The Impact of Agricultural and Trade Policies on Price Transmission in Central Asia

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ABSTRACT   This paper investigates the market integration between international and domestic markets in the case of two-transition countries namely Tajikistan and Uzbekistan. More specifically, our study aims to understand the extent and speed of price transmission from international to local market. We have used cointegration techniques to analyse the price transmission mechanism, such as a vector error correction model (VEC). We have found strong cointegration evidences between world market and domestic market of Tajikistan while no cointegration was observed in case of Uzbekistan. Tajikistan has liberal trade while Uzbekistan frequently used protectionist trade policy.

KEYWORDS   price transmission, market integration, agricultural trade, food prices, Tajikistan and Uzbekistan

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 (Swinnen 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 or because of the government policies that attempt to separate world from domestic markets (Rapsomanikis et.al, 2003; Abbotta and Battistib, 2011). 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 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 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

are on a similar level of development 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. Apart from trade policies, two countries are at similar level with respect to the implementation of other economic reforms.

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.

In the next chapters, we briefly describe reform process in Uzbekistan and Tajikistan with emphasis on agricultural sector, provide literature review on horizontal price transmission, describe methodology, and state our results. The last chapter summarizes and draws conclusions.

Transition process in Uzbekistan and Tajikistan

Transition process in Uzbekistan and Tajikistan as well as in other Central Asian countries started after the break-up of the Soviet Union when these countries became independent. However, the real transition towards market economy began in Tajikistan only after the end of the civil war in 1998. During the civil war most of the fixed capital and infrastructure, that survived the collapse of Soviet Union, was devastated and the poverty rate reached 86 percent of the population in 1999, which was an increase from 51.2 per cent in 1989 (Falkingham, 2000). After the war, the country liberalized international trade, including agricultural trade, and started to reform other institutions and policies.

Uzbekistan did not suffer from the civil wars to such an extent as its Tajik neighbour but the economic situation in the country at the beginning of the transition process was not very bright either. Historically both countries belonged among the least developed republics of the Soviet Union. The poverty headcount ratio in Uzbekistan reached 69 per cent in 1998, which was also an increase from 43.6 per cent in 1989. Since independence, economic policy of Uzbekistan stressed self-sufficiency, economic independence, and import substitution (Nurmetov et. al., 2015). In agriculture, emphasis was placed on increasing domestic production of grains at the expense of heavy reliance on cotton production.

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 (Spoor 2004; Rozelle and Swinnen 2004). Table 1 provides the data on the progress of reforms in both countries. 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). 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.

Macroeconomic performances of Tajikistan and Uzbekistan

After the collapse of the Soviet Union both Tajikistan (1991-1998) and Uzbekistan (1991-1995) 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. In the period between 2000 and 2013,

Uzbekistan reported 7 per cent average annual growth of GDP while Tajik average growth of GDP for that period reached even higher 8 per cent per year (Figure 1).

High economic growth rates in that period are 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 per cent of GDP in 2013 (World Bank, 2014). Uzbekistan is only slightly less dependent on remittances than Tajikistan.

After the civil war, macroeconomic stabilization, economic liberalization, restructuring, and privatization of state-owned industrial enterprises, as well as land reforms and restructuring of large collective farms in agriculture also contributed to high growth in Tajikistan (Kimhi and Lerman, 2015; Pomfret, 2010). Gradual implementation of step-by-step economic reforms combined with achievement of economic stability made a significant contribution to economic growth in Uzbekistan despite huge economic distortions in the economy.

Agricultural production and trade

In Soviet times, Tajikistan and Uzbekistan were mainly specialized in production of agricultural commodities and in extraction of natural resources. Particularly, both countries had comparative advantage in cotton cultivation and fruits and vegetables production. Despite of the recent diversification away from cotton, the share of cotton in total agricultural output is still very high. Agricultural sector remains one of the largest sectors of the economy in both countries. The agricultural employment is sizable in relative terms and there exist a strong linkage between agriculture and other sectors of the economy.

After gaining independence, Uzbekistan's economic policy started to focus on industrialization of the country and consequently the share of the agricultural sector in the whole economy has been declining steadily. In the period of 2000 – 2013, the annual growth rate of agricultural sectors in Tajikistan and Uzbekistan reached 8.7 and 5.4 per cent respectively. Table 2 provides the basic data about development of agricultural production and inputs in both countries.

Agricultural contribution to GDP in Uzbekistan decreased from 37.3 per cent in 1991 to 18.1 per cent in 2013. Overall, the agricultural employment decreased from 42 in 1991 to about 27.4 per cent over the period 2005-2012. In contrast, the share of agricultural production in GDP remained stable at the average level of 24.6 per cent in Tajikistan during the last decade.

