Black Sea and World Wheat Market Price Integration Analysis

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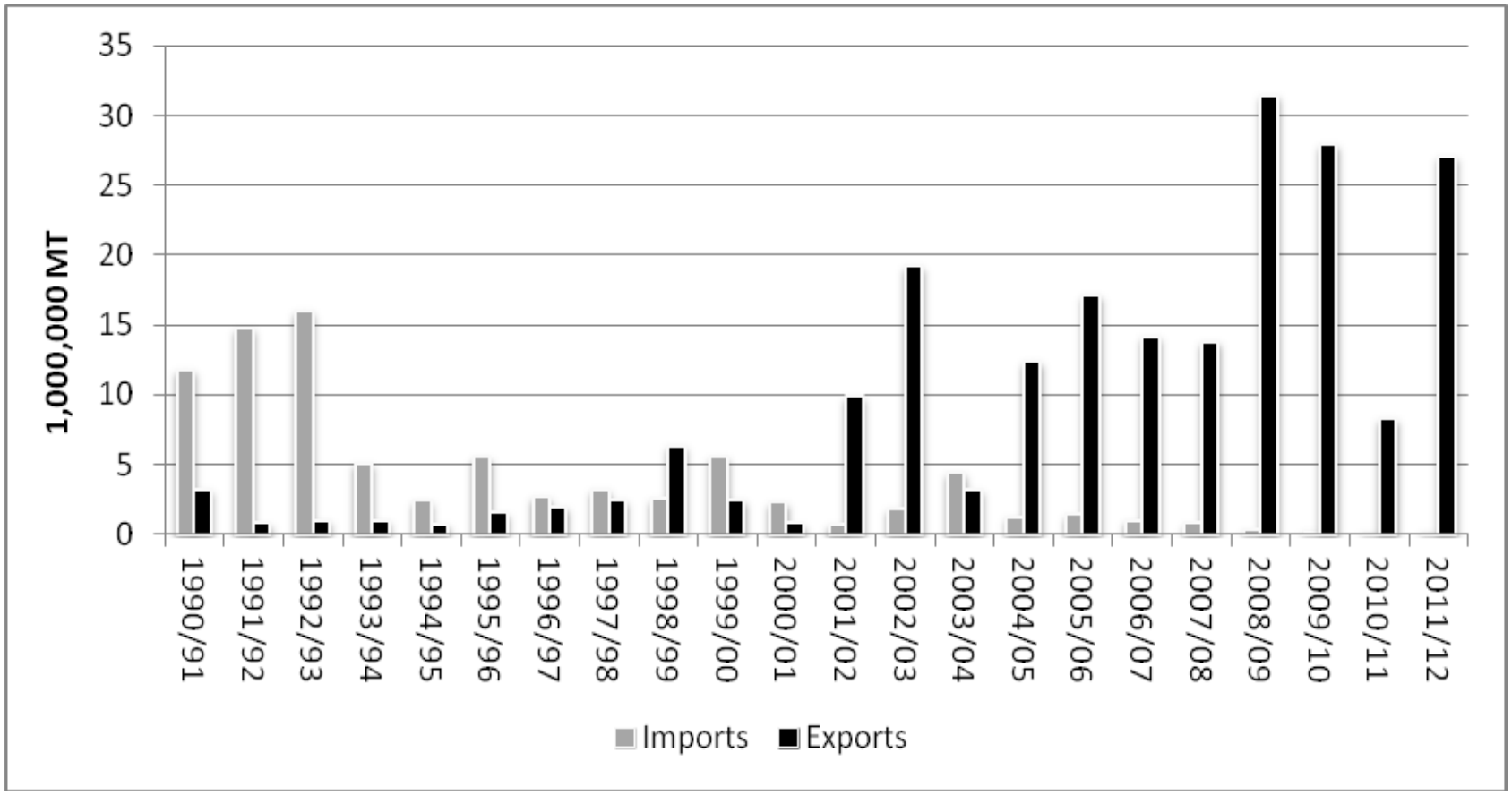
Dynamics of the Russian and Ukrainian wheat exports and imports



