Price dispersion in neighboring countries in the Western Balkans - the case of the Macedonian tomato industry

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Abstract

The aim of this paper was to analyze the degree of change in price and co-movement of prices between markets. The distinctiveness of the study is that it introduced a single product (highly perishable product) price relationship analysis between a pair of spatially separated markets in the countries of the Western Balkan. This study attempts to comprehend to what extent the Macedonian domestic market is integrated into the regional markets, as well as to understand the relationship between the spatially separated regional markets. The data refer to the domestic Macedonian market and four different regional markets (Croatia, Serbia, Kosovo and Montenegro), as major importers of Macedonian fresh tomatoes. These countries were part of a common market until the 1990's and in the past period transited to a market economy. The method used is common time series analysis through unit root test, co-integration test and causality test. The study showed that the Macedonian economy, especially in terms of the tomato industry, is highly vulnerable and dependant on external markets. Future developments do not only depend upon the advances in the country, but also on developments in the export destinations. This also applies to the other concerned countries in the regions. The main finding is that a small country such as Macedonia is absorbed by developments in other countries in the region. This finding is supported by the results of the study that demonstrated a high level of co-integration between the domestic and regional markets.

Keywords: Co-movement of prices, price dispersion, price transmission, spatially separated markets, Western Balkan countries

Introduction

The agricultural sector in the Republic of Macedonia generates around 10% of the Gross Domestic Product (GDP) and is one of the main contributors to the employment and revenue for the economy (SSO, 2011). The agricultural sector in the country is characterized by a large number of small family farms and fewer agricultural companies, manly emerging from the ex-kombinats (Dimitrievski and Ericson, 2010). Vegetable production is one of the major agricultural sub-sectors generating one-third of the agricultural GDP. Besides being a significant source of national income, this sub-sector employs a large number of the population and is identified as strategic with high development potential. Additionally, fresh vegetables traditionally represent an important part of the Macedonian agricultural exports, especially region-wise.

Twenty years ago, a significant part of the present Balkan regional market was part of the single Yugoslav market, but due to developments in the 1990's, seven new markets were formed within the independent states. The trade, cultural and personal links are strong between Yugoslavia's seven successor states; the seven countries are too small to function as fully independent markets on their own - with a combined population of some 22 million, with similar language and cultural patterns, they make an "attractive market" (The Economist, 2010).

In small countries such as Macedonia, where farms are small and diverse with an average of 1.7 ha per farm, farmers tend to cultivate high value products also known as "cash products", such as tomatoes. Tomatoes are a quantity driven export category. Namely, 80% of world tomato exports come from top six exporting countries and 91% from the top ten countries (www, FAO). The top tomato global exporters include Spain, Mexico, Canada, the United States, Italy, France, and Turkey. The number of suppliers of fresh tomatoes increased and consequently the competition in this industry intensified significantly in the past decade (the average annual growth rate of the total value in global terms increased by 10% from 2002 to 2006). Nevertheless, the quantities remained rather stable. This minimal growth in terms of volume demonstrated that higher price per unit was behind the growth in total value. Turkey is the fastest growing exporter of tomatoes in the world last decade, reaching growth rates of 25% in total value in the last few years (www, FAO).

In the Macedonian context, tomatoes, along with cabbage, potatoes, peppers and watermelons, belong to the group of so called "strategic" commodities. These vegetable crops are most common in the country and largely exported. Out of the total agricultural exports from Macedonia in 2009, 254 million USD or 20,6% accounted for these six commodities. The total value of exports for these six commodities amounted 52 million USD in 2009 (SSO, 2010). The total quantity of fresh vegetables exported from Macedonia during the first three quarters of 2009 was 118,000 tons (*ibid*). The major share of fresh vegetable exports value belonged to tomatoes (47%) followed by cabbage (17%), peppers (14%) and cucumbers (13%).