Uzbekistan after refocusing its agricultural production from cotton monoculture towards grains, livestock, and fruits and vegetables reached significant levels of self-sufficiency. However, self-sufficiency policy of the Uzbek government separated largely its agricultural sector from the world markets. 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 to mainly diversify agricultural crop production and to increase self-sufficiency for selected crops, which resulted in growth of grain, fruits, vegetables, and partly livestock production. In particular, wheat production increased from 166.4 thousand tons in 1992 to 812.6 thousand tons in 2012, which is 52 per cent of self-sufficiency ratio. The self-sufficiency ratio in wheat in Uzbekistan is 91.5 per cent (see Table 3).

Cotton and wheat are major crops in Uzbekistan and their production and trade is strongly regulated by the state. Cotton is exclusively sold through the state procurement system. Wheat is marketed both through the state procurement system (50 per cent) and through open market (50 per cent). 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). To a lesser extent, these policy interventions are applied in Tajikistan too.

In Uzbekistan, state often regulates domestic prices for selected agricultural products. For example, meat prices are often regulated in the case when there is meat shortage on domestic market. These state market interventions create uncertainty to agricultural producers in planning production (Nurmetov et al., 2015; Lerman and Sedik 2008; Djanibekov et al, 2012). At input markets, cotton and wheat farms receive credits under favourable conditions in Uzbekistan. 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 per cent of the production contracted by Uzbek government. Small peasant farms (dekhans) do not have access to favourable credits so they have to purchase inputs on free markets at higher prices. Uzbek dekhans, however, are not subject to any output regulations like bigger commercial private farms. Water supply is administered by Water Consumers Associations, which are under Uzbek government control. Cotton and wheat farms are main consumers of water. Water supply is free; there is only symbolic payment for supplied water. However, in all input markets there is a strong state involvement, which is used by Uzbek policy-makers to exert influence on production and trade decisions of farmers.

Tajikistan does not have good conditions for agricultural production, as only 6.1 per cent 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. Figures 2 and 3 provide 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. Figures 4 and 5 show the volume of food export and import by specific food commodities in Tajikistan and Uzbekistan.

Higher reliance on food imports makes Tajikistan more vulnerable than Uzbekistan to volatility of global food prices. Uzbekistan and Tajikistan have signed Free Trade Agreement1 (FTA) within the framework of CIS that applies zero import tariffs in mutual trade with few exemptions (Akramov and Mogilevskii, 2014). However, there are still important impediments to trade in both countries including non-tariff measures, inferior trade infrastructure, and high corruption at regulatory and administrative level.

Table 4 shows the applied *Most Favored Nations (MFN)* tariffs for four countries in Central Asia. Uzbekistan has significantly higher import tariffs on agricultural and food products than Tajikistan.

The level of trade openness (measured as a ratio of trade to GDP) for all four Central Asian countries during the period between 2000 and 2013 is presented in Figure 6. Tajikistan has a significantly higher degree of trade openness than Uzbekistan.

Price transmission mechanism

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[1]The government of Tajikistan had not yet ratified this agreement by the end of 2013, while Uzbekistan authorities acceded to the FTA on special conditions. The main reason behind of these special conditions allow the authorities of Uzbekistan to refrain from offering national regime to other parties and from unchangeable by WTO rules and norms, to which this FTA repeatedly refers, till Uzbekistan's WTO accession or 2020 (Akramov and Mogilevskii, 2014).

The price transmission was typically analyzed 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 the short run (Margarido et al., 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 et al. (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.

In previous literature such as Enders and Siklos (2001), Meyer (2004), Sarno et al., (2004), the standard cointegration has been highly criticized. Goodwin and Piggott (2001) have used threshold cointegration in US corn and soybean markets and found the presence of threshold effects in price transmission process. Sanogo and Maliki (2010) have analyzed the market integration between Nepal and India using threshold model and confirmed the presence of threshold effects. However, the evidence from literature is diverse and varies irrespective of methodology used and importing or exporting country, small or large country case. By more detail, many of empirical studies consisted from the different structural stories, in term of the commodities analysed, countries, time frequencies, periods and model specification (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).

Econometric methodology

We apply time-series modeling 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 (VEC):

$$Z_t = A_1 Z_{t-1} + ... + A_k Z_{t-k} + \varepsilon_t \tag{1}$$

$$\Delta Z_t = \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-k} + \varepsilon_t \tag{2}$$

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. 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.