Source: USDA, December 2012

Russian and Ukrainian Wheat Exports (1000 MT)

	Country	2008/09	2009/10	2010/11	2011/12
1	United States	27,101	24,172	35,977	28,071
2	Australia	13,450	13,764	18,477	23,041
3	**Russia**	18,393	18,556	3,983	21,627
4	Canada	18,674	18,992	16,768	17,603
5	EU-27	25,351	22,115	22,906	16,439
6	Argentina	8,651	5,255	7,742	11,949
7	Kazakhstan	5,701	7,871	5,519	10,619
8	**Ukraine**	13,037	9,337	4,302	5,436
9	Turkey	2,342	4,363	2,945	3,680

> 50% of total wheat is exported to **North Africa** and **Near East Asia**

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Objective of the study

- to investigate short- and long-run wheat price dynamics between Ukraine and Russia and other major wheat exporters - United States, European Union (EU), and Canada.

More specifically the goals are…

- To check whether Black sea wheat markets are integrated with the world grain markets
- To analyze if the price transmission is symmetric (for the pairs of series that are cointegrated)
- To investigate the short run dynamics between cointegrated series

Methods used

- Testing for Unit Roots (ADF, PP, and KPSS)

- Testing for Cointegration (long-run relationship)
  - Residual based test [primary one]
  - Johansen's Maximum Likelihood test

- TAR, M-TAR (asymmetric price adjustment)

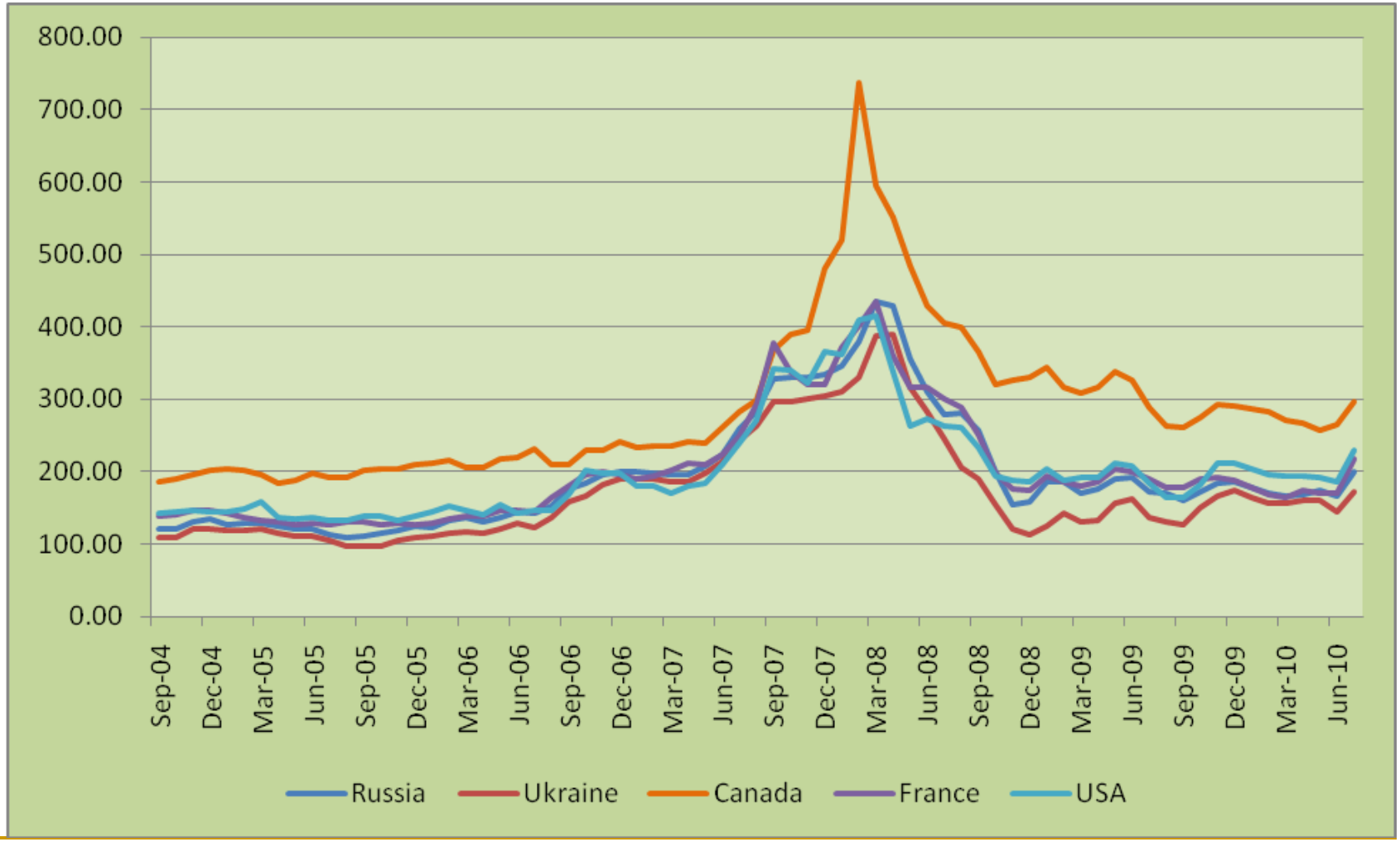
- Error-Correction Model (short-run dynamics)

