Wheat / Flour Price Transmission and Agricultural Policies in Ukraine: A Markov-Switching Vector Error Correction Approach

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Abstract

The analysis of price transmission between raw and processed agricultural products in transition countries is complicated by the frequently changing conditions on their way from plan to market. We utilise a Markov-switching vector error correction model to allow for multiple regime shifts in the price relationship between wheat and wheat flour in Ukraine from June 2000 to November 2004. The analysis reveals four regimes. The observed temporal pattern of these regimes can be matched with certain political and economic events in Ukraine. In particular, we find a strong link between the 'high uncertainty' regime and discretionary policy interventions in 2003.

Keywords: Markov-switching vector error correction model; vertical price transmission; regime shifts; grain policies; Ukraine

JEL classification: C22, Q11, Q18

1 Introduction

> *"Oh! I will go into business again, I will buy wheat in Odessa; out there, wheat fetches a quarter of the price it sells for here. There is a law against the importation of grain, but the good folk who made the law forgot to prohibit the introduction of wheat products and food stuffs made from corn. Hey! hey!? That struck me this morning. There is a fine trade to be done in starch." – Honoré de Balzac, Old Goriot.*

Prices play an extraordinary role in the market economy. They allow coordinating decisions of producers and consumers and allocating scarce resources in the most efficient way. The transition from a planned to a market economy in the post-Soviet countries induced the price liberalisation. However, price liberalisation does not only improve resource allocation, but also leads to higher price volatility in comparison with a system of administratively fixed prices. This is especially true for farm prices, which are characterised by relatively high volatility due to a number of reasons, among which seasonality, weather effects, inelastic demand and supply of the agricultural products are the most important. The policy makers often intervene into the markets to reduce the price volatility.

In Ukraine, the policy makers, for example, actively intervene into the price formation of wheat and wheat products. In recent years the price relationship on wheat and wheat/flour markets in Ukraine has been affected by many shocks. These shocks mainly originated from wheat side and had not only market, but also political nature. Since the relatively outdated farm technologies in Ukraine lead to a high sensitivity of agricultural production to climatic conditions, the weather greatly contributed to shifting Ukraine from the position of net exporter (in 2001 and 2002) to net importer (in 2000 and 2003) of wheat (see Figures 1 and 2). These shifts negatively affected not only wheat producers, but also wheat processors, traders, and certainly consumers due to increased price and margin fluctuations. In order to 'neutralise' these market failures, the policy makers introduced many interventions, including many in the typical Soviet style. These interventions aimed at sustaining the myth that "people can fine-tune markets" (von Cramon-Taubadel 2004:185). They certainly changed the path of vertical price relationship and increased the uncertainty in the market.

We aim at studying the vertical price transmission between wheat and wheat flour in Ukraine during 2000-2004, and the effects of policy changes on this transmission. Section 2 presents recent developments in the wheat market in Ukraine, with particular attention paid to changes in the relevant policies. In section 3 we present the methodology used. Since the price relations are presumably affected by the numerous policy changes during the observation period, the method must be able to capture the structural breaks, which might result from the frequent changes. Hence, we apply a Markov-switching vector error correction model, which allows for these structural breaks in the price adjustment process. We identify different regimes, which correspond to different parameters for the short-run price adjustments and for the residual variances. These regimes allow explaining the vertical price transmission both in 'clear-cut' phases and 'transition' periods (e.g., in the course of shifts from export and import situation and *vice versa*). Section 4 presents the empirical results and links the regime probabilities with the economic policy in Ukraine. The paper concludes in section 5 with a set of policy implications.

2 Policy developments on wheat and wheat flour markets in Ukraine

The policies for Ukrainian grain markets, and wheat markets in particular, have always been politicised. In the course of transition from plan to a market Ukraine did not succeed in completely abolishing of the policy interventions, which had been designed and implemented in the old central planning style. Grain is considered 'strategic', and agricultural policy makers consider "the size of the grain harvest [as] a barometer of conditions in agriculture" (von Cramon-Taubadel, 2001: 103). Thus, so far the grain market has never fully enjoyed the spirit of the 'market economy'.

In the middle of 1990s, Ukrainian government entrenched itself in the agricultural markets. Through various schemes, the state parastatals supplied the key inputs to the large farms, while other state parastatals collected grain as a payment for these inputs (Striewe and von Cramon-Taubadel, 1999). Since the bankruptcy of the large farms has remained under 'taboo', the non-payments proliferated. The 'soft budget constraints' predestined the frequent bail-outs from the budget (for example, in 1997 and 1998, then later in 2000). The direct support for the large former state farms in the form of budget support was nevertheless accompanied by a simultaneous taxation of wheat farmers through depressed farm-gate prices. Before the year 2000, Ukraine remained in a net export situation and since export marketing costs were excessively high, some experts report that the farmers received only 40% of the FOB export price compared to 70% in Germany (Striewe and von Cramon-Taubadel, 1999). In conjunction with the adjustment pressure of transition, these low wheat prices and heavy state interventions led to a fall in production (see Figure 1). As a reaction, many regional administrations at the Oblast level regularly set bans on movements of grains among regions to 'enhance' the regional food security. Hence, the national wheat market was fragmented, the policies were hardly predictable, and thus, the price forecasts were dominated by substantial uncertainty.