Data

We use unique monthly price data for selected agricultural commodities traded in Tajikistan, Uzbekistan and on the world markets. Agricultural commodities traded in Tajikistan represent wheat, rice, beef meat, sheep meat, chicken, sugar, and soy oil. The data period covers January 2004 to December 2014. Tajikistan prices were converted from local currency TJS-somoni to USD 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), except for the price of wheat. Prices of wheat were obtained from Ilyasov et.al, (2014)[2] 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 7. The agricultural food commodities used in our analysis have a significant share in households' consumption in Tajikistan. According to the Household Budget Survey of Tajikistan (*HBST, 2014)[3]*, the share of wheat and bread products made up 25.1 percent, rice 6.1 percent, beef meat 12.1 percent, sheep meat 1.3 percent, chicken meat 2.4 percent and sugar 3.9 percent of households' food expenditures. World prices are reported in US dollars and come from the World Bank database[4]. Only in case of Uzbekistan, the world price of butter was taken from FAOSTAT.

The data for Uzbekistan represent domestic prices of wheat, maize, barley, rice and butter traded in Khorezm region of Uzbekistan. The data period covers January 2001 to December 2009. 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

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[2]Ilyasov et.al. (2014) have estimated wheat markets integration in Central Asia (in case of Tajikistan)
[3] Agency on Statistics under President of the Republic of Tajikistan (Taj Stat) has conducting the Household Budget Survey of Tajikistan (2014) quarterly, and each year with the coverage of 3,000 households across five regions of country (HBST, 2014).
[4]World price of wheat was taken as the 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".

Uzbek prices come from the Statistical Office of Uzbekistan (Uzb Stat) 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 8.

Empirical results and discussion

The Augmented Dickey-Fuller and Phillips-Perron 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 (Table 7 and 8). The Akaike Information Criterion (AIC) determined the lags of the dependent variable in the tests.

Having non-stationary time series we applied Johansen cointegration test, to check whether the prices are cointegrated. Johansen cointegration test[5] 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).

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 makes meat trade more erratic. Second, there is

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[5]Pantula principle was used to determine whether the time trend and the constant term should be included in the model.

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, poor transport infrastructure, 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.

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 percent 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:

$$tajik\_wheat = 0.577^{***} + 1.105^{***} world\_wheat$$

$$tajik\_rice = 1.666^{***} + 1.284^{***} world\_rice$$

$$tajik\_sugar = 0.748^{***} + 0.807^{***} world\_sugar$$

$$tajik\_soyoil = 0.273^{***} + 0.512^{***} world\_soyoil$$

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 (VAR) model to model the short run dynamics. As seen from Table 10 and Table 11, the 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.

Conclusions

Development of agricultural prices has significant welfare effects in Tajikistan and Uzbekistan because the share of agriculture on GDP of these countries is relatively high and consumers spent a significant share of their incomes on food. Inadequate infrastructure, geographical location, and underdeveloped economic and trade institutions as well as cumbersome trade regulations negatively influence the connection of Uzbekistan and Tajikistan to the world agricultural markets.

Uzbekistan and Tajikistan are at similar level of development and have adopted to similar economic reforms. Notable difference between the countries is in their openness to trade. Tajikistan has adopted more liberal agricultural trade regime than Uzbekistan.

The self-sufficiency policy of Uzbekistan has contributed to low dependence of domestic Uzbek prices on the world agricultural prices. There is no cointegration between the world agricultural prices and Uzbek prices. 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.

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, prices of animal products are not cointegrated with the world prices. 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.

Furthermore, even in Tajikistan adjustment of domestic prices to shocks occurring at the world markets is relatively slow. Agricultural and trade policies affect price transmission from world to domestic prices. Liberal trade policies improve integration of domestic markets to world markets, which can in the long-run lead to higher economic growth of the sector and more efficient allocation of resources. Price transmission from the world prices to local prices in Tajikistan and Uzbekistan might be strongly affected by the following aspects: trade monopolies, market power in

upstream and downstream industries, the level of development of infrastructure, access to international markets via neighbouring countries, development of food processing industry, non-tariff barriers, uncertain regulatory environment and others.

Obstacles to agricultural trade need to be dealt with by policy makers to cope with the food security problems in Central Asia.

