# The influence of international agricultural market prices on Macedonian domestic agricultural market

*- Tomato case -*

*Blazhe Jordanov*

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Влијание на интернационалните пазарни цени врз формирањето на цените на Македонскиот домашен пазар
*-Случај Домати-*

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# Summary

This project deals with co-movement of prices and market integration between the Macedonian domestic tomato market and other regional markets in South East part of Europe. This master thesis research investigates for price transmission between spatially separated markets. Consequently, it's trying to comprehend to what extend markets are integrated and to give evidence about the direction of price causality. Main objective is to investigate if price changes at international markets are filtered to the domestic market. Therefore, to prove or deny existence of influence of international market prices when formulating the prices in the domestic market. Various tests are applied in order to test for market integration, co-movement and causality of prices between the markets. Price leadership and direction of price causality is essential in order to reach this thesis objective. Monthly retail market prices from the concerned markets are gathered for several years and price time series are formed. Using the general purpose computer package software STATA these price series were accordingly tested and analyzed. The unit root test was the first test to be applied on the price series. The results have shown that there is statistically significant difference between price series, suggesting that there is insufficient evidence to reject the null hypothesis of price non-stationary. Therefore, my conclusion is that these markets are in order of integration. Next test to perform was the test of co-integration. Using the Johansen approach (1994) the trace test analyses, I test the price series for the number of co-integration. Trace test results revealed that there is a positive integration between the price series of all international markets with the domestic market, confirming the market integration. Especially, high co-integration was revealed among the Serbian and Macedonian and the Croatian and Macedonian markets. Due to the reason that co-integration tests do not offer any evidence about the price causality, using the Granger causality approach (1987) I have analyzed the price series for the causality and price leadership in order to comprehend to what direction price changes are filtered. Are international market price changes filtered to the domestic market? I have tested this hypothesis and the results have shown that all international markets have positive impact on the domestic market. Accordingly, in addition to the conclusions appropriate suggestions are given to tomato producers, the farmers and the entire industry in general.

**Key terms**: spatial price transmission, co-movement of prices, price leadership, market integration, etc.

# Содржина

Овој проект се занимава со движењето на цените и пазарната интеграција на Македонскиот домашен пазар за свежи домати со регионалните пазари на југо-источна Европа. Изтражувањето на оваа мастер теза е трансмисијата на цени помеѓу одвоени пазари. Како резултат, целта на тезата е да се добие јасна слика за нивото на интеграција на Македонскиот пазар и да се покажат докази за влијание на надворешните пазари во формирањето на цената на домашниот пазар. Главна цел е да се испита дали промените во цената на доматите кај интернационалните пазари се филтрираат на домашниот. Такашто, би се докажало или отфрлило какво и да е влијание на овие пазари во формирањето на цената на домашниот. Најразлични тестови ќе бидат аплицирани се со цел да се провери статистички пазарната интеграција, движењето на цените, и насоката на движењето на цените помеѓу пазарите. Лидерот во однос на формирањето на цената и дерекцијата на влијание во формирање на цените е многу важна за исполнување на целите на оваа теза. Месечни цени за неколку години наназад од малопродажните пазари од државите кој ќе бидат анализирани се собрани, се со цел да се формираат временски серии на цени. Користејќи компјутерски статистички софтвер наречен СТАТА овие серии на цени се тестираат и анализираат. Прв тест кој беше аплициран беше тестот на единечен корен, а резултатите покажаа дека не постојат доволно докази да се одбие хипотезата дека цените се непостојани. Со ова се докажува дека пазарите се во интеграционен ред. Следен чекор кој беше преземен според методот кој беше зацртан е Јохансен (1994) тестот на траги, кој покажува бројот на ко-интеграции помеѓу временските серии од цени. Резултатите од овој тест покажаа позитивна интеграција помеѓу сите интернационални пазари и домашниот, со што беше потврдена пазарната интеграција. Интеграција од највисок ред покажаа временските серии на цени помеѓу Српскиот и Македонскиот пазар и Хрватскиот и Македонскиот пазар. Поради фактот дека дека овој тест не дава какви било показатели за насоката во која цените се формираат, кој кого влијае, користејќи го Гранѓер пристапот (1987) ги анализирав сериите за лидерство во однос на формирањето на цените. Овој чекор ја објаснува насоката во која промените на цените се филтрираат помеѓу два пазари. Дали промените во цената кај интернационалните пазари се филтрира на домашниот? Резултатите од тестирањето на оваа последна хипотеза покажаа позитивно влијание на сите пазари врз домашниот. Согласно, на крајот од трудот заедно со заклучоците дадени се и соодветни сугестии до сите кој имаат удел во оваа стопанска гранка.