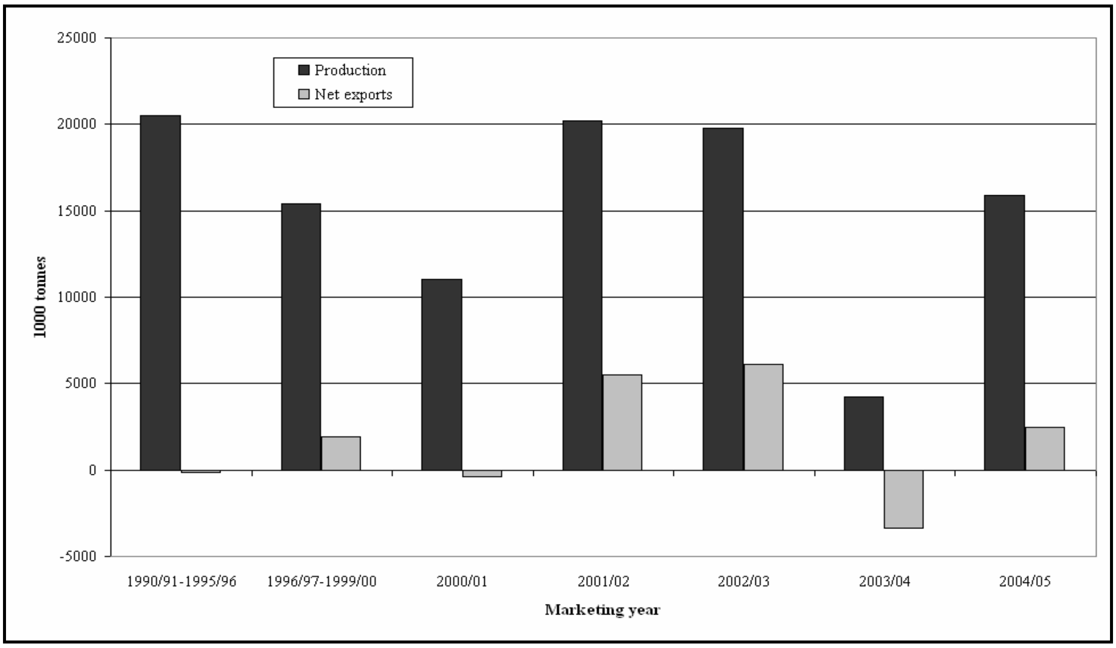


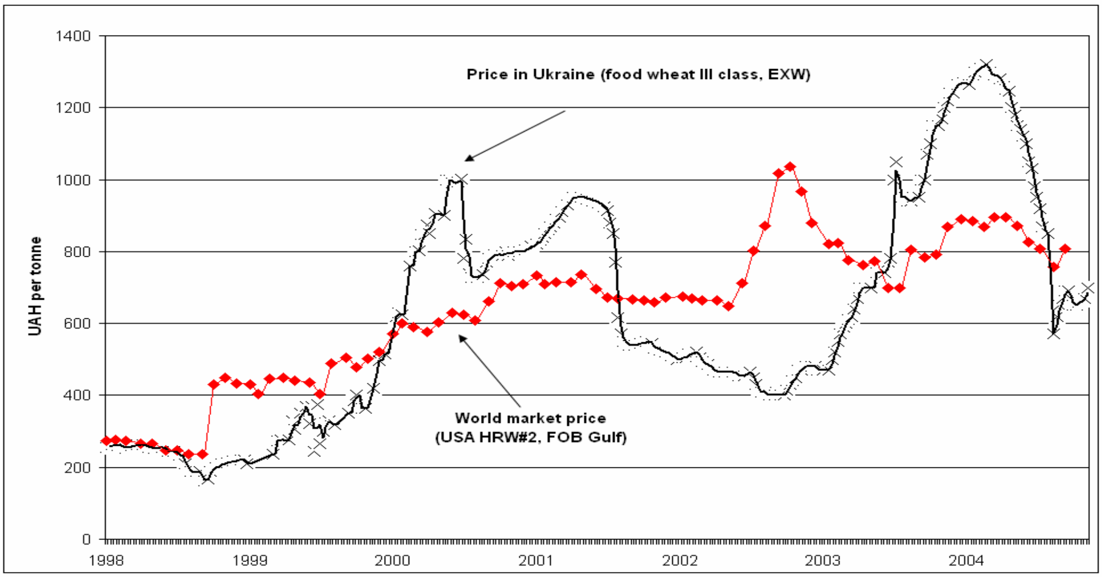
Figure 1. Production and net export of wheat in Ukraine, 1990-2004, based on data from UkrAgroConsult (1998-2004) and FAS/USDA (2000-2004).

In the marketing year 2000/01, Ukraine wheat harvest dropped to the decade's lowest 11 million t, and the country became a net importer of wheat. As a reaction, the government launched a set of progressive reforms. It effectively withdraw from the input and output markets, while the previously abstaining banking sector was encouraged to credit the farms by introducing the partial compensation of interest rates from the national budget, putting the hard budget constraints on the farms, enhancing the large farm restructuring and granting significant tax privileges to the farmers (Demyanenko and Zorya, 2004; von Cramon-Taubadel, 2001). But when the switch from net export to net import situation (mainly due to the excessively high marketing costs) raised domestic wheat prices over the world market level (Figure 2), the policy makers began inadequately reacting. Since many Ukraine's policy makers still have inaccurate understanding of the market mechanisms and price formation in the market economy, the measures to stabilise the wheat prices were wrongly designed. The government made the traders 'guilty' in high wheat prices, introduced grain export certification, fixed bread prices and made attempts to create the pledge price system (Presidential Decree No. 823 "On immediate measures to stimulate grain production and to develop grain market" fro July 29, 2000). To increase the wheat supply, the policy makers temporary cancelled the import duty of wheat and simplified the wheat import regimes, while many regional administrations renewed the bread price regulations. Since those actions were not always transparent and their timing was a long way from being perfect, the uncertainty of price development remained high.

The high wheat prices, low wheat supply and the uncertainty concerning future market developments negatively affected the flour producers. The domestic production of flour decreased and prices sharply grew (see Figure 3). The costs of purchasing wheat sharply rose, and since the bread prices were fixed at low levels, the millers could not fully transmit the increase of wheat prices to the bakeries. The flour market began stabilising only after Ukraine imported much flour, mainly duty-free from the members of the Commonwealth of Independent States (CIS) free trade zone.

Thanks to high wheat prices, progress in reforms and, certainly, favourable weather, in 2001 the wheat harvest reached the decade's record level. The consequent year was similarly successful for the output-oriented policy makers (Figure 1). Ukraine became a large wheat exporter – in the marketing years of 2001/02 and 2002/03, Ukraine exported almost 12 million t of wheat. Domestic prices dropped, and during this period the policy makers were preoccupied with the 'market regulation' to raise wheat prices. This drop was especially severe in the first months after the harvest since the farmers, facing the liquidity constraints in financing the fall seeding campaign, had to sell their grain immediately, since they were unwilling to store the grain in the state-running elevators due to the contract enforcement problems and high storage costs, and since the future price developments were hardly predictable. The government repeatedly tried to introduce the pledge price system together with the intervention system (e.g., Cabinet of Ministers resolutions "On determination of pledge prices and financial support of pledge purchasing of grain" from April 29, 2002 and "On additional measures to manage the pledge and intervention operations" from June 27, 2003), but in all years the lack of budget financing predetermined the failures. In addition, the government continued regulating export by prohibiting wheat export without the contract registration on the agrarian exchanges. In this period, however, the government made also efforts to reduce the marketing costs and encourage the private investments into the market infrastructure, especially sea ports and storage facilities. But in spite of these positive efforts, the 'stop-and-go reforms' continued keeping the wheat market actors in Ukraine strained.

In this period of time, Ukrainian millers almost fully satisfied the domestic demand. Domestic flour production grew from 3.5 million t in 2000/01 to 3.65 million t on average in 2001/2002 and 2002/03 marketing years (APK-Inform, 2004). The flour prices gradually declined along the wheat prices (Figure 3) and the flour imports did not exceed 2% of the total flour supply.



Source: UkrAgroConsult (1998-2004) and FAO (2004).

Figure 2. Domestic and world wheat market prices in Ukraine, 1998-2004, UAH per tonne.