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Table 1. The EBRD transition and reforms indicators of Tajikistan and Uzbekistan

	TAJIKISTAN			UZBEKISTAN		
	1999	*2008*	*2012*	*1999*	*2008*	*2012*
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 & 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 & interest rate liberalization	1.00	2.33	-	1.67	1.67	-
Securities markets & non-bank financial instit.	1.00	1.00	-	2.00	2.00	-
Overall infrastructure reform	1.00	1.33	-	1.33	1.67	-

Source: EBRD, 1999, 2008, 2012 and Pomfret, (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

Figure 1. Tajikistan and Uzbekistan's annual percentage growth rate of GDP, 1990-2013
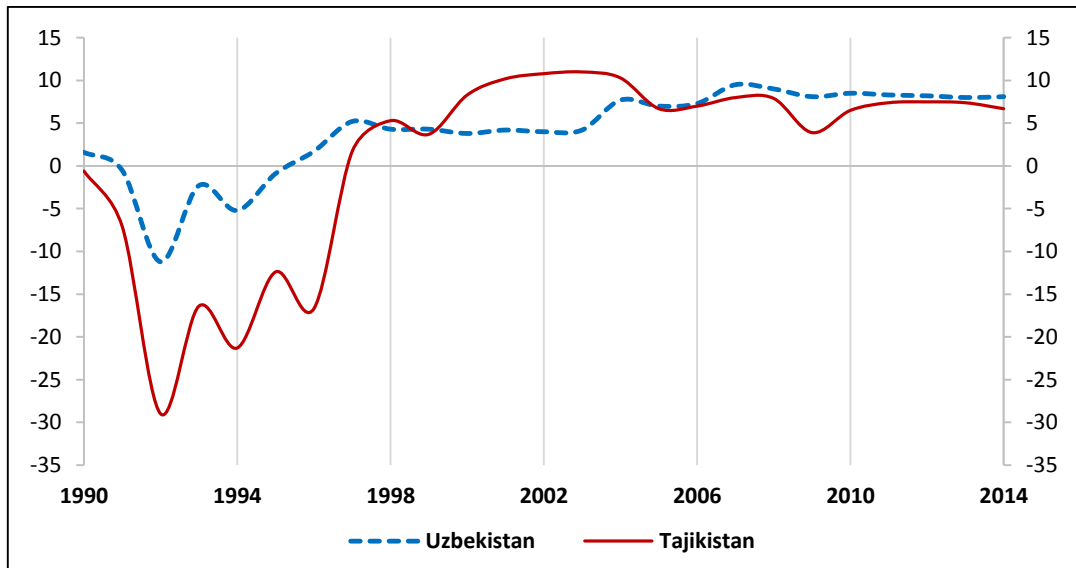
Source: own elaboration based on data of Taj Stat and Uzb Stat, 2014

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)	*14310*	*14310*	*14255*	*42540*	*42540*	*42540*
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 hectare)*	273.5	417.2	418.2	1225.3	1615.9	1615.6
Permanent crop land *(% of land area)*	0.9	0.8	1.0	0.9	0.8	0.9
Cereal yield *(kg per hectare)*	994.0	2164.0	2798.0	1777.0	4042.0	4766.0
Fertilizer consumption *(kg.per hec. arable land)*	-	37.8	58.7	-	-	203.9
Crop production index *(2004-2006=100)*	76.1	97.9	151.1	83.3	100.2	144.4
Livestock production index *(2004 2006=100)*	113.8	102.3	163.9	77.5	99.5	165.8
Cereal production index *(2004 2006=100)*	30.6	102.4	134.0	38.4	102.6	122.3
Food production index *(2004-2006=100)*	90.8	98.2	155.7	73.6	98.0	163.3
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
Note: [a]data for 1991, [b]data for 2012

