

The impact of agricultural and trade policies on price transmission: The case of Tajikistan and Uzbekistan

Abdulmajid Bobokhonov^a, Jan Pokrivcak^{b,c} and Miroslava Rajcaniova^{b,c}

^aTajik State University of Commerce, Dushanbe, Tajikistan; ^bUniversity of West Bohemia, Pilsen, Czech Republic; ^cSlovak University of Agriculture in Nitra, Nitra, Slovak Republic

ABSTRACT

This paper examines the extent and speed of price transmission from international to local markets in two transition economies, Tajikistan and Uzbekistan. The two countries have similar economic backgrounds, but a notable difference is that Tajikistan has adopted a more liberal agricultural trade regime than Uzbekistan. We use a vector error correction model to analyse how global agricultural prices are transmitted to domestic food prices in the two countries. We find strong cointegration between world market and domestic prices in Tajikistan for food crops but not meat, and no cointegration in Uzbekistan.

KEYWORDS Price transmission; market integration; agricultural trade

JEL CLASSIFICATIONS E39, F15, P22

ARTICLE HISTORY Received 10 September 2016; Accepted 23 January 2017

1. Introduction

Rising world food prices during recent years have attracted much attention of economists, as well as policy-makers who deal with potential welfare effects of food prices on producers, consumers and in particular on the poor and vulnerable households. High food prices raise the cost of food for consumers but increase the income of farmers (Swinen and Squicciarini 2012), which belong among relatively poor segments of the society in many countries. Net effects of rising food prices depend on whether households or nations are net sellers or buyers of food items.

Domestic food prices depend on price transmission from world to domestic markets. However, global food prices need not be fully and rapidly transmitted to domestic markets either due to the existence of market imperfections, underdeveloped infrastructure or because of the government policies that attempt to separate world from domestic markets (Abbott and Battisti 2011; Rapsomanikis, Hallam, and Conforti 2003). Governments in net exporting countries, for example, often use export bans or export taxes to prevent rises of domestic prices when global food prices soar, while similarly net food importing countries might reduce tariffs or subsidize imports in such situations. The pass-through

CONTACT Miroslava Rajcaniova ✉ miroslava.rajcaniova@uniag.sk

© 2017 Informa UK Limited, trading as Taylor & Francis Group

of the price shocks from world to domestic markets can have significant income distributional and welfare implications for farmers and consumers; this makes the issue of price transmission very relevant from the policy-making perspective.

In this paper, we study how global agricultural prices are transmitted to domestic prices in two countries of Central Asia, namely Uzbekistan and Tajikistan. Agriculture belongs among the most important sectors in these countries as measured by its share in gross domestic product (GDP), employment or trade. On the other hand, households spend significant share of their income on food. For these reasons, price transmission significantly affects both consumers and producers in Uzbekistan and Tajikistan. In particular, we study the size, speed and nature of pass-through of world agricultural commodity prices to domestic agricultural prices. It is interesting and relevant from policy-making perspective to compare price transmission between Uzbekistan and Tajikistan, as these neighbouring countries have a similar range of farm products and food consumption patterns but they diverge significantly with respect to trade policies. While Uzbekistan relies on strong government involvement in managing international agricultural trade, Tajikistan has adopted more liberal agricultural trade policy.

We conclude that agricultural and trade policies have significant impact on short- and long-run development of domestic prices and that the infrastructure has a crucial role for integration of domestic to the world markets with differentiating impact on integration of crops and animal products.

Section 2 briefly describes the transition to a market-based economy and the structure of agriculture in the two countries. Sections 3–5 review the price transmission literature and set out the methodology and data used here. Section 6 presents results. The final section summarizes and draws conclusions.

2. Transition process in Uzbekistan and Tajikistan

After the collapse of the Soviet Union, both Tajikistan and Uzbekistan experienced declines in total aggregate output, reduction in living standards, increased economic uncertainty and growing income inequality and poverty. The change from decline to growth occurred in 1995 in Uzbekistan and in 1998 in Tajikistan. Since then, we observe improvements in economic indicators in both countries. High economic growth rates in that period are, in both countries, closely related to positive development of global commodity prices, in particular to prices of oil, natural gas, cotton, gold and aluminium of which these countries are exporters. Moreover, economies of Uzbekistan and Tajikistan benefited from increased inflow of remittances as well. Actually, Tajikistan has become the most dependent nation in the world on inflows of remittances. Money transferred by out-migrants back to Tajikistan makes up 49.6% of GDP in 2013 (World Bank 2015). Uzbekistan is only slightly less dependent on remittances than Tajikistan.

The key components of agricultural reform in a transition country include privatization and establishment of property rights to land, land market regulations including liberalization of international trade and input and output liberalization (Rozelle and Swinnen 2004; Spoor 2004). Table 1 provides the data on the progress of reforms in both countries and their basic macroeconomic characteristics. Accordingly, both Uzbekistan and Tajikistan made relatively small progress in economic reforms. Meanwhile, implementation of 'small-scale privatization and housing reform were undertaken quickly' in both countries (Pomfret 2010). Table 2 provides the basic data about development of agricultural production and inputs in both countries.

Table 1. The World Development Indicators (WDI) and European Bank for Reconstruction and Development (EBRD) transition and reforms indicators of Tajikistan and Uzbekistan.

