS(V)ECM and their statistical significance is determined by the delta-method (Greene, 2003: 70)

[1] A time series of market prices at a Black Sea harbour or alternatively wheat export prices for Russia or the Ukraine do not exist for the time period underlying this analysis simply because exports were banned temporarily by the export restrictions.
[2] The test results are available from the authors upon request

The MS(V)ECM is estimated for different specifications with regard to the number of regimes, the number of lags included, and the Markov switching in the intercept, the short-run price transmission and autoregressive parameters and the variances. The optimal model specification is selected according to the Schwarz model selection criteria. The model selection is unambiguous for Ukraine, Germany and the USA in the way that the Schwarz criteria chooses a model with at most 1 transition probability which is very low and which gives economically reasonable results. For Russia, the Schwarz criteria suggests 2 regimes, but the results with 3 regimes are economically more meaningful. The Akaike Information criteria (AIC) and the Hannan and Quinn (HQ) model selection criteria suggest a MS(3)ECM(2) model. In some cases, the AIC suggests a model with 4 regimes. However, estimating this specification yields five estimated transition probabilities extremely close to zero, indicating that the identification of the Markov transition probabilities is questionable. Hence, we choose a 3 regime model which is also clearly favoured by the HQ criteria. If we find high (>50%) contemporaneous correlation between the residuals of any two regimes, we estimate a univariate MSECM which depicts contemporaneous price transmission in the model. We find the MSIAH the optimal type of the MS(V)ECM which allows the intercept, the short-run price transmission, the autoregressive parameters and the variances to switch between the regimes.

The estimates of the main parameters and some additional statistics are given in Table 1. The regime classification is depicted in Figure 3 by indicating to which regime the 230 observations are attributed. Our analysis identifies three price transmission regimes for Ukraine and Russia and two price transmission regimes for Germany and the USA.