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

		Tajikistan			Uzbekistan		
		1992	*2002*	*2012*	*1992*	*2002*	*2012*
	Domestic production ('000 ton)	166.4	544.6	812.6	964.0	4967.4	6612.2
Wheat	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
	Domestic production ('000 ton)	20.2	50.2	82.4	538.9	175.1	325.7
Rice	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
	Domestic production ('000 ton)	5.2	0.1	7.5	38.8	10.1	30.0
Chicken meat	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
	Domestic production ('000 ton)	93.4	53.0	76.5[a]	325.4	394.9	1086.0[a]
Fruits	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]
	Domestic production ('000 ton)	327.1	289.6	1017.5[a]	2522.1	1855.2	4729.1[a]
Vegetables	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
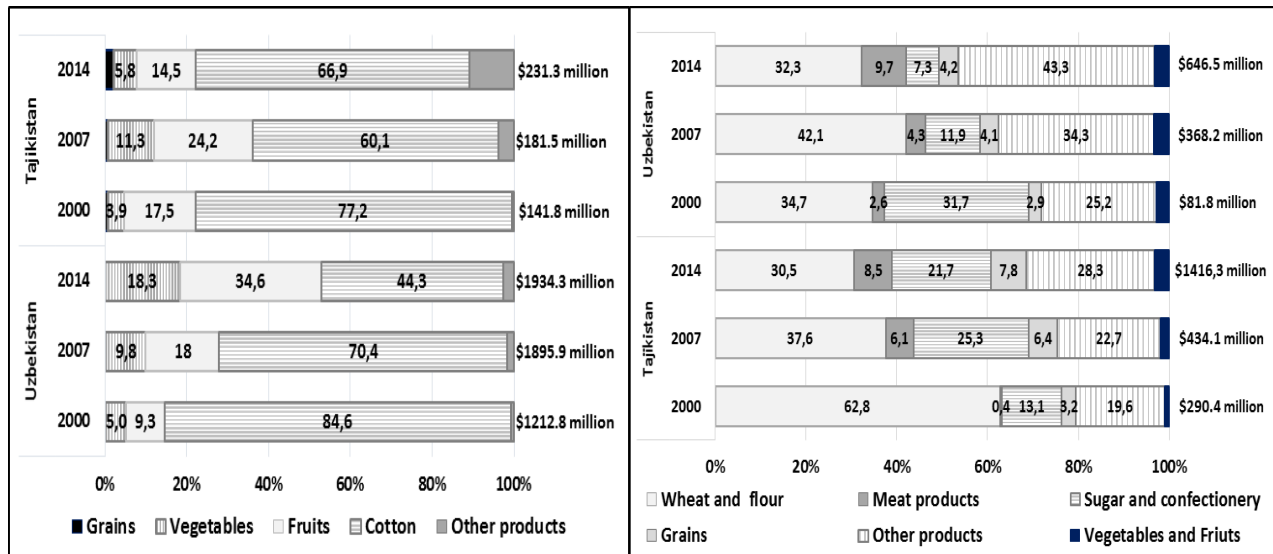*Note: [a]estimated data are 2011*

Figures 2-3. The volume of food trade turnover of Tajikistan and Uzbekistan, 1995-2013
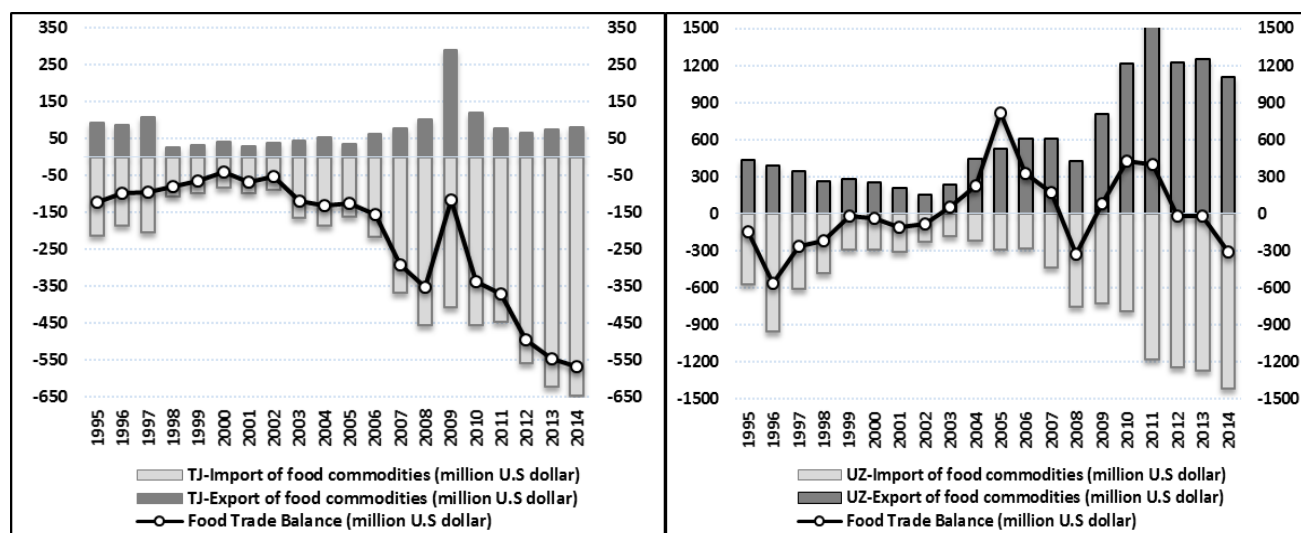
Source: own elaboration based on UNCTAD data, 2015.
Note: (the left figure presents Tajik and right Uzbek data)

Figures 4-5. The volume of export and import by group of food products, 1995-2013


Source: own elaboration based on UNCDAT data, 2015.
Note: (the left figure presents export and right imports)