	Tajikistan			Uzbekistan		
	1999	2008	2012	1999	2008	2012
Population, total (in thousand)	6186.15 ^a	7254.07	7930.92	24,650.40 ^a	27,302.80	29,774.50
GDP per capita (current US dollar)	139.11 ^a	711.51	962.44	558.22 ^a	1082.28	1740.47
Poverty headcount ratio at national poverty lines (% of population)	–	–	34.30 ^b	–	–	15.00
Agricultural business	–	–	2.00	–	–	2.00
Large-scale privatization	2.33	2.33	2.33	2.67	2.67	2.67
Small-scale privatization	3.00	4.00	4.00	3.00	3.33	3.33
Enterprise restructuring	1.67	1.67	2.00	2.00	1.67	1.67
Price liberalization	3.67	3.67	4.00	2.67	2.67	2.67
Trade and forex system	2.67	3.33	3.00	1.00	2.00	1.67
Competitive policy	2.00	1.67	1.67	2.00	1.67	1.67
Banking reform and interest rate liberalization	1.00	2.33	–	1.67	1.67	–
Securities markets and non-bank financial institution	1.00	1.00	–	2.00	2.00	–
Overall infrastructure reform	1.00	1.33	–	1.33	1.67	–

Source: WDI-World Bank Data (2015), EBRD-World Bank (2014) and Pomret (2010).

Note: Indicators are measured on a scale from 1 (no reform) to 4, with pluses and minuses, e.g. 3+ and 3– are represented by 3.33 and 2.67.

^aData for the year 2000.

^bData for the year 2013.

Table 2. Agricultural cultivation potential and data of Tajikistan and Uzbekistan, 1992–2013.

	Tajikistan			Uzbekistan		
	1992	2005	2013	1992	2005	2013
Total land area (1000 ha)	14,310	14,310	14,255	42,540	42,540	42,540
Agricultural land (% of land area)	32.1	33.4	34.8	65.2	62.9	62.9
Arable land (1000 ha)	873.0	773.0	869.0	4467.0	4382.0	4382.0
Land under cereal production ('00 ha)	273.5	417.2	418.2	1225.3	1615.9	1615.6
Cereal yield (kg per ha)	994.0	2164.0	2798.0	1777.0	4042.0	4766.0
Agriculture (as % of GDP)	36.6 ^a	24.0	27.5	37.3 ^a	27.8	18.1
Agricultural output growth index (as per cent)	–15.2 ^a	2.1	8.0	–1.1 ^a	5.4	6.8
Share employment in agriculture (as per cent)	44.7	67.5	48.9	41.9	29.1	27.4 ^b
Rural population (as per cent)	68.3 ^a	73.5	73.4	59.8 ^a	63.3	63.7

Source: World Bank Data (2015) and FAOSTAT (2015).

^aData for 1991.

^bData for 2012.

Notable difference between the countries is in price, trade and exchange market liberalization where Tajikistan is significantly more reformed and opened to world markets than Uzbekistan. After the end of civil war in 1998, Tajikistan liberalized international trade, including agricultural trade, and started to reform other institutions and policies.

On the other hand, economic policy of Uzbekistan stressed self-sufficiency, economic independence and import substitution (Nurmetov, Pokrivcak, and Ciaian 2015). In agriculture, emphasis was placed on increasing domestic production of grains at the expense of heavy reliance on cotton production. By restructuring its agricultural production

Table 3. Self-sufficiency ratio by food commodities in Tajikistan and Uzbekistan, 1992–2012.

		Tajikistan			Uzbekistan		
		1992	2002	2012	1992	2002	2012
Wheat	Domestic production ('000 ton)	166.4	544.6	812.6	964.0	4967.4	6612.2
	Export ('000 ton)	–	–	–	–	–	–
	Import ('000 ton)	900.0	291.6	751.5	4435.0	161.1	614.9
	Self-sufficiency (%)	15.6	65.1	51.9	17.8	96.8	91.5
Rice	Domestic production ('000 ton)	20.2	50.2	82.4	538.9	175.1	325.7
	Export ('000 ton)	–	–	3.7	–	–	–
	Import ('000 ton)	14.1	1.33	36.7	51.3	185.2	23.8
	Self-sufficiency (%)	58.9	97.5	71.4	91.3	48.6	93.2
Chicken meat	Domestic production ('000 ton)	5.2	0.1	7.5	38.8	10.1	30.0
	Export ('000 ton)	–	–	–	–	–	–
	Import ('000 ton)	–	0.85	19.3	29.0	6.5	15.1
	Self-sufficiency (%)	--	10.5	28.0	57.2	60.8	66.5
Fruits	Domestic production ('000 ton)	93.4	53.0	76.5 ^a	325.4	394.9	1086.0 ^a
	Export ('000 ton)	21.6	26.0	18.4 ^a	58.5	73.3	254.4 ^a
	Import ('000 ton)	–	0.6	0.2 ^a	1.1	0.2	0.2 ^a
	Self-sufficiency (%)	161.6	192.0	131.2 ^a	121.4	122.7	130.6 ^a
Vegetables	Domestic production ('000 ton)	327.1	289.6	1017.5 ^a	2522.1	1855.2	4729.1 ^a
	Export ('000 ton)	–	8.4	2.6 ^a	123.8	63.9	201.2 ^a
	Import ('000 ton)	–	5.2	2.2 ^a	1.3	0.7	5.4 ^a
	Self-sufficiency (%)	144.0	101.1	100.1 ^a	105.1	103.5	104.3 ^a

Source: Own calculation based on FAOSTAT (2015).