**Главни изрази**: трансмисија на цени кај одвоени пазари, движење на цените, лидерство во однос на формирање на цената, пазарна интеграција, итн.

# Abbreviations

CAP – Common Agricultural Policy
CRO - Croatia
CNB - Croatian National Bank
DIN – "Dinar" the Serbian national currency
EU - European Union
FAO – Food and Agricultural Organization
FZNH – Faculty of Agriculture Sciences and Food in Skopje, Macedonia
GDP – Gross Domestic Product
KOS – Kosovo
KUN – "Kuna" the Croatian national currency
MAFWE – Ministry of Agriculture, Forestry and Water Economy, Macedonia
MKD – "Denar" the Macedonian national currency
MN - Montenegro
NBRM - National Bank of the Republic of Macedonia
NSORM - National Statistical Office of the Republic of Macedonia
RM – Republic of Macedonia
SRB – Republic of Serbia
WTO – World Trade Organization

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# 1 Introduction

Tomatoes were originally grown in the western parts of South America and Central America. First to bring seeds to Europe in 1519 was the Spanish conqueror Cortez. They were planted as ornamental curiosities, but not eaten. Farmers in Italy were the first to start cultivating tomatoes. However, the French were the first to give the name. French botanist by the name of Tournefort gave the first Latin botanical name to the tomato, Lycopersicon esculentum, in translation to English these words are Wolf peach. Wolf, because it was considered to be poisonous and peach because had a round shape. The English word "tomato" for first time appeared in year 1595, nevertheless the original name comes from the Spanish word "Tomatl". Even though, tomato leaves are the only part that is poisonous, it was long time considered by Europeans as a member of the deadly family. People were very suspicious. In fact, the native version of tomatoes had very small, bright yellow and very shiny fruit (Trowbridge Filippone P., 2006).

Today, tomatoes are the largest traded vegetable in the world. Tomatoes are quantity driven export category. 80% of world tomato exports come from top 6 exporting countries and 91% from the top 10 countries. The global average price per ton is $1,109 per MT. This includes tomatoes for processing as well as all varieties of fresh. The top tomato global exporters include Spain, Mexico, Canada, the United States, Italy, France, and Turkey. The number of suppliers of fresh tomatoes has been increasing in the recent years. Consequently, the competition in this industry has intensified significantly in the past decade. Internationally the average annual growth rate of the total value has increased 10% for the period of 2002 – 2006. Nevertheless, the quantities remained rather same. With zero growth in volume this is demonstrating that higher price per unit was the case of 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 comparing to the last few years (Internet, FAO, 2007, 1).

## 1.1 Problem background

Republic of Macedonia is landlocked country located in South East Europe, covering an area of 25.713 km$^2$ (*See Appendix 1*). Neighboring countries are Greece on South, Bulgaria on East, Serbia and Kosovo on North and Albania on West. The favorable climate and the fertile soil which amounts to 1.275.000 ha are encouraging agricultural development. Even though approximately 50% of the total territory of Macedonia is fertile land according to the last agricultural census in 2007 the total usage of this fertile land by the farmers is around 537.000 ha in 2006 (MAFWE, Annual Agricultural and Rural Development Report, 2007).

Agricultural sector in The Republic of Macedonia generates around 12% of the gross domestic product. Vegetable production is one of the major agricultural sectors generating 8% out of this 12%. Not just that represent a significant source of National income, it employs a large number of the population and has been identified as strategic and high potential sector. Agriculture sector is the main creator of employment and revenue for the economy. Fresh vegetables play very significant role in Macedonian agriculture sector, represent an important part of the Macedonian agricultural exports, especially in the region.

Macedonian domestic agriculture wholesale and retail markets offer fresh consuming tomatoes. Because of the high acidic content of the tomato largely is used in the processing industry for canning and other purposes. Only domestic fresh tomatoes market prices will be considered in this study. This is the case because most of the tomatoes which are used in the processing industry are delivered directly by farmers throughout contract manufacturing with processors. Tomatoes in Macedonia are produced throughout the entire year. Tomatoes are produced on open field, green house and high tunnels using different techniques.