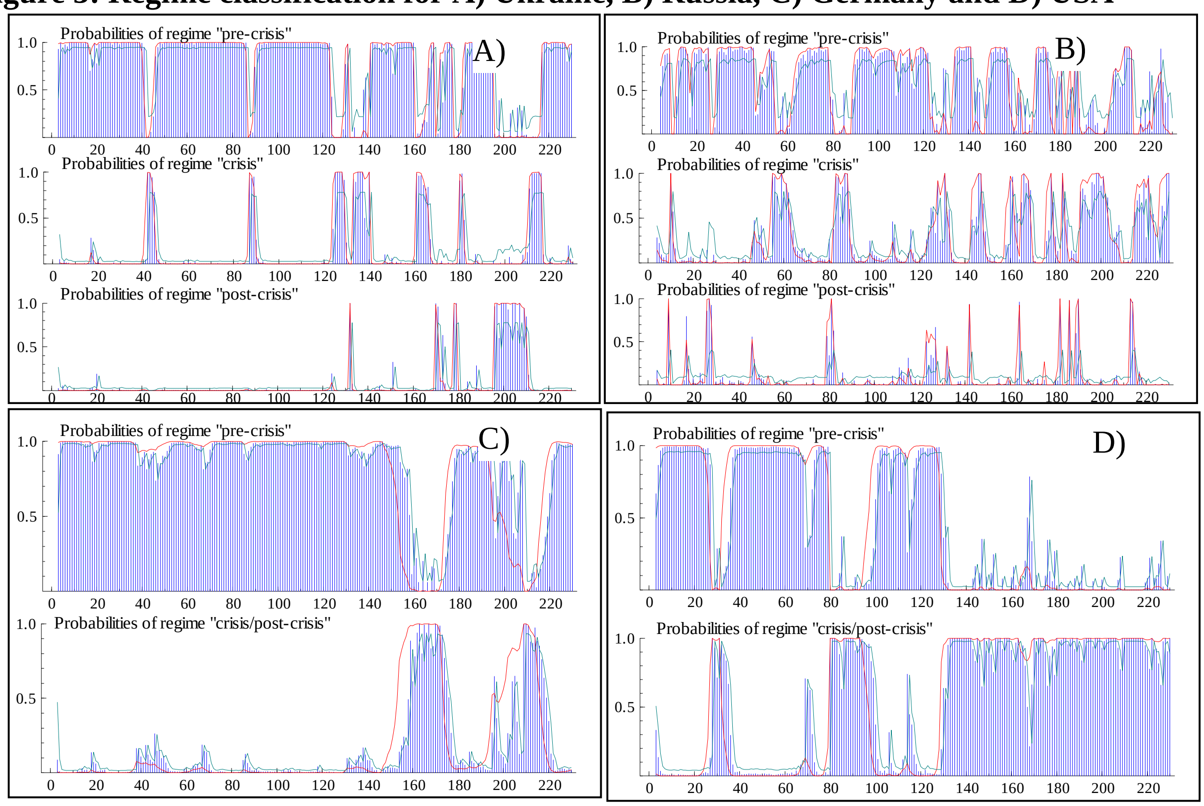
Table 1: Main estimates of the MSVECM

	Ukraine			Russia (South District)			Germany		USA (Colorado)	
	pre-crisis	**crisis**	**post-crisis**	**pre-crisis**	**crisis**	**post-crisis**	**pre-crisis**	**crisis/post-crisis**	**pre-crisis**	**crisis/post-crisis**
MS(V)ECM specif.	MS(3)VECM(1)			MS(3)ECM(2)			MS(2)ECM(1)		MS(2)ECM(1)	
LR-linearity test (Chi^2 value)	309.944***			156.896***			73.176***		48.743***	
Contemp. price transm.	-	-	-	0.056**	0.281***	1.685***	0.141***	0.351***	0.676***	0.683***
long-run equilibrium: • **intercept** • **slope**	0.711 0.837***	2.631 0.555***	-1.757 1.248***	-0.492 1.053***	0.684** 0.862***	-0.432*** 1.043***	-0.288 1.038***	-0.901*** 1.133***	-0.615*** 1.076***	-1.09*** 1.16***
speed of adjustment	-0.024***	-0.078**	-0.139**	-0.038***	-0.121***	-0.387***	-0.06	-0.213	-0.236***	-0.844***
standard error	0.0073	0.028	0.041	0.010	0.018	0.015	0.009	0.02	0.018	0.028
Avg. ECT	0.016	-0.392	0.243	0.030	-0.063	0.004	-0.031	0.006	0.002	0.006
Weighted avg. |ECT|	0.094			0.038			0.021		0.0027	
nb. of observ.	173	35	20	134	70	23	134	94	187	41

Source: own calculations with data given in Figure 2 using MSVAR for Ox (DOORNIK, 2002; KROLZIG, 2006).

A “pre-crisis” regime comprising 173 observations is observed for Ukraine which remains the dominant regime almost throughout the whole time period underlying this analysis (Figure 3). This regime is supplemented on September 1, 2000 by a further regime (“crisis”) of 35 observations in the time period of the crisis which can also be observed in the aftermath of the crisis. Though, a third regime (“post-crisis”) covering 20 observations occurs in spring 2008 (April 4, 2008) when the removal of the export quota was to be expected. Similarly, a “pre-crisis” (134 observations) regime is observed for Russia until a few months before the export taxes were implemented in November 2007. The “pre-crisis” regime is substituted by the “crisis” regime on June 15, 2007 comprehending 70 observations. When the export taxes are removed in July 2008, the “post-crisis” regime of 23 observations occurs.

Figure 3: Regime classification for A) Ukraine, B) Russia, C) Germany and D) USA



Source: Own illustration.

In contrast, our model distinguishes two price transmission regimes for Germany and the USA. The "pre-crisis" price transmission regime is dominant in the time period before the food crisis unfolds comprising 134 and 187 observations, respectively. The "pre-crisis" regime is then supplemented by the "crisis/post-crisis" regime during and in the aftermath of the food crisis on July 20, 2007 and December 14, 2007 comprising 94 observations and 41 observations for Germany and the USA, respectively. It is striking that the "crisis/post-crisis" regime first occurs earlier for Germany at the beginning of August 2007 than for the USA at the end of December 2007.