In early 2003 severe winterkill greatly damaged the winter crops. "When this was followed by a prolonged drought in the late spring and early summer of that year, it became apparent that Ukraine was likely to become a net importer of food grain in 2003/04" (von Cramon-Taubadel, 2004: 183). The wheat harvest equalled to roughly 5 million t (Figure 1) and domestic wheat prices in the expectation of low harvest skyrocketed already at the early winter of 2003 (Figure 2). The government issued several resolutions, including provisions concerning the personal responsibility of regional politicians, investigation of traders' activities, and empowerment of regional authorities to monitor food wheat movements and bread prices, e.g., in the Cabinet of Ministers Resolution No. 1150 "On failures of some executive branches to ensure the food security and measures to stabilize the markets of main staple foods" from July 24, 2003. Later, the government also announced the agreements with Russia and Kazakhstan to purchase about 2 million t of wheat at 'reasonable prices', which in this context implied at a price below the world market level. The press was full of rumours about new and intensified regulation of grain markets in Ukraine and this crisis really provided the anti-reform forces with a pretext for the re-introduction of intervention measures. Some experts state, therefore, "that it may be more appropriate to speak of a crisis in agricultural policy making in 2003 than of a 'crisis' in Ukrainian agriculture" (von Cramon-Taubadel 2004: 185).

Above developments along with the reluctance to quickly abolish the wheat import duties and import value-added tax entailed the unwillingness of private importers to import wheat under the arbitrary legislation and price uncertainty. Due to temporarily low food wheat supply and inelastic domestic demand, wheat prices significantly fluctuated. Only after large imports in the last three months of 2003 (about 3 million t) (UkrAgroConsult, 1998-2004), the price volatility reduced. In the course of the marketing year, the wheat prices slowly fell down, but not to less than 600 UAH per tonne. Low wheat stocks, uncertainty about the harvest 2004 and continuously intense policy interventions due to the coming presidential election at the end of 2004, kept the food wheat prices high and volatile.

The low wheat harvest and the ways of how the wheat crisis has being resolved led to a sharp fall in flour stocks and a consequent rise in flour prices. While during 2001-2002 the flour price averaged 900 UAH per tonne, in June 2003 it reached 1800 UAH per tonne and in November 2003 it came very close to 2000 UAH per tonne (Figure 3). High flour prices and unpredictability concerning food wheat imports caused large flour surges mainly from Russia and Kazakhstan. In the marketing year 2003/04, Ukraine imported 5% of total flour supply or 207 thousand tonnes (APK-Inform, 2004). In addition to the flour imports, the State Material Reserve of Ukraine began to finance milling and sell the flour in large quantities. This 'state' flour, however, was arbitrary available to only large regional mills. These state interventions crowed out the private mills and seriously increased uncertainty concerning flour stocks, equal access to these stocks and flour market prices. In the course of 2004, the flour prices stabilised and gradually decreased.

3 Markov-switching model

The Markov-switching vector error correction model (MSVECM) is a special case of the general Markov-switching vector autoregressive model, which was initially proposed by Hamilton (1989) for analysing the US business cycle. The applicability of this model is, however, not restricted to this specific research question but can be viewed as a general framework for analysing times series with different regimes whenever the corresponding state variable is not observed. Krolzig et al. (2002) and Krolzig and Toro (2001) use the MSVECM to analyse business cycles with a special emphasis on employment. Here, we use a MSVECM for analysing vertical market integration between the markets for wheat and wheat flour in Ukraine. If the markets are integrated, there should exist a long-run relationship between the prices on each market. Price changes on any of the markets depend both on short-run dynamics and on the deviation from the long-run equilibrium so that the familiar vector error correction model would provide a congruent representation of the data generating process. However, with the frequent policy adjustments and changes in the net trade position, it is reasonable to expect structural changes over time, which renders the simple error correction model into an incongruent representation. Hence, a MSVECM, i.e., a vector error correction model with shifts in some of the parameters according to the state of the system can be expected to be more appropriate in this setting:

$$\Delta \mathbf{p}_t = \boldsymbol{\alpha}_0(s_t) + \boldsymbol{\alpha}(s_t)(\boldsymbol{\beta}' \mathbf{p}_{t-1}) + D_1(s_t)\Delta \mathbf{p}_{t-1} + D_2(s_t)\Delta \mathbf{p}_{t-2} + \ldots + D_k(s_t)\Delta \mathbf{p}_{t-k} + \boldsymbol{\varepsilon}_t \quad (1.)$$

Here, $\mathbf{p}_t = (p^f_t, p^m_t)'$ is the vector of market prices for wheat flour (superscript f) and wheat (superscript w), respectively, $\boldsymbol{\alpha}_0$ denotes the vector of intercept terms, α is the vector of adjustment coefficients, β is the cointegrating (long-run equilibrium) vector, Δ indicates first differences, and D_1, D_2, … , D_k are matrices of short-run coefficients. The vector $\boldsymbol{\varepsilon}_t$ contains the residual errors of the flour and the wheat equation, for which the usual assumptions apply. The state variable $s_t = 1, \ldots ,M$ indicates which of the M possible regimes governs the MSVECM at time t. However, the state of the system is not observed; the most general specification would make the probability of being in state s_t dependent on the entire history of regimes S_{t-1}, and on the history of all the variables on the RHS of Equation (1.). This general specification would leave the system unidentified unless some structure is imposed. The basic idea of a Markov-switching model is to assume an ergodic Markov process for the probabilities of observing a certain state, so that the probability for s_t depends only on s_{t-1} and a matrix Π of transition probabilities.

$$Pr(s_t \mid S_{t-1}, \Delta P_{t-1}, \boldsymbol{\beta}' P_{t-1}) = Pr(s_t \mid s_{t-1}, \Pi) \tag{2.}$$

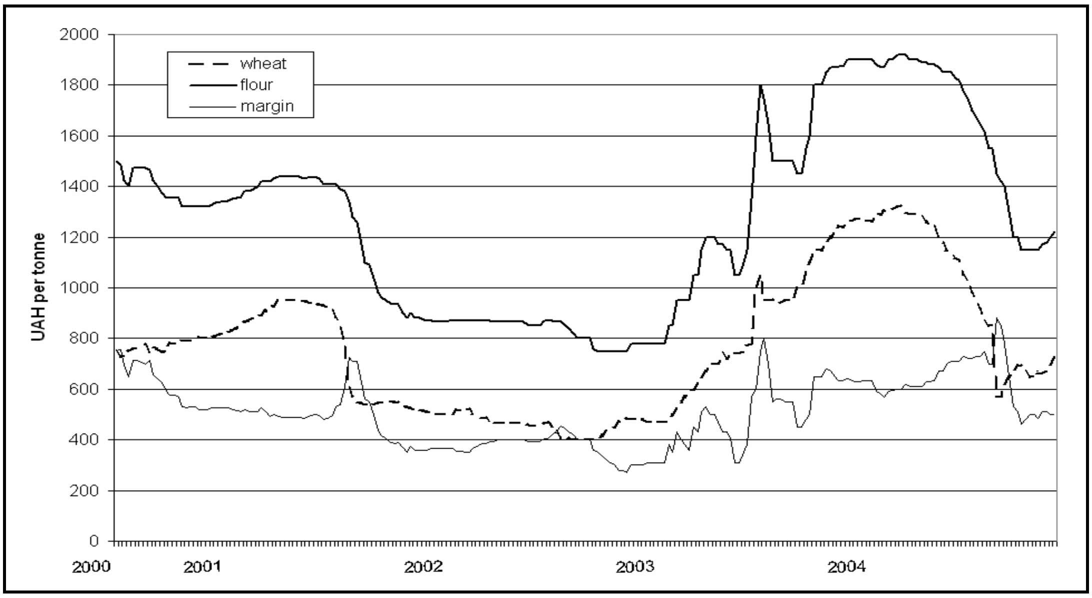
An element π_{ij} of Π gives the transition probability from state i to state j. Hence, the sum of each row of Π must equal one so that the number of unknowns in Π is equal to $M\,(M\text{-}1)$. Note that the vector β does not vary between systems since the long-run equilibrium relation is assumed to be constant over time. However, the intercept term in (1.) changes over time so that there may be regime-dependent changes in the margin.