As mentioned above, tomatoes along with cabbage, potatoes, peppers, watermelons and melons are in the group of vegetables which are so called "strategic" commodities. Strategic because they are mostly cultivated and largely exported. Out of all agriculture products exported in 2009 from Macedonia, 254 million USD or 20,6% is accounted for the six above commodities. Market oriented agricultural sector tend to produce commodities desired by the markets. Tomatoes traditionally are cultivated in Macedonia. But, in the past decade tomatoes and cabbage had largest growth in exports on foreign international markets. The total value of exports for these six commodities increased from 16 million to 52 million USD. (NSORM, 2009)

According to National Statistical Office of The Republic of Macedonia, the total quantity of fresh vegetables exported from Macedonia during the first three quarters of 2009 (January to September) was 118,000 tons. The major share of the value of fresh vegetable exports 47% are tomatoes, followed by cabbage 17%, peppers 14% and cucumbers 13%. (*See Chart 1*)
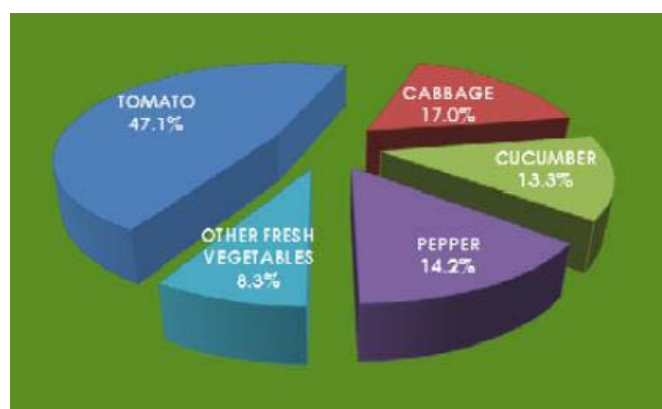


*Chart 1, Source*: *National Statistical Office, Exports of fresh Vegetables, January – September 2009*

Macedonian tomatoes are largely exported on neighboring markets. Almost 80% of the total exports go to the Ex-Yugoslavian countries markets. Nevertheless, some of the Macedonian neighboring markets are part of the EU27 market, countries such as Bulgaria and Greece. According to the National Statistical Office of the Republic of Macedonia, there is a trend of increase in the total tomato export quantities and the total value as result of the increasing exports in recent years. Tomato value of exports increased from 2.8 million USD in 1999 to 22.46 million USD in 2007. Although there was a permanent raise in the quantity and the value of Macedonian tomato exports in the previous ten years, unfortunately in 2009 the value for the first nine months decreased by 9% in comparison with the same period in 2008. Even though there was decrease in value, the average price increased by 10%. Some believe that

this was the case because of the economic crises that occur that year. However, in 2008 the annual value of exports increased by 26% over 2007 (NSORM, 2010). (*See Chart 2*)
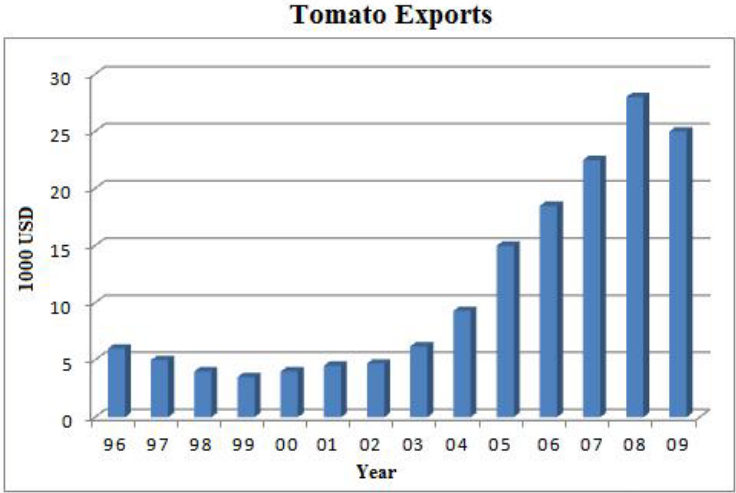


**Chart 2, Source**: *National Statistical Office, Total value of fresh tomato exports in Macedonia for the period January 1996 - September 2009.*

According to National Statistical Office of the Republic of Macedonia in 2009 the largest importers of Macedonian tomatoes with 71% of the total value is Republic of Serbia with Kosovo and Montenegro, 7% Croatia, 7% Bulgaria and the rest 15% was exported to other countries. Among the others countries that imported the rest of 15% in 2009 are: Slovenia, Romania, Greece, Poland, Russia, Albania and others. Only 10.6% of this 15% tomato exports in 2009 went to the EU27 countries, predominately Bulgaria, Greece, Slovenia, Poland and Romania. For this reason, only the large importing countries markets will be considered in this study.