Data

- Monthly wheat FOB prices for:
  - **Russian Soft Wheat (Black Sea ports)**
  - **Ukrainian Feed Wheat (Black Sea ports)**
  - **Canadian Western Red Spring Wheat (St. Lawrence)**
  - **US Soft Red Winter Wheat (Gulf ports)**
  - **French Soft Wheat (Rouen)**

- Time span: **from July 2004 till October 2010**
- Prices were obtained from **the International Grain Council**

Comparison of the analyzed wheat price series, **$ per ton**



Source: IGC, 2011

Step 1: Testing data stationary

- Augmented Dickey-Fuller (ADF)
- Philips-Perron (PP) tests
- Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test

→ **The results suggested that all series are I(1) stationary**

Step 2: Cointegration tests

- **Cointegration** presupposes that observable variables exhibiting non-stationary behavior will nonetheless be linked in the long-run

- Two methods:
  - Johansen Maximum Likelihood Method (both multiple and pairwise comparisons)
  - Engel and Granger residual based test (only pairwise comparisons)

Cointegration test results – Johansen ML on multiple series (trace test)

Ho(Rank=r)	H1(Rank>r)	Trace	5% CV
0	0	112.08**	75.74
1	1	63.47**	53.42
2	2	27.87	34.8
3	3	12.26	19.99
4	4	5.89	9.13

Cointegration tests' results – pairwise for **Russia**

Pairs of series	Engel and Granger procedure			Johansen method		
	# of lags	ADF	PP	Ho(H1)	Trace	5%CV
Russia-France	2	-5.32**	-5.24**	R=0((r>0)	25.98**	19.99
				R=1(r>1)	6.69	9.13
Russia-Canada	1	-2.30	-2.38	R=0((r>0)	13.23	19.99
				R=1(r>1)	5.12	9.13
Russia-USA	1	-3.79**	-3.81**	r=0((r>0)	15.47	19.99
				R=1(r>1)	3.75	9.13

Asterisks denote levels of significance (* for 10 percent, ** for 5 percent). The 5% and 10% critical values for tests with a drift are -3.42 and -3.10 respectively. Critical values were obtained from MacKinnon (1991).