A market oriented agricultural sector tends to produce commodities demanded by the markets. In the past decade, tomatoes and cabbage experienced the largest growth

in exports to foreign international markets. Macedonian tomatoes are largely exported to the neighboring markets. Almost 80% of the total exports went to the Balkan countries market. Some of the Macedonian neighboring countries are part of the EU-27 market, countries such as Bulgaria and Greece. The value of exports of tomato increased from 2.8 million USD in 1999 to 22.5 million USD in 2007 (SSO, 2010). Although there was a stable growth of the Macedonian tomato exports in quantity and value in the last decade, in 2009 the value for the first nine months decreased by 9% in comparison with the same period in 2008 (Figure 1). Even though there was decrease in value, the average price increased by 10%. Some believe that this was the case because of the economic crisis that occurred that year. However, in 2008 the annual value of exports increased by 26% over 2007.

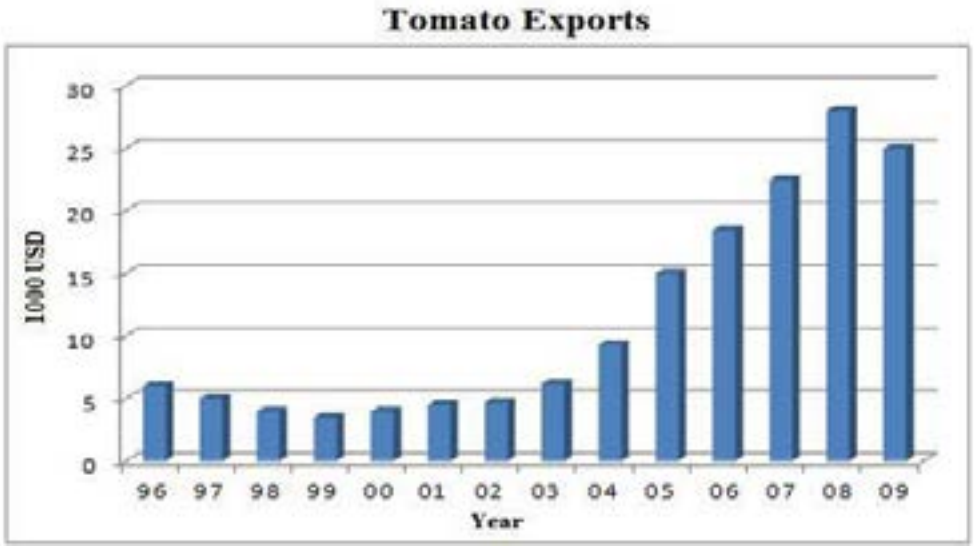

Figure 1. Total value of fresh tomato exports in Macedonia for the period January 1996 - September 2009 (SSO, 2010)

The largest importers of Macedonian tomatoes in 2009 in terms of value were Serbia with Kosovo and Montenegro (71%), Croatia (7%) and Bulgaria (7%). The remaining 15% were exported to other countries, such as Slovenia, Romania, Greece, Poland, Russia, Albania and others. For this reason, only the large importing countries markets were considered in this study.

High fluctuation of prices is equal to high risk. Therefore, lowering the uncertainty reduces the volatility of prices. Price is the primary mechanism by which various levels of the market are linked. Prices tend to increase or decrease because of different reasons, but mainly as a result of supply and demand fluctuations (Kohls and Uhl, 2002). Any change in prices affects not just the relationship between individuals, groups and nations, but, a change in price affects even the export revenues and national incomes of the countries (Goodwin and Holt, 1999). Agricultural production in many countries around the world is subject to considerable

interventions on different bases. Therefore, a gap between domestic and international prices is often created suggesting that this market is not integrated and efficient. Prices are determined through a complex interaction between supply and demand, but are also affected by interventions and protections. Hence, many factors interact to determine the price.

The degree of change in price and co-movement of prices between markets were analyzed in this study. The uniqueness of the research study is that it introduced a single product price relationship analysis between a pair of spatially separated markets in the countries of the Western Balkan. The main objective of this study was to comprehend to what extent the Macedonian domestic market is integrated into the regional markets, as well as to understand the relationship between these spatially separated markets. These fresh products, such as tomatoes, are highly perishable, with high value and are expected to be characterized by a fast rate of price transmission in a perfectly competitive market. Last but not least, this paper examined if the regional agricultural market prices influenced the domestic retail market prices (Figure 2).