The estimation of the MSVECM is based on the maximum likelihood principle. The maximands of the likelihood function consist of the parameters in (1.), a set of parameters corresponding to dummy variables indicating the value of the state variable s_t, and the transition probabilities p_{ij}. Krolzig (1997) advocates the use of a variant of the Expectation-Maximisation algorithm (Dempster et al., 1977). This iterative procedure breaks the maximisation down into two steps. First, the state parameters and transition probabilities are estimated conditional on a set of starting values for the coefficients in (1.). In the second step, these latter parameters are updated using the first order conditions for the maximisation of the likelihood function with respect to the error correction model parameters. This sequence is repeated until the procedure converges, i.e., the state parameters do no longer change between two subsequent iterations. The estimation procedure is available in the MSVAR package (Krolzig, 2004) for the matrix programming language Ox (Doornik, 2002).

4 Empirical results

4.1 Data and unit root tests

The estimation results are based on 227 weekly observations (June 2000 to November 2004) on the average price for III class milling wheat, and of the wholesale price for top quality flour in Ukraine. Figure 3 gives an overview of the development of the price series in the observation period.



Source: UkrAgroConsult (1998-2004).

Figure 3: Weekly prices of wheat and flour as well as margin in Ukraine, UAH per ton, June 2000-November 2004 (227 observations)

Both series are characterised by substantial shifts both in level and in variance over time. As discussed in section 2, the level shifts for the wheat price series are strongly influenced by the expected net trade balance for wheat in Ukraine, e.g., the sharp decreases in late summer 2001 and 2004. The two price series develop in a roughly parallel way over time. On the other hand, the variation in the margin over time is considerable, in particular at times when any of the series exhibits unusual dynamics. These characteristics raise doubt concerning the stability of the price relationships in terms of dynamics, and underline the necessity of taking into account structural breaks in the further analysis.

As a prerequisite for the cointegration analysis, we first establish the time series properties of the price series (in natural logarithms). The usual ADF test statistic is supplemented with an additional unit root test for processes with level shifts (Lanne et al., 2002). For this latter test, the unknown break point was by a grid search over all possible break dates with a sufficiently large lag order. The date which gave the minimal residual sum in the auxiliary regression was then chosen. The null hypothesis of a unit root in the undifferenced series cannot be rejected by any of the two tests. However, the tests provide strong evidence against the null hypothesis of a unit root in both the flour and wheat price series in first differences (Table 1). Even when structural change is taken into account, both price series (in logs) seem to be appropriately modelled as integrated processes of order 1.

Table 1. Results of unit root tests.

	Augmented Dickey-Fuller Test			**Unit root test with level shift**		
Series	Test statistic	Specification	5% critical value	Test statistic	Specification	5% critical value
ln p^f_t	-1.556	(6 lags, constant)	-2.86	-1.161	(8 lags, trend, shift dummy)	-3.03
ln p^w_t	-1.336	(3 lags, constant)		-1.468	(3 lags, trend, shift dummy)	
Δln p^f_t	-4.452	(5 lags)	-1.94	-4.473	(7 lags, constant, impulse dummy)	-2.88
Δln p^w_t	-6.639	(2 lags)		-6.636	(2 lags, constant, impulse dummy)	

4.2 Cointegration analysis

For integrated variables, an estimating equation, which consists of I(0) variables alone, is given by the VECM representation. We apply the usual Johansen trace test, which is based on successive a reduced rank regression of the vector autoregressive representation with 4 lags. The first test, with null hypothesis of no cointegrating relations, is rejected against the alternative of at least one cointegraing relation with a p-value of less than 0.1 % (LR^{trace} = 30.048). The next test, with corresponding null that the number of cointegrating vectors is one against the alternative that the number of cointegrating vectors is larger than one cannot be rejected (LR^{trace} = 1.922, p-value = 0.167). The two series may hence be linearly combined so that the residual term is stationary. The long-run relationship (including a constant term) is given in Equation (3.), standard errors in parentheses.

$$\ln p_t^f = \underset{(0.200)}{1.5976} + \underset{(0.030)}{0.8368} \ln p_t^w + u_t \qquad (3.)$$

The corresponding adjustment coefficients (standard errors in parentheses) are α^f = - 0.1274 (0.026) for the flour equation, and α^w = 0.0211 (0.041) for the wheat price equation, respectively. Since the deviations from the long-run equilibrium are obtained from the cointegrating vector normalised with respect to the flour price, both adjustment coefficient have the expected sign. The adjustment coefficient in the wheat price equation, however, is not statistically significant. Hence, the adjustment process towards the long-run equilibrium takes place through price changes for flour, with half of a unit deviation from the long-run equilibrium being corrected within 5 weeks.

Diagnostic tests of the corresponding vector error correction model reveal several problems. First, autocorrelation was checked by means of a vector autocorrelation test up to lag order 12. The corresponding Lagrange multiplier test statistic is 52.648, which compares to a critical χ^2 value at the 5 % level with 48 degrees of freedom of 65.17. The residuals of the system seem not be affected by a significant extent of autocorrelation. The situation is worse with regard to the vector tests for heteroskedasticity and non-normality. The full White test for vector heteroskedasticity yields a test statistic of 268.35, which exceeds the critical χ^2 value with 105 degrees of freedom (129.92) substantially. A similar picture arises for the non-normality test, where the null hypothesis of normal residuals is rejected with a p-value of less than 0.01 %. A closer look at the single equations reveals that most of these problems originate from the flour equation. However, increasing the lag length above the order suggested by the Akaike information criterion (AIC) failed to resolve the problems with heteroskedasticity and autocorrelation.

Fat tails in the distribution of the residuals and heteroskedasticity could both be caused by instability of the underlying price series. Hence, the system is checked for stability by means of a Chow forecast test. The null hypothesis is that all parameters of the system remain constant over time, which is tested against the alternative that the parameters (all coefficients except for b plus the residual covariance matrix) change over time. The Chow test statistic is asymptotically χ^2 distributed; however, the actual distribution under the null was found to be non-standard in Candelon and Lütkepohl (2000) so that the bootstrap provides a feasible alternative. We employ the procedure implemented in JmulTi (http://www.jmulti.org) to calculate the empirical p-values for different breakpoints. Figure 4 shows the bootstrapped p-values of the Chow forecast test for the sample; every 4th week was used as a possible break date.