Cointegration tests' results – pairwise for **Ukraine**

Pairs of series	Engel and Granger procedure			Johansen method		
	# of lags	ADF	PP	Ho(H1)	Trace	5%CV
Ukraine-France	3	-2.33	-3.64*	R=0((r>0)	24.66**	19.99
				R=1(r>1)	5.28	9.13
Ukraine - Canada	1	-1.90	-1.99	R=0((r>0)	12.48	19.99
				R=1(r>1)	4.70	9.13
Ukraine-USA	2	-2.91	-3.24*	r=0((r>0)	12.48	19.99
				R=1(r>1)	4.56	9.13

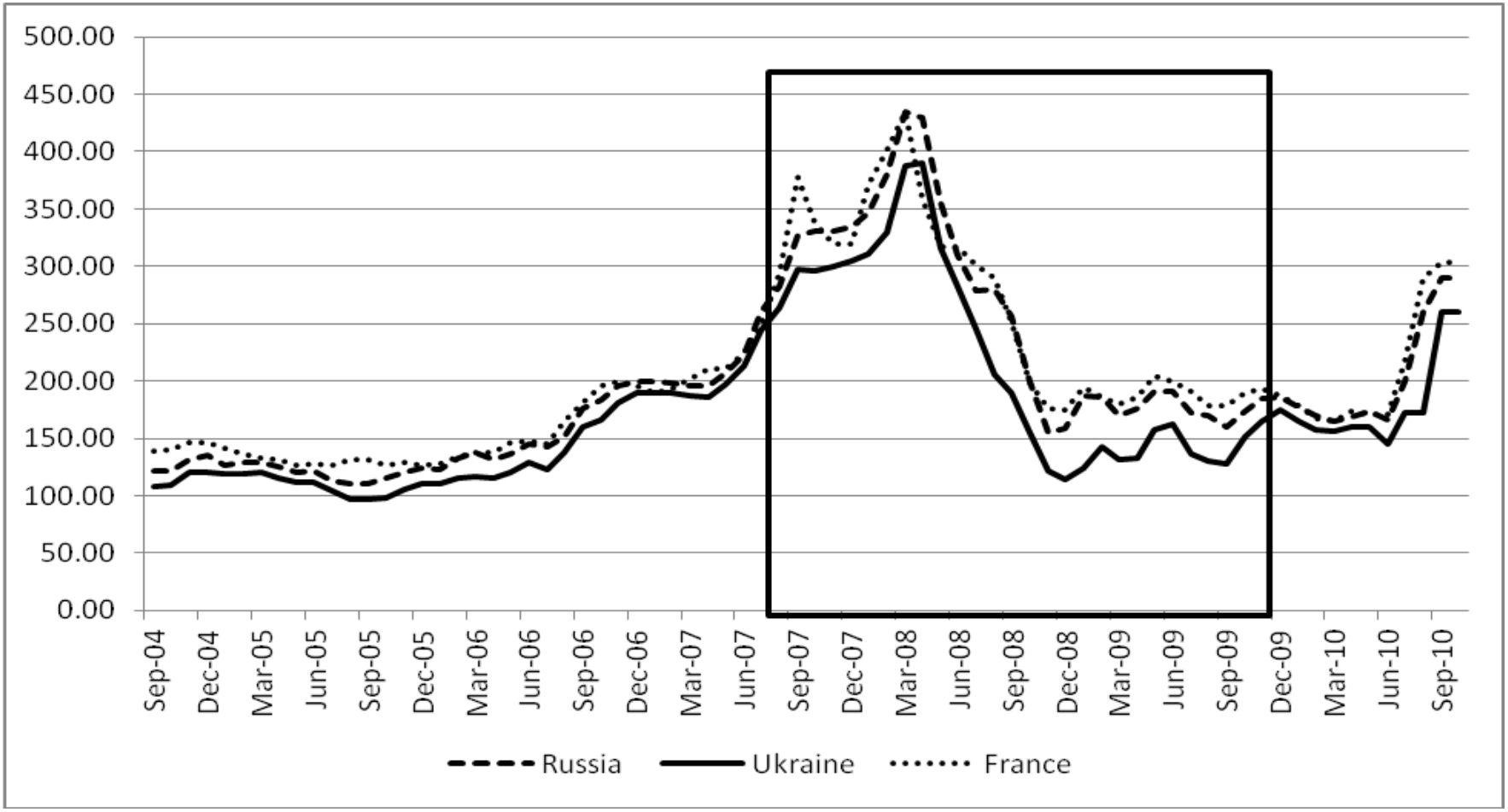
Asterisks denote levels of significance (* for 10 percent, ** for 5 percent). The 5% and 10% critical values for tests with a drift are -3.42 and -3.10 respectively. Critical values were obtained from MacKinnon (1991).