^aEstimated data are 2011.

from cotton monoculture towards grains, livestock, and fruits and vegetables Uzbekistan reached significant levels of self-sufficiency in agricultural commodities. However, self-sufficiency policy of the Uzbek government separated its agricultural sector from the world markets (Table 3).

In Uzbekistan, cotton is exclusively sold through the state procurement system while wheat is marketed both through the state procurement system (50%) and through open market (50%). Other commodities are sold through non-regulated local markets or traditional bazaars. Despite liberalization of output markets for all commodities except for cotton and wheat, which were only partially liberalized, there are substantial ad hoc state regulations affecting trade in Uzbekistan. Fresh fruits and vegetables can be exported to foreign market directly by agricultural producers but government restricts export if it has adverse implications for domestic markets (e.g. price increase).

Uzbek state often regulates domestic agricultural prices. For example, meat prices are regulated when there is meat shortage on domestic market. These state market interventions create uncertainty to agricultural producers in planning production (Djanibekov, Bobojonov, and Lamers 2012; Lerman and Sedik 2008; Nurmetov, Pokrivcak, and Ciaian 2015).

At input markets, cotton and wheat farms receive credits under favourable conditions. The credit can be used only for input purchases (fuel, fertilizer, water, electricity, agricultural machinery services) at subsidized prices and only from authorized companies. The credits can be also used to cover labour and insurance costs. The maximum amount of favourable credit is up to 60% of the production contracted by Uzbek government.

However, in all input markets (including water) there is a strong state involvement, which is used by Uzbek policy-makers to exert influence on production and trade decisions of farmers.

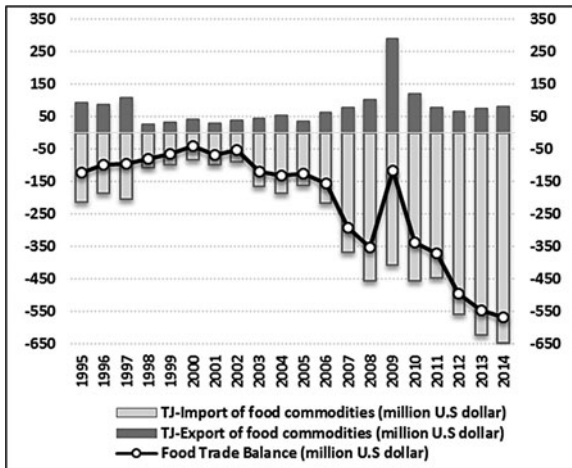


Figure 1. The volume of food trade turnover of Tajikistan (a) and Uzbekistan (b), 1995–2013. Source: Own elaboration based on UNCTAD data (2015).

In contrast, Tajikistan has liberalized trade regime in agricultural products and removed majority of government interventions. Subsidies and taxes were used in Tajikistan to a much lesser extent than in Uzbekistan.

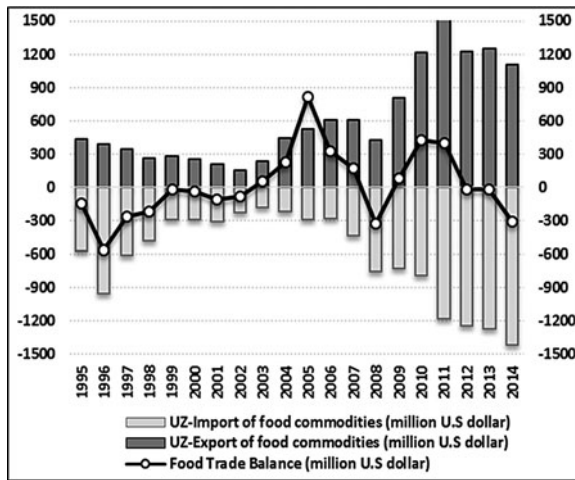
Tajikistan does not have good conditions for agricultural production, as only 6.1% of its land is suitable for production of arable crops. Growing domestic population cannot be supplied from domestic agricultural production. Therefore, Tajikistan has to rely on world markets to obtain enough food. Tajikistan imports grain and flour, dairy and meat products, vegetable oil, sugar and confectionery preparations, coffee, tea and so on. Figure 1(a,b) provides the total food trade turnover of Tajikistan and Uzbekistan with net trade food balances.

Tajikistan is a significant net food importer country. Net food trade position of Uzbekistan is more balanced. Both countries reduced the volume of cotton export and Uzbekistan increased export of fruits and vegetables. Tajikistan has started gradually to export small volume of grains. Figure 2(a,b) shows the volume of food export and import by specific food commodities in Tajikistan and Uzbekistan.

Table 4 shows the applied most favoured nations (MFN) tariffs for four countries in Central Asia. Uzbekistan has significantly higher import tariffs on agricultural and food products than Tajikistan. Tajikistan has a significantly higher degree of trade openness than Uzbekistan.

3. Price transmission mechanism

The price transmission was typically analysed through the horizontally related markets as links between prices at different locations or through the various stages of the supply chain (Vavra and Goodwin 2005). Overall, the issues of horizontal price transmission have been widely investigated within the framework of 'law of one price.' In the context of perfect trade linkage between several or two markets, the movement of commodities prices will be equalized in both markets in the long run, while allowing for deviations in



Figures 2. The volume of export (a) and import (b) by group of food products, 1995–2013. Source: Own elaboration based on UNCTAD data (2015).

Table 4. Import tariffs for agricultural products in Central Asia countries, 2012–2014.