## 1.2 Problem

Before 1991, Macedonia had more or less controlled markets. Agriculture market, agriculture production and price policy was controlled by the government. Since the declaration of independence from Yugoslavia in 1991, prices of agricultural products in Macedonia for the most part were determined by market influence. During the 1990's agricultural price policy was based on a combination of producer and input subsidies, and high level of tariff and quantity-based import protection. Therefore, consumers had to pay high prices for fresh and processed agricultural commodities. The budgetary cost to government was small, even if the economic cost was high. Price policy reform was initiated in the beginning of the 2000, in combination with the reform of free trade policy which was required for World Trade Organization membership, which followed in 2003. To compensate farmers for the reduction of import protection, other payments were introduced for the majority of key crops, among which were the tomatoes. Price distortions and fluctuations emerge because of the highly variable levels of external protection and the several changes linked with the execution of the reform. This has inevitably created uncertainty among farmers and producers. Since 2006,

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Macedonia is a candidate member of the EU and subsidy policy is ongoing trying to adjust as much as possible to trends of the CAP, the Common Agricultural Policy of the EU. The main purpose of the reform is to increase competitiveness of Macedonian farm producers by stimulating commercial production. Commercial production implies to commodities which are required by the markets, domestic and international export markets. This is done in order to reduce uncertainty and volatility of the prices. Volatility of price can be assumed as measure of risk. High fluctuation of prices is equal to high risk. Therefore, lowering the uncertainty will reduce 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 because of supply and demand fluctuations. Consequently, every change in prices affects the relationship between individuals, groups and even between national markets. Thus, change in price affects more or less everyone in the market chain: producers, purchasers, traders and consumers. According to Goodwin and Holt (1999) every change in prices affects not just the relationship between individuals, groups and nations, but, change in price affects even the export revenues and national incomes of the countries. Not just developing, but developed countries as well.

Agricultural production in many countries around the world is subject of considerable interventions on different bases. Therefore, gap between domestic and international prices often is created suggesting that this market is not integrated and efficient. Prices are not determined by supply and demand but by interventions and protections. Thus, this gap is considered to be the main reason why international market prices can't be relevant and can't be used in studies regarding development of agriculture in countries where has been intervention in prices. However, domestic agricultural products market prices in absence of interventions are expected to be in correlation with international market prices (Mundlak and Larson 1990).

Many factors combine to make the price. Prices are both the cause and an effect. The degree of change in price and co-movement of prices between markets will be analyzed in this study. Velocity with which shocks are transmitted among producer, wholesale and retail market prices is an important factor which has been studied by many economists. Nevertheless, this study main focus will be analysis of prices on spatially separated markets. Doing so, trying to comprehend to what extend the price changes shocks are filtered from international markets to the domestic. Hence, the objective is to understand the relationship between the markets and the degree of market integration. This research uniqueness is that is introducing single product price relationship analyses between two spatially separated markets in this part of Europe. Macedonian tomato market integration and prices relationship with different international markets haven't been studied so far by any researcher, making this study novelty in the field.

## 1.3 Aim

The main objective of this study is to comprehend to what extend Macedonian domestic market is integrated to regional and international markets and to understand the relationship between these two spatially separated markets. To examine if international agricultural market

prices are influencing the domestic retail market prices. Therefore, the main research question in this study is the following:

Is the development of prices on international markets, importers of great part of Macedonian tomatoes, affecting the development of prices on the domestic market?

Answering this question, I truly believe that will give the reader a real picture of the position of the Macedonian agriculture market in the region. From regional perspective in international setting to understand the chances on the current single European market and the future enlarged EU27 market.