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 prod.	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
Fruit, vegetables, plants	19.2	16.7	10.8	10.8	12.5	12.5	17.3	15.8
Coffee, tea	11.0	9.7	9.7	9.7	12.0	11.9	29.0	29.0
Cereals & 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 & oils	8.5	7.5	5.7	5.9	6.7	6.7	7.2	7.9
Sugars & confectionery	14.9	13.0	4.4	6.0	6.3	6.3	26.3	24.5
Beverages & tobacco	30.9	27.6	15.1	14.7	31.2	31.1	31.6	27.3
Other agricultural prod.	5.6	5.3	2.2	2.5	6.5	6.1	10.7	10.5

Source: WTO, World Tariff Profiles 2013-2015

Figure 6. Trade openness ratio of Tajikistan and Uzbekistan compared to others Central Asia Countries (2000-2013)
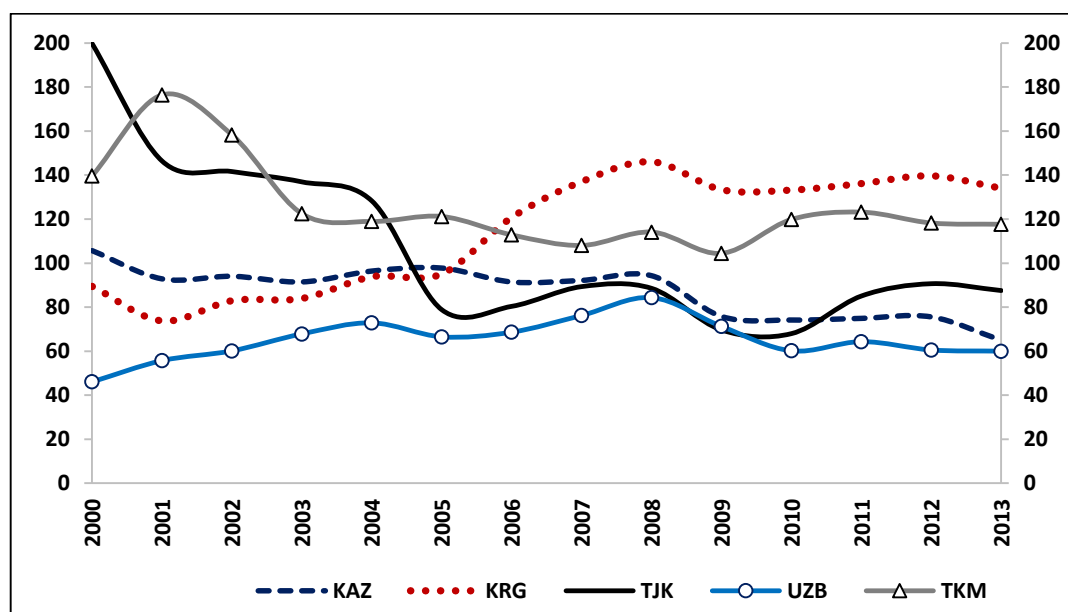
Source: Own calculation based on World Bank Data, 2015