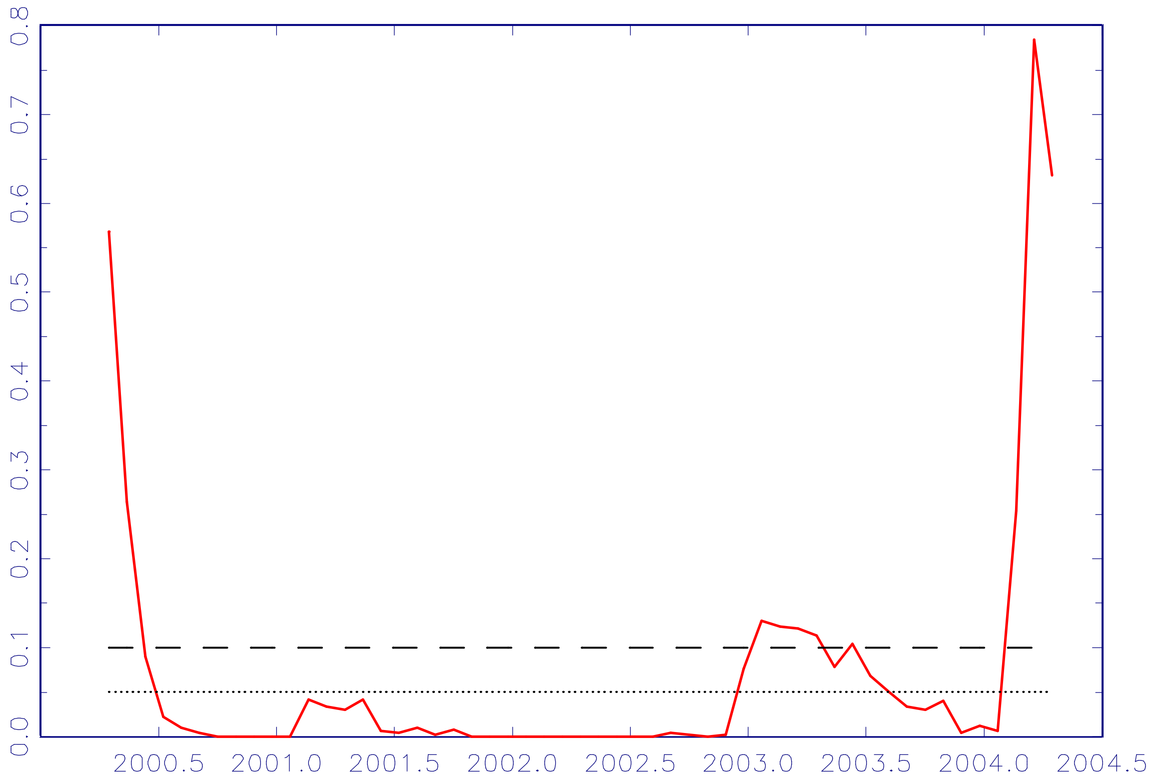


Figure 4. Graph of bootstrapped Chow forecast test p-values (based on 500 replications)

The p-values for the vast majority of the searched break date lies substantially below the 5 % level (dotted line in Figure 4). The system seems hence to be affected by structural breaks; the representation of the price movements on Ukrainian wheat flour and wheat markets as a single, time-invariant error correction model is not appropriate. The following subsection provides the results of an alternative model based on a MSVECM representation, which is found to be better suited for this data set.

4.3 Markov-switching vector error correction model

The number of lags and the number of regimes in the MSVECM have been selected according to the AIC. A formal test for the number of regimes M against the alternative M+1 is difficult because a number of parameters of the unrestricted model are not identified under the null hypothesis, leading to a non-standard distribution of the usual likelihood-based test statistics. Nevertheless, the AIC turned out to be strongly in favour for the specification with 4 regimes and 3 lags in the VECM. The residual diagnostics for this model are in line with the usual assumptions: Neither vector autocorrelation, heteroskedasticity nor non-normality seem to be problematic for the MSVECM. Hence, this model might be viewed as a congruent representation of the underlying process.

The estimated parameters of the final MSVECM specification using data from June 2000 to November 2004 are presented in Table 2. One interesting feature is the drop in the speed of adjustment coefficients in comparison to the simple VECM. The magnitude of the significant coefficient in the flour equation is reduced by factor 3 (regimes 1-3) and factor 6 (regime 4). The speed of adjustment coefficient in the wheat equation remains statistically insignificant across all regimes. Another intriguing feature is the distinct variation in the residual standard errors σ_ε^f and σ_ε^w between the regimes. Speed of adjustment, residual standard errors and the resulting margin in the long-run relation (which may be calculated from the estimated coefficient for the regime-specific constant and the corresponding speed of adjustment coefficient estimate) allow for a more detailed interpretation of the single regimes.

Regime 1 **"Normal trade"** is characterised by relatively small values for the residual standard errors σ_ε^f and σ_ε^w; both the margin (which depends on the constant, once restricted to be in the error correction term) and the speed of adjustment parameter in the flour equation is at its usual level (α^f = -0.04).

Regime 2 **"Calming"** exhibits still increased residual standard errors (σ_ε^f : factor 1.5, σ_ε^w : factor 3 relative to regime 1); margin and α^f are back at the usual levels.

Regime 3 **"Alert"** shows a strong increase in the variability of the errors for flour (σ_ε^f : factor 7, σ_ε^w : factor 2 relative to regime 1); the margin is slightly reduced by about 12 %, and α^f is still unchanged.

Regime 4 **"Disarray"** has the highest residual standard errors in both equations (σ_ε^f : factor 10, σ_ε^w : factor 12 relative to regime 1); the margin is exceptionally high, and the speed of adjustment in the flour price change equation is halved.

Table 2. Markov-switching vector error correction model (MS(4)-VECM(3))