	Kazakhstan		Kyrgyzstan		Tajikistan		Uzbekistan	
	2012	2014	2012	2014	2012	2014	2012	2014
Simple average MFN applied:								
Total	9.5	8.6	4.6	4.6	7.8	7.7	15.4	14.8
Non-agricultural products	8.8	8.1	4.2	4.1	7.3	7.2	14.9	14.2
Agricultural products	13.4	11.6	7.4	7.6	10.8	10.7	19.2	18.8
MFN applied duties by group of agricultural products								
Animal products	23.8	19.7	7.6	7.6	9.6	9.6	13.8	15.3
Cereals and preparation	9.5	7.5	6.8	6.8	6.7	6.7	15.8	15.3
Dairy products	13.2	11.2	7.8	8.3	9.9	9.9	20.3	18.7
Oilseeds, fats and oils	8.5	7.5	5.7	5.9	6.7	6.7	7.2	7.9
Sugars and confectionery	14.9	13.0	4.4	6.0	6.3	6.3	26.3	24.5

Source: WTO ITC UNCTAD 2015.

the short run (Margarido, Turolla, and Bueno 2007). From the studies on price transmission, most of the attention was paid to developed countries in Western Europe or USA. Only few studies can be found focusing on markets in developing and transition countries. Peter (2008) found that the cointegration relationship exists between world and domestic Indonesian rice market and found the elasticity of 0.369, meaning that markets are partially cointegrated. Yavapolkul, Munisamy, and Ashok (2006) observed that the developed and developing countries' rice and wheat markets during the post-Uruguay trade negotiations were only partially cointegrated which means that Uruguay round of the trade negotiation did not improve the world markets to be fully integrated. Baffes and Bruce (2003) presented that only few of the Latin American countries are integrated after the agricultural trade liberalization.

The evidence from literature is diverse and varies irrespective of methodology used and importing or exporting country, small or large country case. Empirical studies generally differ in terms of analysed commodities, countries, time frequencies, time periods and specifications of the models employed (Frey and Manera 2007). Apart from the

trade liberalization, there are many factors that could influence the market integration outcome (as for example non-trade barriers, the policies of domestic and world markets, poor communication and infrastructure that leads to higher transaction costs, competition and so on).

To our knowledge, there are no papers in the literature on price transmission from global to domestic prices in countries of Central Asia. Policy-makers can use our results in evaluating the impacts of global agricultural price changes on domestic agricultural prices and to assess the impact of trade and agricultural policies on domestic prices and price transmission. Our results can also contribute to the discussion on impacts of agricultural and trade policies on food security in Central Asian countries.

4. Econometric methodology

We apply time-series modelling techniques to evaluate horizontal price transmission from world markets to Tajik and Uzbek (region of Khorezm) markets. In this study, an error correction model is employed to quantify the extent, speed and nature of price transmission. As the first step, we test the stationarity of time series using two unit root tests: the augmented Dickey–Fuller (ADF) test and the Phillips–Perron (PP) test. The number of lags of a dependent variable is determined by the Akaike Information Criterion (AIC). If both time series are not stationary, they are suitable to test for cointegration relationship between them. We employ the Johansen approach to test for cointegration. The Johansen's (1988) approach starts with a vector autoregressive model and reformulates it into a vector error correction model:

$$Z_t = A_1 Z_{t-1} + \dots + A_k Z_{t-k} + \varepsilon_t \quad (1)$$

$$\Delta Z_t = \sum_{i=1} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-k} + \varepsilon_t \quad (2)$$

where Z_t is a vector of non-stationary variables (world and domestic prices), A are different matrices of parameters, t is time subscript, k is the number of lags and ε_t is the error term assumed to follow i.i.d. (independent and identically distributed) random process with a zero mean and normally distributed $N(0, \sigma^2)$ error structure. The estimates of Γ_i measure the short-run adjustment to changes in the endogenous variables, while Π contains information on the long-run cointegrating relationships between variables in the model.

5. Data

We use unique monthly price data for selected food products traded in Tajikistan, Uzbekistan and on the world markets. Food products traded in Tajikistan represent wheat, sheep, chicken, rice, beef meat, sugar and soy oil. The data period covers January 2004 to December 2014. Tajikistan prices were converted from local currency TJS somoni to US dollars using current exchange rates obtained from the International Monetary Fund and the National Bank of Tajikistan. The domestic Tajik prices come from the Statistical Office of Tajikistan (Taj Stat 2015), except for the price of wheat. Prices of wheat were obtained from Ilyasov et al. (2014)¹ for the period of 2003–2013 while wheat prices for the year of 2014 come from Taj Stat. Table 5 provides summary statistics of Tajik prices.

The trends of Tajik's domestic prices of the selected food commodities along with world price trends are presented in Figure 3. The agricultural food commodities used in

Table 5. Descriptive statistics of Tajikistan's prices.

Variable	Obs.	Mean	Std. dev.	Min	Max
World/kg					
Wheat	132	0.251	0.072	0.141	0.440
Sheep	132	5.103	0.965	3.746	6.995
Chicken	132	1.901	0.270	1.489	2.512
Rice	132	0.396	0.116	0.194	0.659
Beef	132	3.328	0.860	2.144	5.999
Sugar	132	0.354	0.131	0.128	0.653
Soy oil	132	0.862	0.260	0.460	1.423
Tajikistan/kg					
Wheat	132	0.378	0.119	0.171	0.608
Sheep	132	4.812	1.640	2.529	7.557
Chicken	132	2.687	0.530	1.867	3.832
Rice	132	1.436	0.564	0.437	2.140
Beef	132	4.303	1.615	2.142	7.181
Sugar	132	0.878	0.267	0.480	1.542
Soy oil	132	1.194	0.183	0.901	1.604

Source: Own calculation based on World Bank and Taj Stat data.