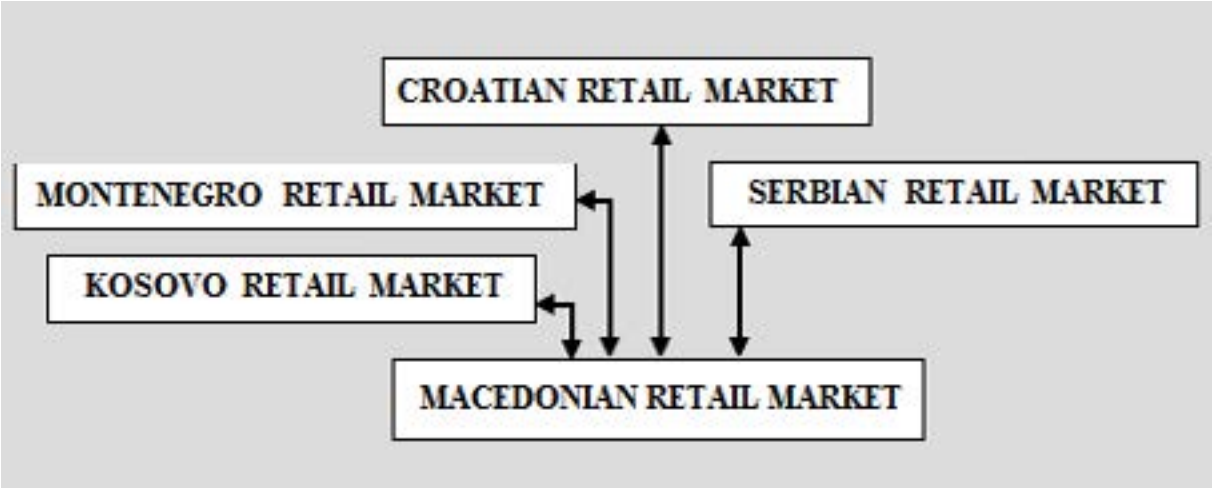

Figure 2. Price integration and spatial price transmission between domestic and regional markets

Due to the lack of relevant data, Slovenia and Bulgaria were excluded from this study. We found no recent studies regarding this issue of “tomato price transmission” in the Balkans. Moreover, no similar cases of price transmission in markets formed due to the break-down of a single market (such as ex-Yugoslavia) were studied, not even in the case of the Soviet Union where several new markets emerged but no such recent research was found.

Data and methods

The market integration and direction of price changes were analyzed in this paper. Numerous studies use common time series econometric analysis techniques to test the co-movement of prices. The development of these techniques includes co-integration and error correction models. Undoubtedly, these techniques may provide

evidence of market integration and price transmission and with these techniques in mind, the focus of the investigation is on integration and direction of causality. This is essential to accomplish the objectives. Time series models have small data requirements compared to other methods; they rely on price series only, which are available for all concerned markets in this study. The method with the techniques applied on the time series in this research is described in the following figure (Figure 3).