	Regime 1		Regime 2		Regime 3		Regime 4	
	ΔP^f	ΔP^w	ΔP^f	ΔP^w	ΔP^f	ΔP^w	ΔP^f	ΔP^w
Const.	0.063*	-0.013	0.063*	-0.013	0.063*	-0.013	0.063*	-0.013
	(0.011)	(0.021)	(0.011)	(0.021)	(0.011)	(0.021)	(0.011)	(0.021)
ΔP^f_{t-1}	-0.030	-0.299*	0.236*	-0.173	0.233*	0.110*	0.240	0.877*
	(0.034)	(0.055)	(0.064)	(0.206)	(0.092)	(0.051)	(0.221)	(0.417)
ΔP^f_{t-2}	0.051*	0.043	0.097	-0.035	-0.124	0.051	0.789*	0.592
	(0.026)	(0.043)	(0.057)	(0.177)	(0.117)	(0.061)	(0.251)	(0.452)
ΔP^f_{t-3}	-0.221*	-0.295*	0.001	-0.224*	0.163	0.075	0.431	1.054
	(0.030)	(0.048)	(0.035)	(0.111)	(0.094)	(0.057)	(0.366)	(0.662)
ΔP^w_{t-1}	0.293*	0.619*	-0.039*	0.038	0.308*	0.329*	-0.351	-0.999*
	(0.063)	(0.105)	(0.018)	(0.056)	(0.107)	(0.061)	(0.220)	(0.421)
ΔP^w_{t-2}	-0.017	-0.208*	0.048	0.410*	-0.361*	0.096	1.275*	1.450*
	(0.011)	(0.018)	(0.035)	(0.121)	(0.109)	(0.064)	(0.361)	(0.661)
ΔP^w_{t-3}	0.044	0.432*	0.068	0.508*	0.222*	-0.026	0.160	2.941*
	(0.032)	(0.054)	(0.040)	(0.130)	(0.056)	(0.032)	(0.395)	(0.725)
ECT_{t-1}	-0.041*	0.008	-0.041*	0.004	-0.044*	0.014	-0.026*	-0.027
	(0.007)	(0.013)	(0.007)	(0.013)	(0.007)	(0.013)	(0.010)	(0.018)
$\sigma_\varepsilon^{f/w}$	0.0034	0.0056	0.0052	0.0170	0.0229	0.0123	0.0368	0.0631
Constant restricted in the ECT term	-1.5604		-1.5301		-1.4489		-2.4179	

Note: All data is in natural logarithm. Standard errors in parentheses. * means statistical significance at 1%.

Source: Own calculations using MSVAR for Ox (Krolzig, 2004, Doornik, 2002).

The transition matrix Π in Table 3 contains the transition probabilities from regime s_{t-1} to regime s_t. The values on the main diagonal indicate the probability of no change in regime. Regimes 1 and 2 are found to be the most persistent, which is also indicated by the average duration of each regime. While regimes 1 and 2 both last for about 4 weeks on average, regime 3 only is only 2 weeks on average, and regime 4 only has a mean duration of 1½ weeks. From either regime 1 or 2, if a regime change takes place, regime 3 is the most likely outcome in the subsequent period (probabilities of 14 and 15 %, respectively). From regime 3, the system might either calm down (regime 2: 24 %; regime 1: 12 %), or the uncertainty in the market might culminate in disarray (regime 3: 12 %). Once in regime 4, the usual route of calming goes via regime 3 as an intermediate step (37 %) or directly into regime 1 with a 19 % probability. Note, however, that even this state of disorientation in the market has some persistence, with a probability of no change of 37 %.

Table 3. Transition matrix for the MSVECM with 4 regimes

to regime … / from regime …	1	2	3	4
1	0.736	0.067	0.142	0.055
2	0.121	0.728	0.151	0.000
3	0.117	0.236	0.528	0.119
4	0.194	0.069	0.370	0.367

Figure 5 gives more information on the duration of each regime. The graph plots the cumulative probability on the y-axis against the duration of the regime on the x-axis. Regimes 1 and 2 follow virtually undistinguishable routes, while regime 3 is substantially shorter. The "disarray" regime 4 is not very stable; the probability of observing it for more than 3 subsequent weeks is less than 5 %.

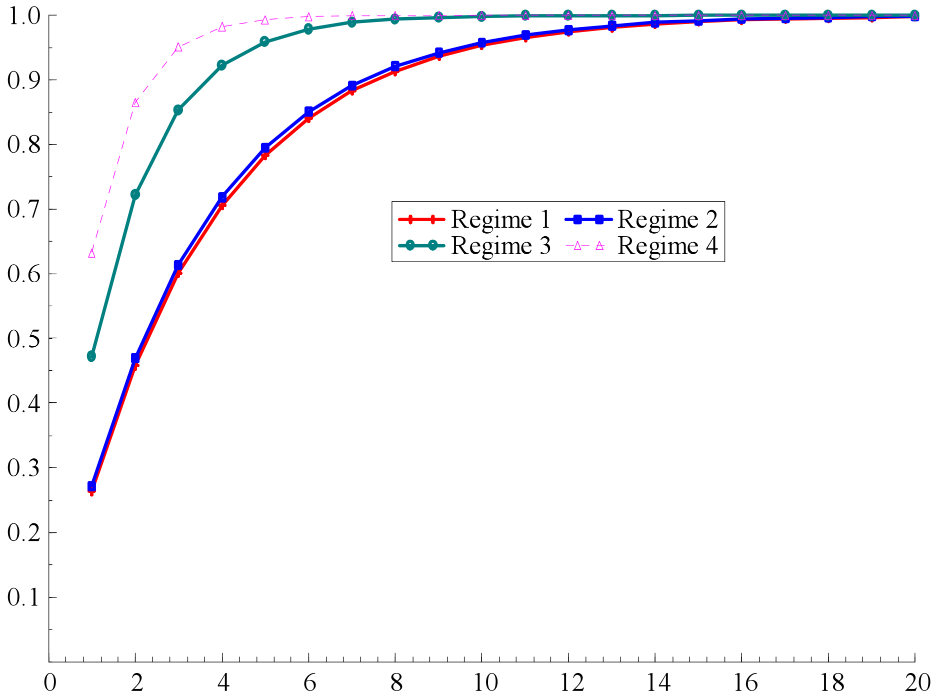


Figure 5. Cumulative probabilities for duration of regime s_t less than or equal to t weeks

In Section 2, we have discussed various factors, which might have been important determinants of market integration on Ukrainian flour and wheat markets in the observation period. In the next step, we try to link these events to the observed regimes of the MSVECM. In particular, regime 4 is the most interesting, because the lack of adjustment and the inflated uncertainties in the price equations imply a substantial social cost for the Ukrainian wheat economy. In Figure 6, the development of the two price series in the top panel is compared with the smoothed probabilities for regime 4 in the bottom panel. These latter indicate the probability that the system state is in regime 4 at time t. The distinct peaks of the graph highlight that regime 4 is clearly identified although it is the most rare of the four regimes.