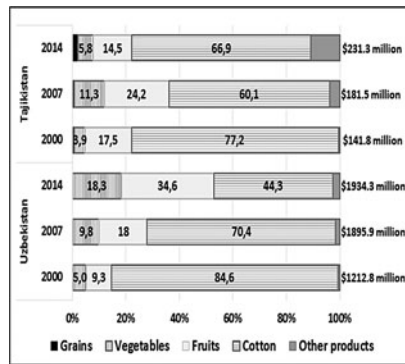


Figure 3. The world and domestic (Tajikistan) price trends for selected food commodities in the period of 2004–2014. Source: Own collaboration based on World Bank and Taj Stat data.

our analysis have a significant share in households' consumption in Tajikistan. According to the Household Budget Survey of Tajikistan,² the share of wheat and bread products made up 25.1%, rice 6.1%, beef meat 12.1%, sheep meat 1.3%, chicken meat 2.4% and sugar 3.9% of households' food expenditures. World prices are reported in US dollars and come from the World Bank database.³ Only in case of Uzbekistan, the world price of butter was taken from the Food and Agriculture Organization Corporate Statistical Database (FAOSTAT).

The data for Uzbekistan represent domestic prices of wheat, maize, barley, rice and butter traded in Khorezm region of Uzbekistan.⁴ The data period covers January 2001 to December 2009.⁵ The commodities and data periods are chosen because of data availability. Uzbek prices were converted from local currency UZB suoms to US dollars using the current exchange rate. All Uzbek prices come from the Statistical Office of Uzbekistan (Uzb Stat 2015) and its Khorezm regional authorities. The summary statistics of Uzbek prices are given in Table 6.

The trends of Uzbek's prices of the selected food commodities along with world price trends are presented in Figure 4. As seen from Figures 3 and 4, Tajik's prices show more

Table 6. Descriptive statistics of Uzbekistan's prices.

Variable	Obs.	Mean	Std. dev.	Min	Max
World/kg					
Wheat	108	0.192	0.072	0.121	0.439
Maize	108	0.131	0.045	0.083	0.287
Barley	108	0.124	0.040	0.082	0.248
Rice	108	0.275	0.117	0.141	0.659
Butter	108	2.133	1.006	0.999	4.609
Uzbekistan–Khorezm/kg					
Wheat	108	0.247	0.140	0.098	0.636
Maize	108	0.240	0.122	0.102	0.522
Barley	108	0.237	0.103	0.100	0.509
Rice	108	0.739	0.359	0.301	2.191
Butter	108	3.394	0.972	1.891	5.611

Source: Own calculation based on World Bank (2015), FAOSTAT (2015) and Uzb Stat (2015).

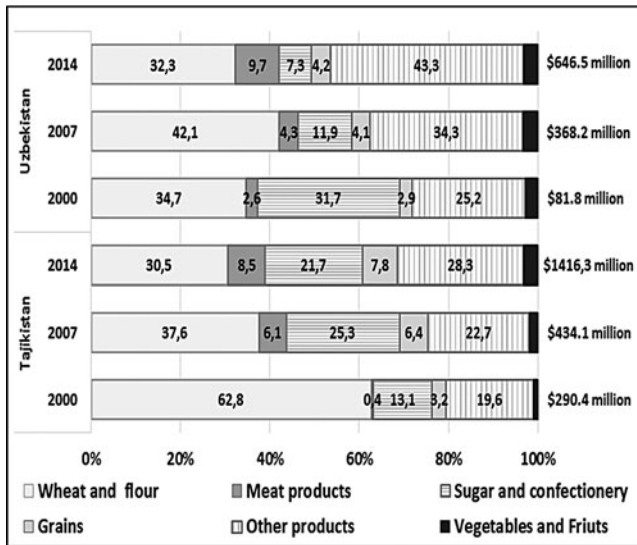


Figure 4. The world and domestic (Uzbekistan) price trends for selected food commodities in the period of 2001–2009.

Source: Own calculation based on World Bank (2015), FAOSTAT (2015) and Uzb Stat (2015).

significant adjustment towards world prices than it is in the case of Uzbek’s prices. This leads to a hypothesis that domestic and world prices in Tajikistan are cointegrated to a higher extent than it is in Uzbekistan.

6. Empirical results and discussion

The ADF and PP tests confirm that all our time series are non-stationary; we stationarized them by taking first differences. The tests indicated that all variables were stationary in first differences (Tables 7 and 8). The AIC determined the lags of the dependent variable in the tests.

Table 7. The augmented Dickey–Fuller and Phillips–Perron tests for Tajikistan's price series.