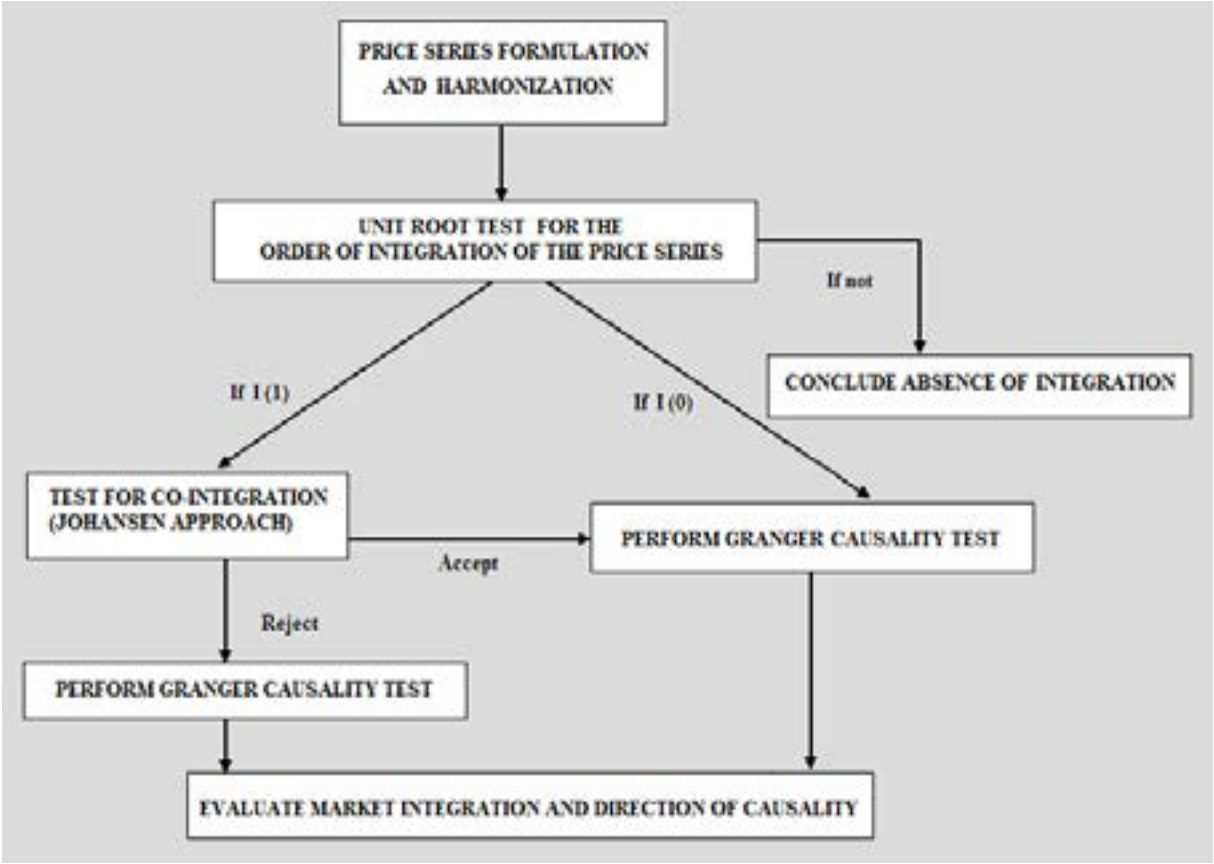

Figure 3. Market integration and causality direction - methodology applied

The monthly price data series for several years were analyzed using the above mentioned techniques. The data refer to the domestic market and four different regional markets (Croatia, Serbia, Kosovo and Montenegro), as major importers of Macedonian fresh tomatoes. The data were collected through the following major sources: Market Information System in Agriculture of Croatia (www, TISUP), Agro-Marketing Information System of Montenegro (www, AMSM), Market information system (www, FOODKS), Macedonian Ministry for Agriculture, Forestry and Water Economy (www, MAFWE) and the Food and Agriculture Organization of the United Nations (www, FAO).

Time series econometric analysis techniques were used to test for price co-movement in these markets. These techniques are a standard tool for analyzing spatial market relationships. The STATA general-purpose computer statistical software package was used to perform different tests on the time series data. An

error correction mechanism was applied in order accurately test for long run relationships. The first objective of the method presented above (see Figure 3) was to provide evidence of market integration and co-movement of prices. The second objective was to test the assertion that changes in prices at one market p1 are transmitted to the other market p2, at all points of time. Therefore, the sequences of the tests applied follow the scheme as described below;

The first step, for each pair of prices (domestic and regional) was to test the order of integration using unit root test. The literature review suggested using the Augmented Dickey-Fuller ADF (Dickey and Fuller, 1979) or the Phillips Perron Unit Root Test (Phillips and Perron, 1988). The motivation to use the Phillips Peron Unit Root test was because it is more reliable and more recent than the Dickey Fuller Test. Then, if discovered that the series have a diverse order of integration, we conclude absence of integration, *i.e.* that the markets are not integrated. The second step, if established that the price series were in I(0) order (the markets are integrated), the Granger Causality test was applied within a Vector Auto Regression (VAR) framework, in order to test the causality between the concerned markets.