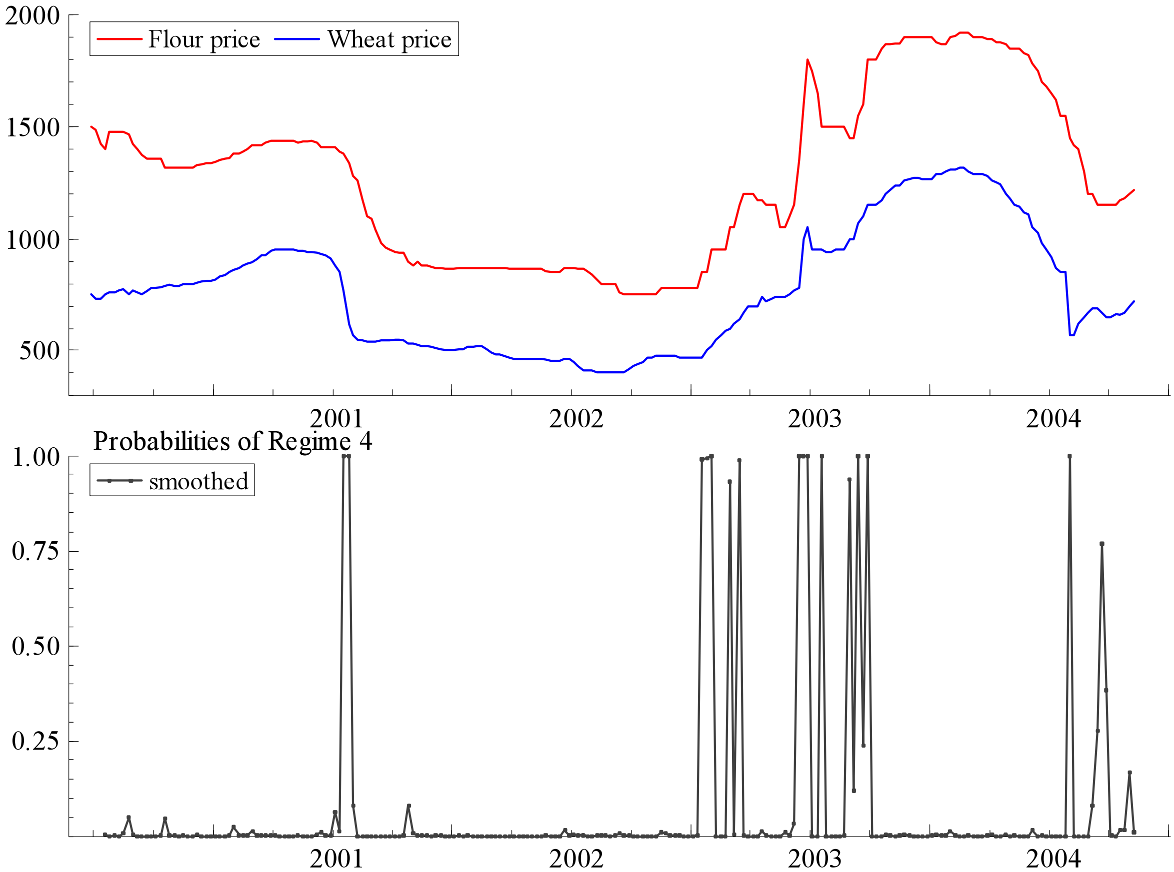


Figure 6. Price development for flour and wheat in Ukraine and probabilities of regime 4, 2000-2004

The peaks for the probability of observing regime 4 occur at times when the flour and wheat markets in Ukraine were subject to major shocks. The first peak corresponds to the second half of July 2001. This corresponds to the start of an extraordinary good harvest, which also initiated a change in the net trade balance for wheat, from a net import situation to a net export situation. The price for wheat dropped more rapidly than the price for wheat flour, leading to an above-average margin. The following period up to the beginning of 2003 seems to be rather stable; the first indication of "disarray" shows up no earlier than end of January, 2003. At that time, the first news concerning the severe winterkill of the wheat crop in Ukraine began to spread. The subsequent one-period occurrences of regime 4 in the 9th and 11th week of 2003 belong to the same category; they are probably influenced by partially conflicting information about the actual extent of the damage caused by winterkill to the wheat crop.

In the course of the year 2003, several other peaks can be observed, which are of particular interest since they can be linked to direct policy interventions on the market for wheat and wheat flour. The first set of these occurs in the summer and begins with a block of three weeks duration (24th – 26th week of 2003), and is followed by a one-period observations in week 29. These dates coincide with heavy political activity; both on June 29 and on July 24, important cabinet resolutions were issued, which set out the intended government reaction to the low harvest and to the possible shortage of domestic wheat. The temporal lead of two weeks, which with regime 4 is observed, is explained by the intense public discussion preceding the official resolutions. The interventionist character of many of the proposed measures, e.g., allowing for regional control of physical grain shipments, or regulating bread prices, set the normal market relationships in turmoil, as signalled by the high probability for regime 4. After this period, a "calming" is observed. However, this last only about four weeks. Then, rumours spread out concerning wheat imports from Kazakhstan and Russia at very favourable conditions. Indeed, the official announcement of the imports dates in this block, which consists of three single-period observations of regime 4 in weeks 35, 37, and 39. With the beginning of October, the error correction model between flour and wheat markets shifted again towards the more stable regimes. Figure 7 provides a more aggregate view by only distinguishing between 'normal' regimes (1 and 2), which are characterised by relatively low residual standard errors, and 'alert' regimes (3 and 4), which exhibit much higher residual standard errors. According to this graph, most of the year 2003 must be viewed as a period in which the markets where far from functioning in a stable way. This supports the view by, amongst others, von Cramon-Taubadel (2004) that the perceived crisis is more likely due to agricultural policy, and not a crisis of agriculture itself.

Both Figure 6 and Figure 7 indicate that regimes 3 and 4 dominate the markets again, starting from July 2004. These recent regime shifts can be linked to the campaign for the presidential election. Both candidates explicitly referred to the regulations of wheat trade, and those of bread price control in their election programmes. It seems as if the ups and downs of the pre-election opinion polls were transmitted at least partially on the price relationships for wheat flour and wheat.