## 1.4 Method

This master thesis discusses price transmission and co-movement of prices. Time series analysis will certainly present valuable insights regarding the relationship between prices on spatial separated markets. Relationships between prices are studied, prices from different markets from regional perspective in international setting (*See Figure 1*).
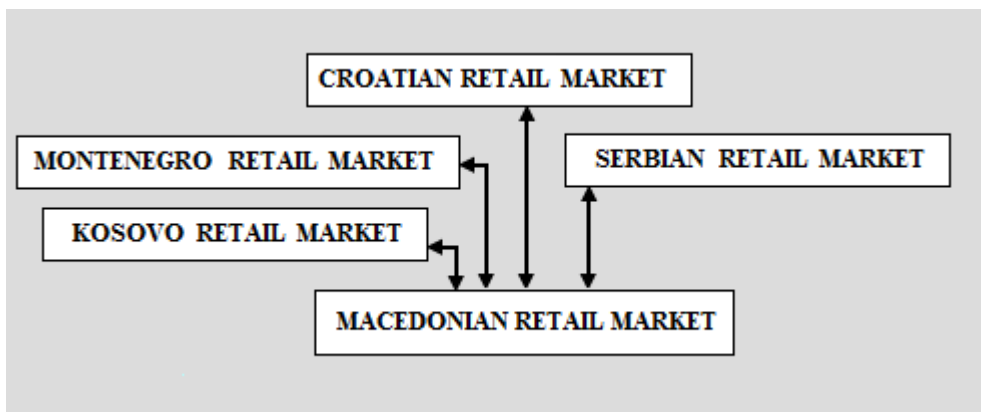


*Figure 1, Price integration and spatial price transmission between domestic and International markets.*

The extent of spatial price transmission will be analyzed. Numerous studies use time series econometric analysis techniques to test the co-movement of prices between different markets. These techniques are standard tool for analyzing spatial market relationships. These techniques include co-integration and error correction models which can provide evidence of price transmission. These techniques test for: completeness, co-integration and causality of prices. Time series models have small data requirements compared to other methodologies. They simply rely on price series only, which are easily obtainable, not just for developed but for developing countries as well.

As mentioned above this study consists of a set of econometric analyses techniques. Monthly price information for domestic and international markets is analyzed by testing the existence of long run equilibrium between the price series. In this analyzes more attention is given to determination of the relation between the prices and to their causality.

## 1.4 Delimitations

Most of the delimitations in this study are related to time constrains, sources and availability of statistical data. Slight delimitation arises perhaps due to a different data collection methodology of different available sources. In some cases, the available data was only for certain time of period. Therefore, only this period was analyzed for these particular markets. In the case of Serbia and Montenegro, the available retail markets price data was in weekly format. Hence, this price data was properly adjusted to monthly format.

Even though Bulgaria is large importer with 7% of the total Macedonian exports, and prospective market for Macedonian tomatoes, due to a lack of data was left out from this study, particularly for the period of: 2005, 2006 and 2007.

## 1.5 Structure of the research

The outline of the master thesis is illustrated above (*See Figure 2*). The intent is to give the reader insights about the structure of the research. In **Chapter 1** reader gets introduced to the problem, aim, method, delimitations and the structure of the study. **Chapter 2** gives insights about the literature that will be used in this study used, literature review based on secondary sources. **Chapter 3** elaborates the method that I have build in order to conduct my research. **Chapter 4** gives information about the data that later will be analyzed using the model described in the previous chapter. Hence, Macedonian domestic tomato market retail prices and International tomato market prices will be presented. The empirical findings are presented in **Chapter 5**, results from the analysis and discussions. In **Chapter 6** general conclusions is given from all together analyzed and discussed in order to achieve the aim of the study.
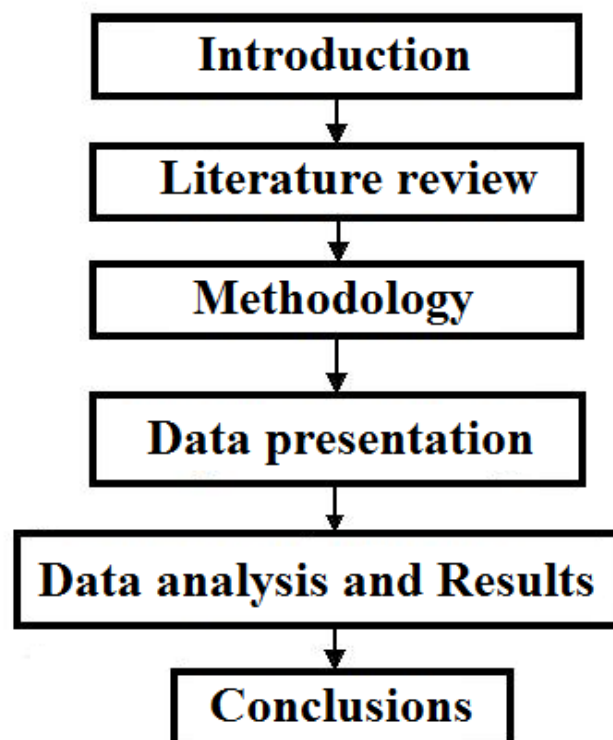