The third step, given that the tests reveal that the series were integrated of the same order I(1), was to perform two possible tests on price series: (1) the null hypothesis of non co-integration against the alternative hypothesis of one co-integrating vector applying the Johansen procedure (Johansen and Juselius 1994), or (2) the null of non co-integration following Engle and Granger (1987). Evidence towards the null hypothesis of no co-integration was used to show that prices co-move and that markets were integrated. No test for restrictions on the co-integrating parameter estimate beta were performed, because the assumptions about the extent of price transmission based on the range of this parameter were in general misleading. If discovered that the null hypothesis of non co-integration was not rejected then it could be concluded that the markets were not integrated, and thereby we were not able to conclude the existence of price transmission between the two markets.

Step four, if the previous test points out that price series were co-integrated, then the Granger causality test was to be performed next, with focus on the Error Correction. The form of a Vector Error Correction Model (VECM) was used to examine the short run dynamics, as well as the speed of adjustment. But, in this case, the direction of Granger causality in the long run following Granger (1988) was tested.

Unit root test

Phillips–Perron Unit root test is used in statistics analyzing time series. In this case, time series with prices from two spatially separated markets, one domestic and one international were analyzed. This test was used to check if the null hypothesis of the time series was I(1). Subsequently, we conclude the order market integration. This test was built on the Dickey–Fuller test bases, but modified. The PP test model was:

$$yt = c + dt + a\ yt - 1 + e(t),$$

whereas the e(t) was the innovation process. The test assesses the null hypothesis under the model variant appropriate for series with different growth characteristics (*c* = 0 or *d* = 0). As, the augmented Dickey–Fuller test and the PP test addressed the issue that the process producing data for Yt may have a higher order of autocorrelation than it was admitted in the test equation, therefore making Yt − 1 endogenous. Please note, that in this unit root test, 3 lags were applied. The number of lags was determined by Akaike Information Criterion, AIC.

Co-integration test

If two prices in spatially separated markets p1t and p2t included stochastic trends and were integrated of the same order, then the prices were considered to be co-integrated if:

$$p1t - \beta p2t = ut$$

The β was representing a co-integrating vector, and at the same time the equation was considered to be of co-integrating regression. The above relationship could be estimated by the Ordinary Least Squares (Engle and Granger, 1987) or by the Full Information Maximum Likelihood approach developed by Johansen (1991).

The prices p1t and p2t were considered to be co-integrated if there was a linear combination between them that does not have a stochastic trend. Co-integration entails the prices to move closely together in the long run, even though in short run they might drift apart.

According to Engle and Granger (1987), one can test the null hypothesis of no co-integration by applying unit root tests on the parameter ut. Well-known statistics unit root tests are the Augmented Dickey Fuller Test and the Phillips-Perron Test. On the other hand, Johansen (1991) suggests two tests for the number of co-integration vectors in the system. One is the maximal eigenvalue test and the second is the trace test. Both tests have the null hypothesis that there are at most r co-integration vectors. This Johansen procedure allows a wide range of hypothesis testing on the parameters ut and β using the likelihood ratio tests.

Since the parameter ut was stationary, prices contained stochastic trends that have a long-run proportionality. The co-integrating parameter β was measuring the long-run equilibrium relationship between the prices. If there was a case where this parameter equaled to one than this reflected proportionality of unity and meant that the price transmission was complete.

If two spatial markets were integrated, the changes in prices at market one at certain time p1t would cause price changes in market two at certain time p2t, or vice versa. Granger causality provided additional evidence as to which direction the price transmission was occurring.