	Augmented Dickey–Fuller test results				Phillips–Perron test results			
	Level		First diff.		Level		First diff.	
	ADF _c	ADF _t	ADF _c	ADF _t	PP _c	PP _t	PP _c	PP _t
World								
Wheat	–1.856	–2.254	–7.611***	–7.599***	–1.816	–2.157	–8.776***	–8.762
Sheep	–1.519	–2.573	–5.422***	–5.396***	–1.129	–1.900	–7.296***	–7.283***
Chicken	0.114	–2.542	–5.975***	–6.076***	–0.287	–2.074	–5.000***	–5.031***
Rice	–1.969	–1.011	–4.561***	–4.895***	–2.160	–1.833	–10.976***	–11.141***
Beef	–0.173	–2.523	–6.192***	–6.242***	–0.728	–2.816	–6.952***	–6.894***
Sugar	–2.250	–1.936	–5.797***	–5.960***	–2.414	–1.925	–7.574***	–7.710***
Soy oil	–1.723	–1.872	–5.700***	–5.711***	–1.451	–1.229	–7.341***	–7.343***
Tajikistan								
Wheat	–1.942	–2.196	–5.171***	–5.193***	–1.996	–1.874	–10.968***	–11.062***
Sheep	–0.752	–1.882	–6.030***	–6.008***	–0.757	–1.493	–8.432***	–8.400***
Chicken	–1.858	–2.009	–3.632***	–4.324***	–1.479	–1.291	–10.115***	–10.138***
Rice	–2.508	–1.663	–6.239***	–6.606***	–2.267	–1.158	–8.416***	–8.724***
Beef	–1.034	–2.183	–4.034***	–4.015***	–0.686	–1.749	–9.133***	–9.103***
Sugar	–1.789	–1.367	–6.762***	–6.896***	–1.642	–1.452	–9.196***	–9.244***
Soy oil	–2.267	–2.334	–3.632***	–3.112***	–1.586	–1.344	–9.930***	–9.961***

Source: Own calculation.

Note: ADF_c is the ADF with an intercept and ADF_t with an intercept and a deterministic trend. *** denote significance at the 1% significance level. PP_c is the PP with an intercept and PP_t with an intercept and a deterministic trend. *** denote significance at the 1% significance level.

Table 8. The augmented Dickey–Fuller and Phillips–Perron tests for Uzbekistan's price series.

	Augmented Dickey–Fuller test results				Phillips–Perron test results			
	Level		First diff.		Level		First diff.	
	ADF _c	ADF _t	ADF _c	ADF _t	PP _c	PP _t	PP _c	PP _t
World								
Wheat	–1.611	–2.230	–6.038***	–6.029***	–1.436	–1.899	–8.088***	–8.072***
Maize	–1.434	–2.357	–6.331***	–6.300***	–1.229	–2.202	–8.446***	–8.403***
Barley	–1.718	–1.938	–6.048***	–6.032***	–1.718	–2.105	–7.483***	–7.453***
Rice	–0.623	–2.744	–6.585***	–6.554***	–0.383	–3.385*	–10.405***	–10.369***
Butter	–1.281	–3.503**	–3.615***	–3.626**	–0.471	–2.035	–4.624***	–4.629***
Uzbekistan								
Wheat	–1.639	–2.525	–5.574***	–5.598***	–1.517	–1.996	–9.087***	–9.058***
Maize	–1.376	–2.312	–9.195***	–9.174***	–1.291	–2.213	–9.195***	–9.174***
Barley	–1.995	–2.545	–6.307***	–6.305***	–1.803	–2.263	–8.507***	–8.489***
Rice	–2.031	–2.176	–10.579***	–10.561***	–2.087	–2.221	–10.579***	–10.561***
Butter	–1.357	–1.684	–10.094***	–10.373***	–1.376	–1.672	–10.094***	–10.373***

Source: Own calculation.

Note: ADF_c is the ADF with an intercept and ADF_t with an intercept and a deterministic trend. *, **, *** denote significance at the 10%, 5% and 1% significance levels. PP_c is the PP with an intercept and PP_t with an intercept and a deterministic trend. *, **, *** denote significance at the 10%, 5% and 1% significance levels.

Having non-stationary time series we applied Johansen cointegration test, to check whether the prices are cointegrated. Johansen cointegration test⁶ results indicate that most of the prices in Tajikistan are cointegrated with the world prices. There is a cointegrating relationship between world and Tajik prices of wheat, rice, sugar and soy oil. On the other side, there is no cointegrating relationship between world prices and prices in Khorezm region in Uzbekistan (Table 9).

Table 9. The Johansen cointegration test results for Tajikistan and Uzbekistan.

Tajikistan	Rank	Johansen trace statistics	Uzbekistan	Rank	Johansen trace statistics
Wheat	0	33.890	Wheat	0	12.214
	1	4.488***		1	2.139
Sheep	0	11.640	Maize	0	11.437
	1	2.534		1	1.841
Chicken	0	5.862	Barley	0	11.567
	1	2.758		1	2.953
Rice	0	23.396	Rice	0	12.197
	1	8.021**		1	3.420
Beef	0	21.569	Butter	0	9.305
	1	8.446		1	1.608
Sugar	0	24.863			
	1	5.417***			
Soy oil	0	16.965			
	1	2.066**			

Source: Calculated.

Note: **, *** denote significance at the 5% and 1% significance levels.

This is consistent with our expectations. Tajikistan has open agricultural trade with the rest of the world with limited trade barriers only, and therefore Tajik domestic prices reflect the development of the world prices. Uzbekistan, on the other hand, is significantly less connected to the world markets because of its self-sufficiency policy in agriculture. Uzbek prices therefore do not react to changes in the world prices as much as Tajik prices.