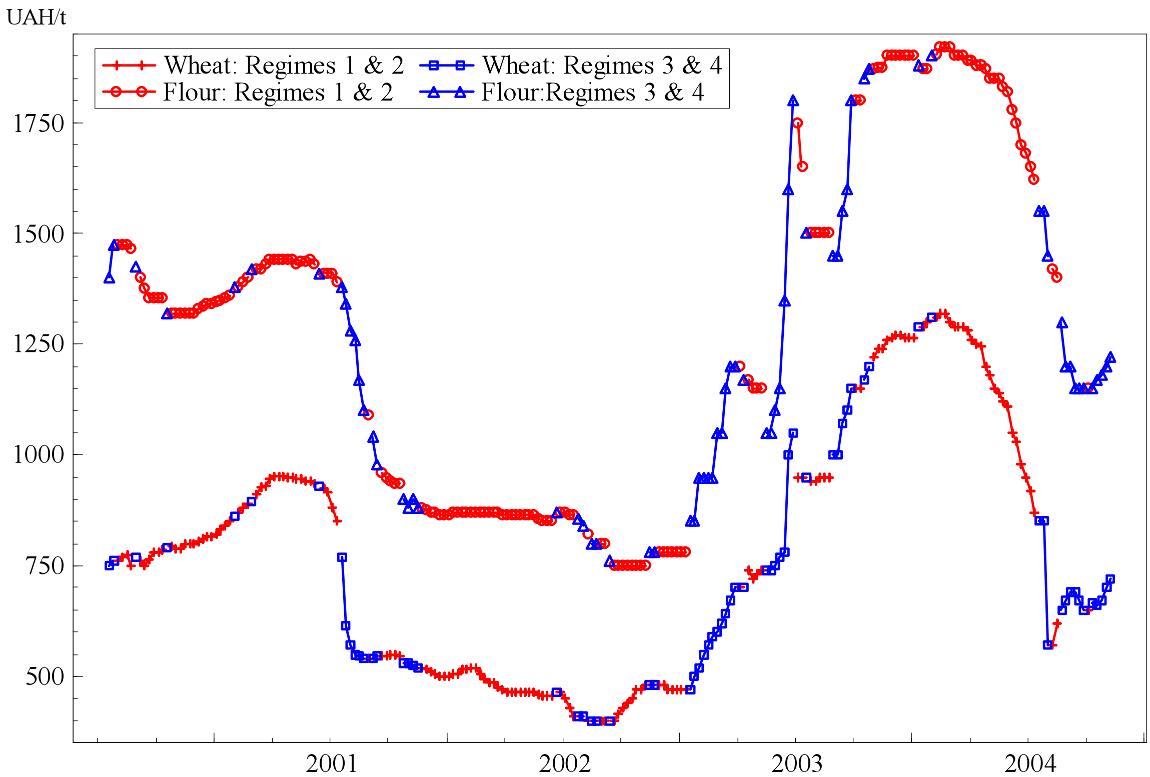


Figure 7. 'Normal' (1&2) and 'alert' (3&4) regimes of the MSVECM for wheat and flour prices in Ukraine, 2000-2004

5 Conclusions

This paper analysed vertical market integration between the markets for wheat and wheat flour in Ukraine over the years 2000-2004. The political interventions on these markets have been manifold, and the impact of many of these interventions on the functioning of the markets remains questionable. In particular, political reactions to changes in the net trade balance for wheat were discussed. These reactions were often neither transparent nor consistent; their credibility was often unclear. Also, most of the acts and resolutions passed by the cabinet had often been accompanied by rumours in the market.

In view of this background, we assume that structural stability of the price relationship between wheat and wheat flour might be a too strong assumption. The suspicion of structural instability was found to be confirmed in the analysis of the basic vector error correction model by means of Chow forecast test. Instead of this standard model, we explore the usefulness of the Markov-switching vector error correction model (MSVECM) for the case at hand. The MSVECM has found increasing popularity in the business cycle literature in recent years. We employ this model for the analysis of market integration between wheat and flour markets in Ukraine, using 228 weekly observations on the price of wheat and flour from June 2000 to November 2004. The MSVECM specification for the logarithmic price series with three lags (in differences) and four regimes was found to be congruent representation of the underlying process.

The endogenously estimated regimes could be interpreted as different conditions, which govern the price relationship between flour and wheat at a given point in time. Differences in the residual standard errors, the margin between the two prices, and the magnitude of the speed of adjustment coefficient constitute the main characteristics of each regime. The most imprecise regime, i.e., the one with the highest residual variance and most volatile margin, is the estimated regime No. 4. The prevalence of this regime over time could be linked to the development of certain factors outside the model. In particular, for the year 2003, and the latter part of 2004, political interventions and high probabilities for regime 4 move occur concurrently; this is a particular negative feature since the proclaimed goal of many of the interventionist measures was to dampen instabilities on the market for wheat. The social cost of pushing otherwise well-functioning markets in a regime of "disarray" is considerable. Finally, it was shown that the relationship between wheat and wheat flour prices was also affected by the turbulences of the election campaign in 2004. The future development of agricultural policy in Ukraine should acknowledge these results and refrain from discretionary interventions in the markets to avoid increased uncertainty regarding price relationships.

The approach, although already found useful in its present form, could be extended by aiming at the direct incorporation of policy variables. For example, based on a rigorous screening of newspapers and similar media could be used to construct an index of awareness for new developments on the corresponding markets. Such information could then be utilised in the econometric procedure to check whether a re-estimation of the MSVECM taking this prior information on the state variable into account gives a similar picture or not.

6 References

APK-Inform (2004). Ukrainian Grain Market. Weekly Analytical and Statistical Report. APK Inform, Kyiv, Ukraine, July.

Candelon, B. and Lütkepohl, H. (2000). On the Reliability of Chow Type Tests for Parameter Constancy in Multivariate Dynamic Models. Discussion Paper, Humboldt-Universität Berlin.

von Cramon-Taubadel , S. (2002). Grain Market Regulation in Ukraine: Options and Evaluation. Insti-tute for Economic Research and Policy Consulting in Ukraine, Advisory Paper S6, www.ier.kiev.ua.

von Cramon-Taubadel , S. (2004). The 2003 wheat harvest: Crisis! What crisis? In: S. von Cramon-Taubadel, S. Demyanenko and A. Kuhn (eds.). Ukrainian Agriculture - Crisis and Recovery. Aachen: Shaker Verlag: 183-200.

von Cramon-Taubadel, S., Ed. (2001). Price determination and government policy on Ukrainian grain markets. In: S. von Cramon-Taubadel, S. Zorya and L. Striewe (eds). Policies and Agricultural Development in Ukraine. Aachen: Shaker Verlag.

Dempster, A.P., N. M. Laird and D. B. Rubin. Maximum likelihood from incomplete data via the EM algorithm (with discussion). Journal of the Royal Statistical Society B 39: 1-38.

Demyanenko, S. and S. Zorya (2004). Taxation and Ukrainian agriculture. In: S. von Cramon-Taubadel , S. Demyanenko and A. Kuhn (eds.). Ukrainian Agriculture: Crisis and Recovery. Aachen: Shaker Verlag: 25-39.

Doornik, J.A. (2002), Object-Oriented Matrix Programming Using Ox, 3rd ed. London: Timberlake Consultants Press and Oxford: www.nuff.ox.ac.uk/Users/Doornik.

FAO (2004): World market prices of wheat. UN Food and Agriculture Organisation. http://www.fao.org.

FAS/USDA (2000-2004). Grain Market Reports. Foreign Agricultural Service, US Department of Agriculture, Kyiv Post.

Krolzig, H.-M. (2004). MSVAR – an Ox package designed for the econometric modelling of univariate and multiple time series subject to shifts in regime. Version 1.31k: http://www.economics.ox.ac.uk/research/hendry/krolzig/msvar.html.

Krolzig, H.-M. and J. Toro (2001). A New Approach to the Analysis of Business Cycle Transitions in a Model of Output and Employment. Department of Economics discussion paper series No. 59, University of Oxford: Oxford.

Krolzig, H.-M., M. Marcellino and G.E. Mizon (2002). A Markov-switching vector equilibrium cor-rection model of the UK labour market. Empirical Economics 27(2): 233-254.

Lanne, M., Lütkepohl, H. and Saikkonen, P. (2002). Comparison of unit root tests for time series with level shifts. Journal of Time Series Analysis 23(6): 667-685.

Striewe, L. and S. von Cramon-Taubadel (1999). Die Getreideproduktion der Ukraine: Verpasste Chancen und dringender Handlungsbedarf. In: S. von Cramon-Taubadel and L. Striewe (eds.). Die Transformation Der Landwirtschaft in Der Ukraine: Ein Weites Feld. Wissenschaftsverlag Vauk Kiel KG: 74-87.

UkrAgroConsult (1998-2004). Agrinews. Weekly Issues, Kyiv.