Causality test

When the market integration test was concluded, the concept of co-integration had an important implication. According to Granger Representation Theorem (Engle and Granger, 1987) if two trending I(1) variables are co-integrated their relationship may be validly described by an Error Correction Model (ECM). In this case the price series from two spatially separated markets were analyzed, therefore, p1t and p2t were co- integrated and the Vector Error Correction Mechanism (VECM) was described as:

$$\begin{pmatrix}\Delta p_{1t}\\ \Delta p_{2t}\end{pmatrix}=\begin{pmatrix}\mu_1\\ \mu_2\end{pmatrix}+\begin{pmatrix}\alpha_1\\ \alpha_2\end{pmatrix}(p_{1t-1}-\beta p_{2t-1})+A_2\begin{pmatrix}\Delta p_{1t-1}\\ \Delta p_{2t-1}\end{pmatrix}+\ldots+A_k\begin{pmatrix}\Delta p_{1t-k}\\ \Delta p_{2t-k}\end{pmatrix}+\begin{pmatrix}v_{1t}\\ v_{2t}\end{pmatrix}$$

In the equation above the parameters v1t and v2t represented the iid disturbances with zero mean and constant set variance. The operator Δ symbolized that the I(1) variables have been differenced in order to achieve stationary. In the concept of the error correction model the insertion of the levels of the variables p1t and p2t next to their differenced terms Δ p1t and Δ p2t was crucial. Parameters included in the matrices A2... Ak, measured the short run effects. On the other hand, the co-integrating parameter β described the long run equilibrium relationship between the two markets prices. The vector $\begin{pmatrix}\alpha_1\\ \alpha_2\end{pmatrix}$ included the parameters $0<|\alpha i|<1$, i=1,2 which are generally known as error correction coefficients. These coefficients measured the degree of corrections of the errors that the market initiated by adjusting p1t and p2t towards restoring the long run equilibrium relationship.

According to Granger (1988) causality can be tested for long run within the context of the error correction representation of a co-integrated system of variables. The direction can be estimated by testing the null that the error correction coefficients a1 and a2 in the VECM presented by equation (5). In more details, if in equation:

a1=0, a2≠0, p2 cause p1 in the long run,

a2=0, a1≠0, p1 cause p2 in the long run,

a1≠0, a2≠0, the both series cause each other in the long run.

This test provided only evidence of the direction of causality, but not of the factors that influenced it.

Results

Unit Root test

Based on the results of the Phillips-Perron Unit Root test, with and without a deterministic trend, there was insufficient evidence to reject the null hypothesis of non-stationary prices for all of the differenced price series. Means, variances and co- variances were changing over time. The difference in all performed tests was statistically significant, revealing that all price series were non-stationary. Consequently, the results of this test revealed that the null hypothesis was rejected implying that all the variables in the model were bound together in the long run indicating that all price series were in integration order I(1).

Co-Integration test

Due to the fact that the results from the Phillips-Perron test did not provide any statistically significant evidence to reject the null hypothesis of non-stationary prices, prices were considered as non-stationary. The next step was to estimate each pair of the price series in order to the test for co-integration. The Johansen approach was used to test for the number of co-integrations. The results are presented in the tables below (Tables 1 to 4).

Table 1. Johansen test for co-integration results for the price series. Number of co-integration vectors, Macedonia (MK) and Croatia (CRO)

Number of co-integrating vectors

Null	Alternative	Trace statistics / Rank test	Critical value 5%
0	1	78.9037*	15.41
1	2	20.6074	3.76

Co-integrating vector

	Parameter	Standard Error
MK	1	0.00
CRO	2.8	0.38

*Indicates statistically significant

Table 2. Johansen test for co-integration results for the price series. Number of co-integration vectors, Macedonia (MK) and Serbia (SRB)1

Number of co-integrating vectors			
Null	Alternative	Trace statistics / Rank test	Critical value 5%
0	1	70.6105*	29.68
1	2	19.0941	3.76
Co-integrating vector			
	Parameter	Standard Error	
MK	1	0.00	
SRB	-1.35	0.25	

*Indicates statistically significant

Table 3. Johansen test for co-integration results for the price series. Number of co-integration vectors, Macedonia(MK) and Montenegro (MN)