Meat prices in Tajikistan are not cointegrated with the world prices, however. There could be several reasons for this. First, poor infrastructure (roads, railways, ...) makes meat trade more erratic. Second, there is bigger product differentiation in meats than in crops. Especially, Tajikistan and Uzbekistan population consists of mainly Muslims, which consume Halal meat, which is differentiated from the regular meat. Halal meat is mainly imported to Tajikistan from Iran, Turkey and Arabic countries. Third, lack of logistics services of refrigerated vans and underdeveloped packaging services have a stronger impact on trade with animal products than on trade with crops. Our finding is in agreement with the Organisation for Economic Co-operation and Development (OECD) conclusion that there are short supply chains for meat in both countries (OECD 2013).

Negative and statistically significant error correction terms in the equations for Tajik wheat, rice, sugar and soy oil prices show that any short-term fluctuations between the world and domestic prices will lead to a long-run relationship. The estimated coefficients indicate that the disequilibrium is corrected. However, within a year, only 18% of Tajik wheat price is corrected which is still the fastest adjustment of prices to shocks occurring at the world markets out of all investigated commodities.

The long-run relationships for individual commodities between the world and domestic prices:

$$\text{tajik_wheat} = 0.577^{***} + 1.105^{***} \text{ world_wheat}$$

$$\text{tajik_rice} = 1.666^{***} + 1.284^{***} \text{ world_rice}$$

$$\text{tajik_sugar} = 0.748^{***} + 0.807^{***} \text{ world_sugar}$$

$$\text{tajik_soy oil} = 0.273^{***} + 0.512^{***} \text{ world_soy oil}$$

Uzbek price series are not cointegrated with the world prices, there is no long-run relationship between world and domestic prices and we can proceed with vector autoregression model to model the short-run dynamics. As seen from Tables 10 and 11, the

Table 11. Adjustment estimates for world and Uzbekistan's prices.

	Wheat		Maize		Barley		Rice		Butter	
	World	Uzb	World	Uzb	World	Uzb	World	Uzb	World	Uzb
(Intercept)	-	-	-	-	-	-	0.015**	-0.010	-	-
X.diff.world.t_1	0.226**	0.284	0.196**	0.262	0.361***	0.195	-0.012	1.082***	0.663***	-0.017
X.diff.world.t_2	-	-	-	-	-0.172**	-0.072	-0.372***	0.213	-	-
X.diff.dom.t_1	-0.498	0.116	-0.052	0.097	0.015	0.187*	0.044	0.075	0.135***	0.010
X.diff.dom.t_2	-	-	-	-	0.010	0.021	-0.055	-0.035	-	-

Source: Calculated.

Note: *, **, *** denote significance at the 10%, 5% and 1% significance levels, Uzb: Uzbekistan, Khorezm region.

prices react mainly on their own previous changes. Very few significant coefficients of Uzbek prices indicate that the price formation is not caused by world price development.

7. Conclusions

Development of agricultural prices has significant welfare effects in Tajikistan and Uzbekistan because the share of agriculture in GDP of these countries is relatively high and consumers spent a significant share of their incomes on food.

Uzbekistan and Tajikistan have a similar range of farm products and food consumption patterns and have adopted similar economic reforms. Notable difference between the countries is in their openness to trade. While self-sufficiency policy of the Uzbek government separated its agricultural sector from the world markets, Tajikistan has adopted relatively liberal agricultural trade regime.

The self-sufficiency policy of Uzbekistan has contributed to low dependence of domestic Uzbek prices on the world agricultural prices. Furthermore, substantial ad hoc state regulations affecting trade in Uzbekistan and significant government involvement in upstream and downstream industries create uncertainty, which has negative impact on trade. This was confirmed by our empirical analysis. There is no cointegration between the world agricultural prices and Uzbek prices.

Tajik crop prices, on the other hand, are cointegrated with the world agricultural prices, which might be a reflection of the more liberal agricultural trade adopted by Tajikistan. However, Tajik domestic prices of animal products are not cointegrated with the world prices. The reason behind this is that there is a significant level of product differentiation between domestic and foreign meat products and lower trade integration due to the insufficient trade infrastructure and institutions which are reflected in short supply chains for meat.

Furthermore, even in Tajikistan, adjustment of domestic prices to shocks occurring at the world markets is relatively slow.

Inadequate infrastructure, geographical location and underdeveloped economic and trade institutions as well as cumbersome trade regulations negatively influence the connection of both Uzbekistan and Tajikistan to the world agricultural markets.

In Central Asia, agricultural and trade policies affect price transmission from world to domestic prices, which can, in the long run, impact allocation of resources economic as well as growth of the sector.

Notes

1. Ilyasov et al. (2014) have estimated wheat markets integration in Central Asia (in case of Tajikistan).
2. Agency on Statistics under President of the Republic of Tajikistan (Taj Stat) has been conducting the Household Budget Survey of Tajikistan quarterly, and each year with the coverage of 3000 households across five regions of country.
3. World price of wheat was taken as the hard red winter wheat (HRW) nominal price; rice as average of three auctions, such as 'Nominal Vietnamese Rice Price - 5%', 'Nominal Thailand Rice Price - 5%' and 'Nominal Thai, A1 Special Rice Price'.
4. Data for Uzbekistan are represented by prices from Khorezm region due to data availability.
5. The difference in time periods for Uzbekistan and Tajikistan are due to constraints on data. However, there is an overlap of five years, and furthermore, this time periods are representative for both countries. Further analysis would be needed when new data become available.
6. Pantula principle was used to determine whether the time trend and the constant term should be included in the model.