The likelihood-ratio (LR) test indicates for all 4 cases that the non-linear MS-(V)ECM is superior to the linear model at a significance level lower than 1%. Since high contemporaneous correlation (>50%) between the residuals of any of the regimes is observed for Russia, Germany and the USA, a univariate error correction model (ECM) is estimated in these cases. Thus, highly significant contemporaneous price transmission is identified in all regimes of the analysis for Russia, Germany and the USA. It is striking that the contemporaneous price transmission is increasing with time and is highest in the "post-crisis" and "crisis/post-crisis" regime.

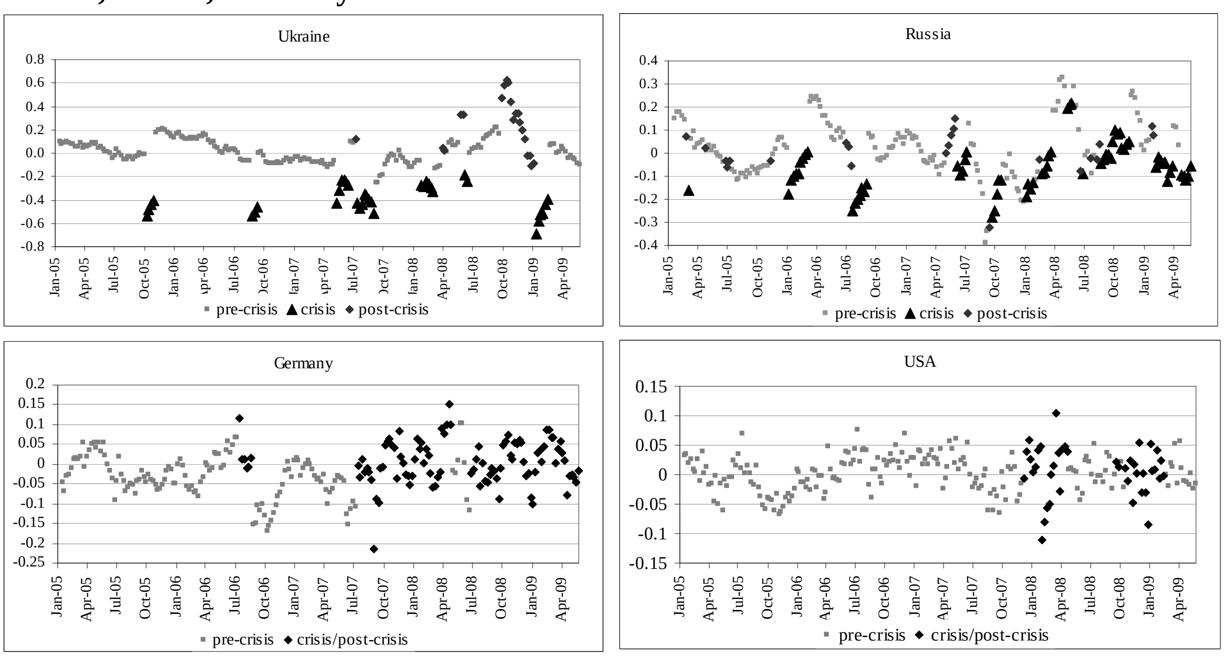
With regard to the long-run price transmission we find for Ukraine and Russia that it dampened by -50% and -22% respectively, in the "crisis" regime when compared to the „pre-crisis" regime. In the "post-crisis" regime, long-run price transmission strengthened again but to a lower level for Ukraine and a higher level for Russia than in the "pre-crisis" regime. Our results suggest that the long-run price transmission weakened in the "crisis/post-crisis" regime even for Germany and the USA, though to a degree much lower than for Russia and the Ukraine, amounting -9% and -8% respectively.

The speed of adjustment of deviations from the long-run equilibrium accelerated in the "crisis" and "crisis/post-crisis" regime compared to the "pre-crisis" regime not only for Russia and

Ukraine but also for Germany and the USA, by 225%, 218%, 233% and 258%, respectively. The speed of adjustment even accelerated further in the “post-crisis” regime by 254% in Ukraine and 700% in Russia. In general it can be observed that the speed of adjustment is lowest in Ukraine and highest in the USA in the different regimes.