Number of co-integrating vectors			
Null	Alternative	Trace statistics / Rank test	Critical value 5%
0	1	41.9071*	15.41
1	2	19.0941	3.76
Co-integrating vector			
	Parameter	Standard Error	
MK	1	0.00	
MN	0.26	0.39	

*Indicates statistically significant

Table 4. Johansen test for co-integration results for the price series. Number of co-integration vectors, Macedonia (MK) and Kosovo (KOS)

Number of co-integrating vectors			
Null	Alternative	Trace statistics / Rank test	Critical value 5%
0	1	31.1632*	15.41
1	2	6.1342	3.76
Co-integrating vector			
	Parameter	Standard Error	
MK	1	0.00	
KOS	2.3	0.64	

*Indicates statistically significant

The results from the Johansen test (Johansen and Juselius, 1994) provided sufficient evidence for the alternative of one co-integrating relationship, indicating that the domestic and international markets were co-integrated. The trace statistics tests revealed evidence of at least one co-integration vector with all pairs of price series, one domestic and one regional. Applying the Johansen procedure, we tested for the null of non co-integration against the alternative hypothesis of one co-integrating vector. Thus, in this case, the null hypothesis of non co-integration hypothesis by this

1 Certain influence on the results might have the fact that Serbia and Montenegro constituted a single market, separated only in 2006. Johansen trace test was rejected suggesting that co-integration was positive. The results demonstrated statistically significant evidence that co-integration exists between Macedonian domestic retail market and Croatian retail markets. Following the Serbian tomato retail market which was characterized by a relatively high level of co-integration with Macedonian are the Montenegro and Kosovo markets which showed significant evidence of co-integration as well.

Granger Causality test

The test for co-integration does not give evidence of price causality and the direction of prices changes movement. In order to test the direction of the price changes, each pair of the price series was tested for the Granger causality. Consequently, this test was expected to provide sufficient evidence that the price changes in domestic market were influenced by regional price changes. The results from the Granger Causality tests on the each of the price series are presented in Table 5.

Table 5. Granger causality test results for each pair of price series

Pair of price series	Observations	F statistic	Probability value
MK and CRO	71	34.358*	0.000**
MK and SRB	47	21.464*	0.000**
MK and MN	47	12.812*	0.005**
MK and KOS	41	24.595*	0.000**

*Indicates statistically significant fitness between price series
**Indicates statistically significant causality direction

By noting the results provided in Table 5, there is obvious statistically significant evidence that price changes at all of the international/adjacent markets were filtered down to the domestic Macedonian market. This assertion is supported by the goodness-of-fit measure illustrated in the F statistics column, which was highly significant for all pair of prices in the markets, respectively. The results demonstrated a high level of fitness between the price series in Macedonia and Croatia, followed by Kosovo, Serbia and Montenegro. Thus, the results showed that the Macedonian prices were influenced by regional markets and that this result was statistically significant. This led to the conclusion that tomato prices in the former regions of Yugoslavia, nowadays representing individual countries, are filtering down to the domestic market of Macedonia. The hypothesis was rejected according to the above illustrated test results for each of the price series, indicating statistical significance

that all regional prices influence the domestic market prices in the long run.

Discussion and conclusions

With the unit root test performed on each of the price series, the conclusion was that there is insufficient evidence to reject the null hypothesis of non-stationary prices. Consequently, the statistical analysis showed that all of the price series are non-stationary and in integration order of I(0). Due to this reason, the next step in our analysis was the test for the number of co-integration among price series using the Johansen approach. In this co-integrating test the results showed failure to reject the null of non co-integration which represented that all pairs of market prices are co-integrated. Failure to reject the null of non co-integration in the test meant that the two prices drifted apart in the long run, because they were driven by stochastic trends which were not proportional.

Therefore, changes in one price, in this case the regional market price of adjacent countries, may be to a certain degree transmitted to the domestic Macedonian market price. This was especially the case with the larger Croatian and Serbian markets because test results on price series have shown statistically significant indication that these markets were characterized by a higher order of co-integration with the domestic Macedonian market.