Acknowledgment

This work was supported by the Czech Science Foundation (GACR) [grant number 16-02760S].

Disclosure statement

No potential conflict of interest was reported by the authors.

References

- Abbott, P., and A.B. de Battisti. 2011. "Recent Global Food Price Shocks: Causes, Consequences and Lessons for African Governments and Donors." *Journal of African Economies* 20 (suppl 1): 12–62.
- Baffes, J., and L.G. Bruce. 2003. "The Transmission of World Commodity Prices to Domestic Markets Under Policy Reforms in Developing Countries." *Policy Reform* 6 (3): 159–180.
- Djanibekov, N., I. Bobojonov, and J. Lamers. 2012. "Farm Reform in Uzbekistan." In *Cotton, Water, Salts and Soums: Economic and Ecological Restructuring in Khorezm, Uzbekistan*, edited by P. Vlek, J. Lamers, C. Martius, I. Rudenko, A. Manschadi, and R. Eshchanov, 95–112. Netherlands: Springer.
- EBRD-World Bank. 2014. "Business Environment and Enterprise Performance Survey (BEEPS)." Accessed 13 April 2016. <http://data.worldbank.org/data-catalog/BEEPS>
- FAOSTAT. 2015. *The Statistical Data Warehouse (SDW)*. Rome: Food and Agriculture Organization of the United Nations. <http://data.fao.org/>
- Frey, G., and M. Manera. 2007. "Econometric Models of Asymmetric Price Transmission." *Journal of Economic Surveys* 21: 259–325.
- Ilyasov, J., K. Akramov, L. Goetz, and P. Dorosh. 2014. "Market Integration and Price Transmission in Tajikistan's Wheat Markets: Rising like rockets but falling like feathers?" Paper presented at the Regional Research Conference "Agricultural Transformation and Food Security in Central Asia." The University of Central Asia's Institute of Public Policy and Administration (IPPA) and the International Food Policy Research Institute (IFPRI), Bishkek, April 8–9.
- Johansen, S. 1988. "Statistical Analysis of Cointegration Vectors." *Journal of Economic Dynamics and Control* 12: 231–254.
- Lerman, Z., and D. Sedik. 2008. *The Economic Effects of Land Reform in Tajikistan*. Policy Studies on Rural Transition No. 1-2008. Budapest: FAO Regional Office for Europe and Central Asia. <http://www.fao.org/3/a-aq331e.pdf>
- Margarido, M., F. Turolla, and C. Bueno. 2007. "The World Market for Soybeans: Price Transmission into Brazil and Effects from the Timing of Crop and Trade." *Nova Economia* 17 (2): 241–268.
- Nurmetov, K., J. Pokrivcak, and P. Ciaian. 2015. "Rural Reforms and Agricultural Productivity Growth in Uzbekistan." Paper presented at the International Conference of Agricultural Economist, Milan, August 9–14.
- OECD. 2013. *OECD Review of Agricultural Policies: Kazakhstan 2013*. Paris: OECD Publishing. DOI:10.1787/9789264191761-en
- Peter, W. 2008. "The Transmission of Import Prices to Domestic Prices: An Application to Indonesia." *Applied Economics Letter* 15 (7): 499–503.
- Pomfret, R. 2010. "Central Asia After Two Decades of Independence." *WIDER Working Paper 2010/053*. Helsinki: UNU-WIDER.
- Rapsomanikis, G., D. Hallam, and P. Conforti. 2003. *Market Integration and Price Transmission in Selected Food and Cash Crop Markets of Developing Countries: Review and Application*. Commodity Market Review 2003–2004. Rome: Food and Agriculture Organization of the United Nations.
- Rozelle, S., and J. Swinnen. 2004. "Success and Failure: Insights from the Transition of Agriculture." *Journal of Economic Literature* 42 (2): 404–456.
- Spoor, M. 2004. *Agricultural Restructuring and Trends in Rural Inequalities in Central Asia: A Socio-Statistical Survey*. United Nations Research Institute for Social Development, Geneva. Programme Paper No. 13, November.
- Swinnen, J., and P. Squicciarini. 2012. "Mixed Messages on Prices and Food Security." *Science* 335 (6067): 405–406.

- Taj Stat, Dushanbe. 2015. *Agency on Statistics Under President of the Republic of Tajikistan*, Dushanbe. <http://www.stat.tj>
- UNCTAD. 2015. Trade Data. United Nations Conference on Trade and Development, Geneva. <http://unctad.org/en/Pages/Statistics.aspx>
- Uzb Stat. 2015. State Committee of the Republic of Uzbekistan on Statistics, Tashkent. <http://www.stat.uz>
- Vavra, P., and B.K. Goodwin. 2005. "Analysis of Price Transmission Along the Food Chain." OECD/FAO Working Papers no. 3. Paris: OECD Publishing.
- WDI World Bank Data. 2015. *World Development Indicators*. Washington, DC: The World Bank. <http://data.worldbank.org/>
- WTO ITC UNCTAD. 2015. World Tariff Profiles 2015. World Trade Organization, International Trade Centre and UNCTAD, Geneva. https://www.wto.org/english/res_e/booksp_e/tariff_profiles15_e.pdf
- Yavapolkul, N., G. Munisamy, and G. Ashok. 2006. "Post-Uruguay Round Price Linkages Between Developed and Developing Countries: The Case of Rice and Wheat Markets." *Agricultural Economics* 34: 259–272.

Copyright of Journal of International Trade & Economic Development is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.