Therefore,

- Based on the results we confirm cointegration of Russian-French, Russian-US and Ukrainian-French pairs of prices

- The long-run elasticities are equal to
  - 1.04 (case of Russia-France)
  - 1.16 (case of Russia-USA)
  - 1.05 (case of Ukraine-France)

Possibility of a structural break?



Source: IGC, 2011

Chronology of government decisions on grain export restrictions and export quotas, starting from 2006 (1000 MT)

Period	Wheat	Barley	Corn
10/17/2006-12/31/2006	400	600	600
12/14/2006-06/30/2007	3	600	500
02/15/2007-06/30/2007	228	606	30
02/26/2007-06/07/2007		Quotas cancelled	Quotas cancelled
06/08/2007-06/30/2007	Quotas cancelled		
07/01/2007-10/31/2007	3	3	3
01/01/2008-03/31/2008	200	400	600
01/01/2008-07/01/2008	1,200	900	
05/21/2008	Quotas are cancelled		
08/2010	500	500	2,000
10/2010-12/2010	500	200	2,000
12/2010	1,000	200	3,000
03/2011	1,000	200	5,000
05/2011	Quotas are cancelled		
05/2011-01/2012	Tariffs are introduced		
10/2011	Tariffs cancelled, except for barley (01/01/2012)		

Source: UkrAgroConsult, FAO, 2009

TAR model snapshot

$$\Delta\bar{\varepsilon}_t = \gamma_1 \bar{\varepsilon}_{t-1} + \sum_{i=1}^{p} \gamma_{i+1} \Delta \bar{\varepsilon}_{t-i} + \omega_t$$

$$\Delta\bar{\varepsilon}_t = I_t \gamma_1 \bar{\varepsilon}_{t-1} + (1 - I_t)\gamma_2 \bar{\varepsilon}_{t-1} + \varphi_t \quad , \quad \text{where}$$

$$I_t = \begin{cases} 1 \; if \;\; \bar{\varepsilon}_{t-1} \geq \tau \\ 0 \; if \;\; \bar{\varepsilon}_{t-1} < \tau \end{cases}$$

Step 3: Testing for asymmetric price transmission – TAR model*

	Russia - France	Russia-USA	Ukraine –France
Variable	Parameter estimate	Parameter estimate	Parameter estimate
γ_1	-0.80 (-5.31)**	-0.26 (-2.05)*	-0.22 (-1.18)
γ_2	-0.74 (-4.76)**	-0.36 (-2.30)*	-0.38 (-2.75)**
$H_0: \gamma_1 = \gamma_2 = 0 (\Phi)$	22.08**	4.38**	6.82**
$H_0: \gamma_1 = \gamma_2 (F)$	0.11[0.74]	0.24 [0.62]	0.33 [0.57]
τ	-0.019	-0.04	0.016

*M-TAR model provided similar results

Step 3: Testing for asymmetric price transmission – cont.

- The results show that for all three cointegrated pairs of wheat prices the price transmission is **symmetric**

- This implies that the adjustment towards the equilibrium is of the same magnitude regardless of the direction of the change.

Step 4: Error-Correction Model

- Error Correction Models (ECMs) estimate the speed at which a dependent variable returns to equilibrium after a change in an independent variable

- Before the ECM can be formed, there first has to be evidence of cointegration

ECM results

	Speed of adjustment, α_1	Test F-value	Time of adjustment
Russia-France	-0.48**	12.32**	3.5 months
Russia - USA	-0.20**	10.69**	10 months
Ukraine - France	-0.20**	11.38**	10 months

Policy Implications

- Trade liberalization issues
  - Long-run transmission results indicate that Ukraine and Russia are integrated with the world market
  - Transmission is symmetric
- Estimation of elasticities
  - Modeling global wheat market behavior
- Future research

THANK YOU!