The regime-specific standard errors suggest that despite the export controls in Russia and Ukraine which aimed stabilize the markets, the markets were destabilized during the crisis, which even amplified in the post-crisis period for Ukraine. Though, the standard error is higher in Ukraine and lower in Russia in the “crisis” and “post-crisis” regime than in the “crisis/post-crisis” regime in Germany and the USA, respectively.

Figure 4: Size of the ECT terms of the 3 regimes (“pre-crisis”, “crisis”, “post-crisis“) for Ukraine; Russia, Germany and USA



Source: Own illustration

Finally, regarding the average size of the deviations from the long-run equilibrium, in other words, the error correction term (ECT), we find it to be slightly positive in the „pre-crisis“ regime for Ukraine, dropping substantially to a negative level in the “crisis” regime but increasing again strongly to a positive level in the „post-crisis“ regime, thereby exceeding the level in the „pre-crisis“ regime (also see Figure 4).

Similarly, we find for Russia the average ECT to be positive in the „pre-crisis“ regime, negative in the “crisis“ regime and positive in the „post-crisis“ regime, but lower than in the “pre-crisis” regime. For Germany we find that the ECT turned from a negative value before the crisis to a positive value in the “crisis/post-crisis” regime. For the USA the average ECT term is slightly positive even in the „pre-crisis“ regime but further increases in the “crisis/post-crisis” regime. Overall, the weighted average |ECT| is lowest for the USA and highest for Ukraine.

5 Discussion and Conclusions

The results of our price transmission analysis confirm our initial hypothesis that world market price changes were incompletely transmitted to the local markets in Ukraine and Russia, exports were strongly reduced and partially banned.

Furthermore, our results suggest that the occurrence of the „crisis“ regime in Ukraine and Russia was induced by the governmental market interventions, but that a regime change took place even in Germany and USA which did not intervene in their export markets but at a later point of time when the food crisis unfolded in the second half of 2007. This could be interpreted that changes took place on the world market during the food crisis which were induced by factors beyond governmental market interventions. Besides, since no separate „post-crisis“ regime is identified for Germany and the USA, this might indicate that these changes were not temporarily but instead long-lasting and thus more fundamental. These factors remain to be determined in future research.

The results also indicate that the long-run price transmission dampened and the speed of adjustment increased not only for Ukraine and Russia but also for Germany and the USA. Though, these two effects were significantly more pronounced for Ukraine and Russia than for Germany and the USA. However, the graphical analysis indicated that the world market price transmission diminished even before the export controls became effective during the crisis. From this it might be followed that world market price transmission could have been reduced during the food crisis due to factors beyond export controls, e.g. the exertion of market power. However, this was relevant for Russia and Ukraine only until the export controls became effective.

The estimated standard errors indicate that the instability increased during the food crisis in all four countries. Also, the deviations from the long-run equilibrium increased in all of the four countries during the crisis, but the weighted average ECT is highest in Ukraine, followed by Russia, and it is significantly lower in Germany and the USA. This might suggest that wheat markets were clearly more destabilized in Ukraine and Russia than in Germany and the USA, despite the governmental market interventions in Ukraine and Russia which aimed to stabilize the markets.

Also, the negative value of the average ECT in the „crisis" regime of Ukraine and Russia is a clear sign that the situation of the wheat farmers worsened. This deterioration was timely limited and the average ECT changed again to a positive value in the „post-crisis" regime. In contrast, the average ECT increased in the "crisis/post-crisis" regime for Germany and the USA indicating that the situation of the farmers improved. From this it might be followed that a further disadvantage of the export restrictions is that it disadvantaged the farmers by pushing the growers' price below its equilibrium level. This reduces the incentives to invest in wheat production in order to increase production efficiency and wheat production.

Summarizing, the analysis of world market price transmission for wheat during the food crisis 2007/2008 has made evident that the temporary export restrictions induced negative effects on wheat markets in Russia and Ukraine. Although instability increased on the world markets itself, we have shown that the increase in the market instability was particularly pronounced in Russia and Ukraine. Also, the export restrictions dampened price transmission to the farmers' prices, which pushed the growers' prices below their long-run equilibrium level. Thus, investment incentives in wheat production which could result from high world market prices were foregone.

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