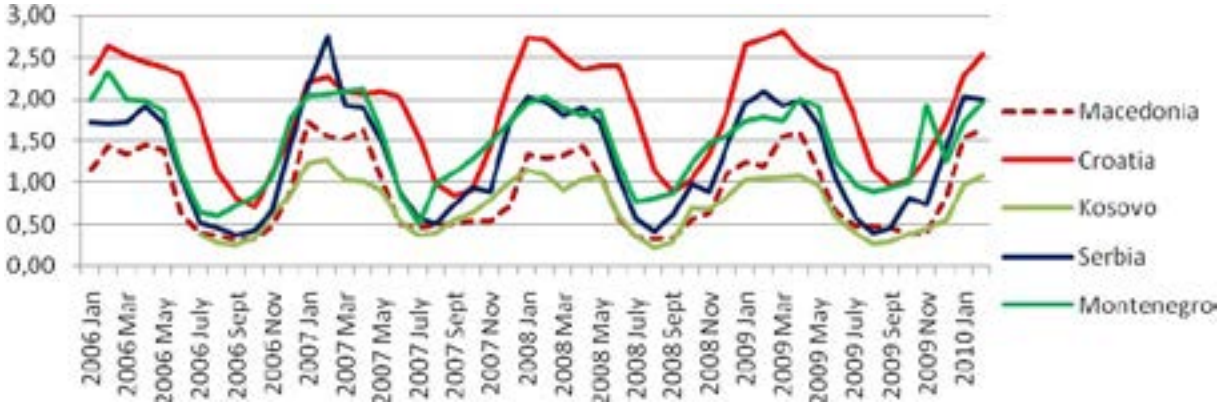

Figure 4. Regional market price of adjacent countries, in euro/kg, own calculation

Finally, the last test performed on each pair of the price series was the causality test. This test was applied since there was no statistically sufficient evidence to prove the direction of causality and the price leadership by using the Johansen approach. According to the Granger Causality test results on each pair of the price series, there was statistically significant evidence that price changes in adjacent regional market have an influence upon the domestic market price changes in Macedonia.

As stated in the literature review, demand and supply theory was the principle that explains the movement of prices and changes in prices of homogenous goods sold in perfectly competitive and integrated markets. The results of this study clearly showed that the Macedonian domestic tomato market was integrated with the adjacent international markets, formerly being an integrated part of Yugoslavia. Consequently, supply and demand fluctuations and changes in prices in the adjacent countries continue to be filtered down to the domestic Macedonian market. Although these countries are nowadays politically independent it is obvious that the Macedonian market is highly dependent on the developments in other nearby countries. The result shows that even if political association is substantially reduced, economic linkages still remain strong as noted by The Economist (2010).

It should be noted that the degree of influence is a matter of a different research topic. The difference in prices between domestic and regional markets in theory should be equal to the transfer costs, especially for the case of the Serbian and Croatian markets where the Macedonian export sector is focused on somewhat larger markets. According to the analysis, larger markets, such as the Serbian and Croatian markets, reveal a statistically significant influence on price formation at the domestic Macedonian market. This might be the case due to the nature of the tomato industry, the specifics of the supply chain from producer to consumer, the nature of the domestic export sector and larger actors that may have a substantial influence on the industry in the regional market. In general the conclusions of these study results are fairly typical. Similar problems have been studied by researchers in the field over an extended period of time (Gardner, 1975).

However, this study provides novelty in terms of price transmission in transition economies. Obviously, the study yields no results that tend to indicate that the

Macedonian tomato market is strongly influenced by domestic government policies. Instead, price formulation is mainly driven by the supply and demand fluctuations in larger neighboring countries. As a consequence, policies in neighboring countries might have a substantial impact on domestic farmers and the entire industry in Macedonia which further implicates the transition process of the Macedonian economy. Hence, it becomes ever more important for the farmers and the industry in a relatively small transitions economy such as Macedonia to achieve a rapid advance in technology implementation thereby lowering costs and enhancing quality. Even though the prices do not appear to decline rapidly in real terms over time and there is a stable relationship between prices in Macedonia and the other regional markets, the tomato producers typically situated at rather small sized farms, need to improve technology in order to remain competitive on international markets.

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