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 7: The world and domestic (Tajikistan) price trends for selected food commodities in the period of 2004-2014
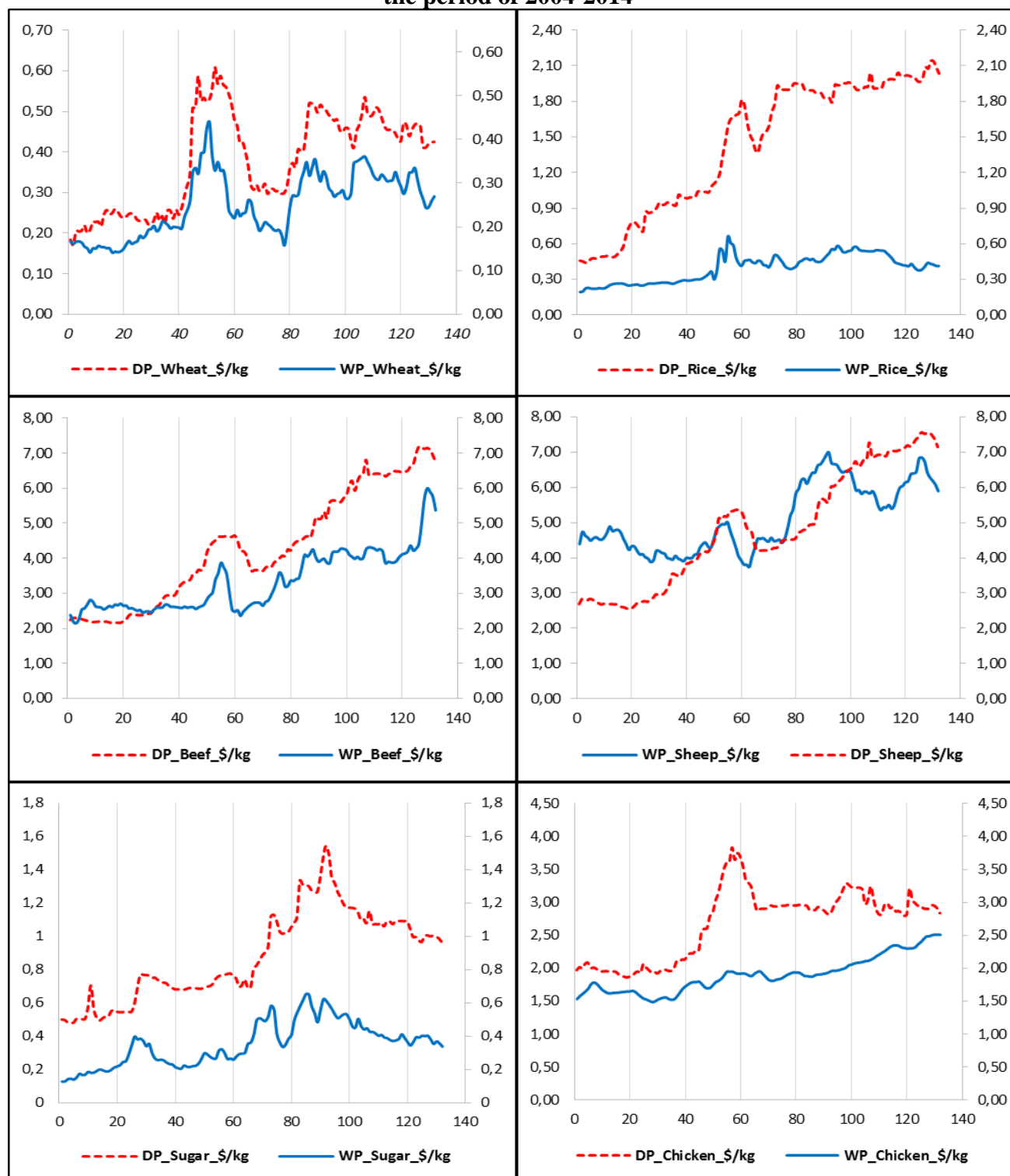
Source: own collaboration based on *World Bank and Taj Stat data*

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, FAO and Uz Stat.

Figure 8. The world and domestic (Uzbekistan) price trends for selected food commodities in the period of 2001-2009
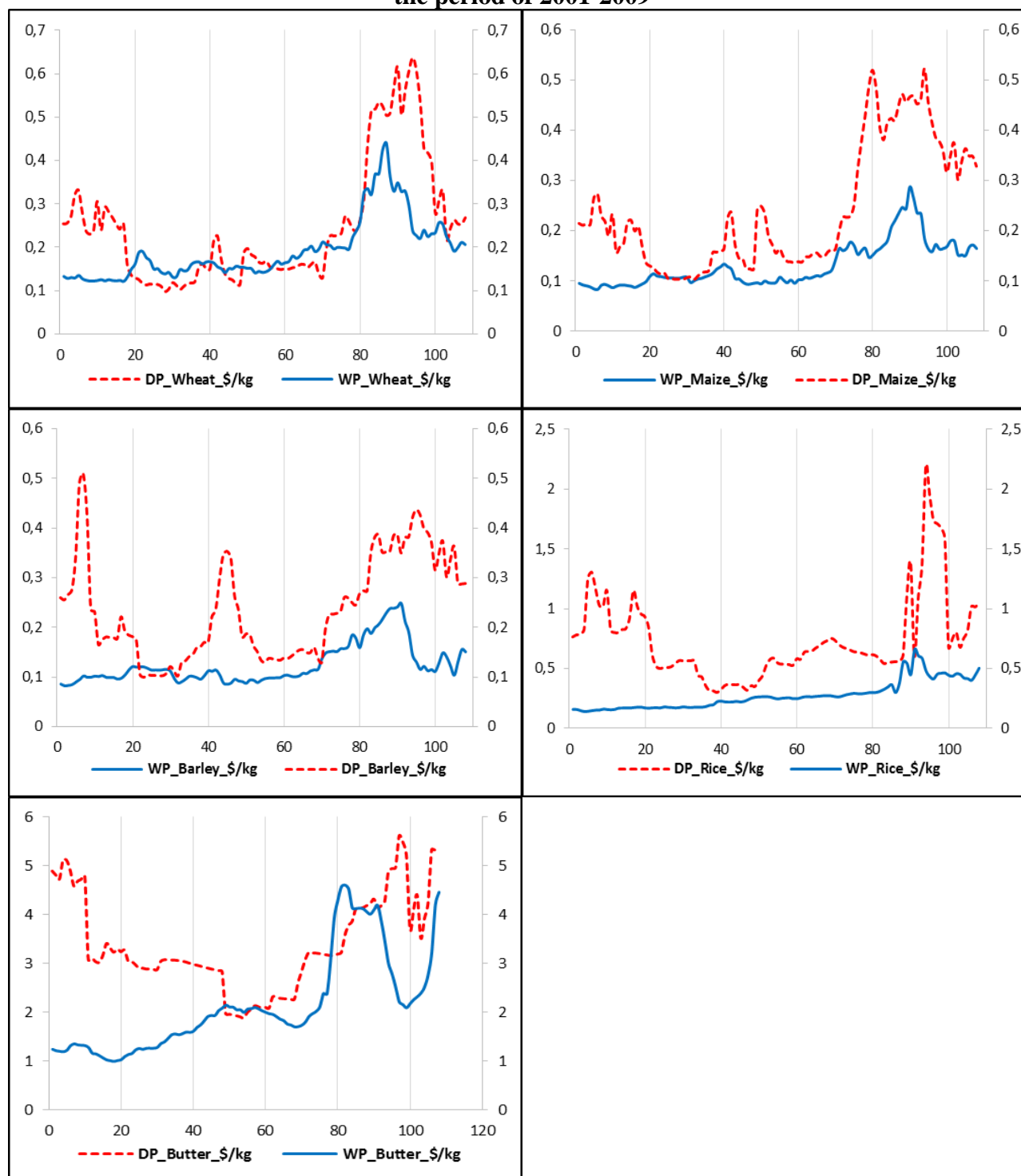
Table 7. The Augmented Dickey-Fuller and Phillips-Perron tests for Tajikistan's price series

| | *Augmented Dickey Fuller test results* | | | | *Phillips Perron test results* | | | |
| | **Level** | | **1ˢᵗ Diff** | | **Level** | | **1ˢᵗ 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%, 5%, and 10% significance levels. PP_c is the PP with an intercept and PP_t with an intercept and a deterministic trend. *, **, *** denote significance at the 1%, 5%, and 10% significance levels.

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** | | **1ˢᵗ Diff** | | **Level** | | **1ˢᵗ 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 1%, 5%, and 10% significance levels. PP_c is the PP with an intercept and PP_t with an intercept and a deterministic trend. *, **, *** denote significance at the 1%, 5%, and 10% significance levels.

Table 9. The Johansen co-integration test results for Tajikistan and Uzbekistan

	Rank	*Johansen trace statistics*		*Rank*	*Johansen trace statistics*
Tajikistan			*Uzbekistan*		
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***			
Soyoil	0	16.965			
	1	2.066**			

Source: calculated

*Note: *, **, *** denote significance at the 1%, 5%, and 10% significance levels.*

Table 10. Adjustment estimates for world and Tajikistan's prices

	Wheat		Sheep		Chicken		Rice	
	World	*Taj*	*World*	*Taj*	*World*	*Taj*	*World*	*Taj*
(Intercept)	-	-	-0.001	0.004**	-	-	-	-
X.diff.world.t_1	0.296***	0.037	0.433***	0.049	1.008***	-0.200	0.059	0.008
X.diff.world.t_2	-	-	-	-	-0.293**	0.485	-	-
X.diff.world.t_3	-	-	-	-	-0.084	-0.253	-	-
X.diff.domestic.t_1	0.162*	-0.009	0.098	0.287***	0.031	0.118	0.124	0.25***
X.diff.domestic.t_2	-	-	-	-	0.024	0.060	-	-
X.diff.domestic.t_3	-	-	-	-	0.005	0.159*	-	-
ECT.t_1	-0.091**	-0.182***	-	-	-	-	0.016	-0.049***

	Beef		Sugar		Soy oil			
	World	*Taj*	*World*	*Taj*	*World*	*Taj*		
(Intercept)	0.003	0.007***	-	-	-	**-**		
X.diff.world.t_1	0.445***	-0.035	0.432***	0.144*	0.389***	0.026		
X.diff.world.t_2	-	-	-0.110	-0.206***	-	-		
X.diff.domestic.t_1	0.048	0.227***	0.127	0.072	0.304*	0.133		
X.diff.domestic.t_2	-	-	-0.194	0.005	-	-		
ECT.t_1	-	-	0.017	-0.144***	0.117*	-0.100***		

Source: calculated

*Note: *, **, *** denote significance at the 1%, 5%, and 10% significance levels, Taj:Tajikistan*

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	-	-	-	-	-0.175*	-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 1%, 5% and 10% significance levels, Uzb: Uzbekistan, Khorezm region*