*Figure 2, Structure of the thesis.*

# 2 Literature review

In the previous chapter an introduction of the thesis topic was given. Brief background and a problem discussion were provided and the research question was outlined as well. However, in this chapter selected literature about spatial price transmission and other literature regarding formulation of the method in order to reach my research objective will be provided.

## 2.1 Price transmission

The science of prices and transmission of prices is relatively new. This science had significant progress over the past several decades. According to Goodwin and Holt (1999), end of the last century was the point in time when many economists focus was on the analysis of vertical price transmission. Different kinds of literature were written by economists about the price transmission in different levels of the food marketing chains. Nevertheless, the science has progressed and literature about spatial and vertical price transmission has grown, most recent critical review is in Fackler and Goodwin (2001). The given attention by the economists to start writing literature at the end of the last century was in general provoked by the social and political concerns. This has initiated progressive processes in the food industry and the whole food distribution sector.

*"The degree to which a price shock is transmitted from one point affects a price at another point can broadly indicate whether efficient arbitrage exists in the space that includes the two points. At two extremes, one may assume that a full transmission of price shocks can indicate the presence of a frictionless and well functioning market, while at the other extreme a total absence of transmission may make the very existence of a market questionable.*

*Therefore, the degree of price transmission can provide at least a broad assessment of the extent to which markets are functioning in a predictable way, and price signals are passing-through consistently between different markets." (Internet, FAO, 2010, 1)*

In order to assess the price transmission and market integration the individual have to understand the properties of the price transmission. Literature points out that the properties are very similar to those of the standard competition model. Standard competition model reveal that in single undistorted world, the simple Law of One Price (LOP) is supposed to regulate the spatial price relations. Nevertheless, transmission of the price changes among different markets and different levels of the chain, from producers, purchasers and traders in one market depends on many factors. Regarding the spatial transmission between markets factors the literature suggests at least four groups of factors that can affect the price transmission.

## 2.2 Factors that affect the spatial price transmission

- **Transport and transaction costs.** These costs are considered to be the main factors that affect the price transmission. According to Williamson they can be classified into three groups of information, negotiation, and monitoring and enforcement costs. They take the role of wedges between prices in different markets. The objective is to

overcome by the total price differences between the two markets, doing so, to let for arbitrage and integration to take place. Literature suggests these costs to be assumed as stationary (Goodwin, 1990).

- **Exchange rates.** This factor affect the price transmission in means of what extent the changes in the exchange rates are "passed through" on the output prices in order to study the relationship between the two markets (Mundlak and Larson, 1990).

- **Border and domestic policies**. Factors that directly affect spatial price transmission are trade policies. Domestic policies affect price formation and affect both vertical and spatial price relations (Mundlak and Larson, 1990). Barriers have strong effects on price transmission. Among the border measures are: tariffs, variable tariff, tariff rate quota, prohibitive tariffs, and technical barriers. All these tariffs have strong affect on price transmission. Taxes that are based on the quantity and the fixed tariffs act exactly like fixed transaction costs respectively.

- **Type of the product**. According to (Kohls & Uhl, 2002) different types of products have different rate of price transmission. Products such as vegetables, fruit, fresh milk are perishable and undergo minimal processing are expected to have relatively quick price transmission mechanism. On other hand, products such as maize, wheat, sunflower are not perishable products and undergo certain levels of processing are expected to have slower price transmission mechanism.

## 2.3 Law of One Price

As mentioned above, the simple Law of One Price states that identical product in efficient markets converted to a common currency should sell for the same price. This is a basic economic law with simple equation: market price one at certain time $p_{1t}$ should be equal to market price two at same time $p_{2t}$ plus the exchange rate $E_t$. Please note that in this simple law other factors are not considered. The equation is illustrated as follows:

$$p_{1t} = p_{2t} + \varepsilon_t \tag{1}$$

According to Mundlak and Larson (1990), this basic equation of simple law should be modified accordingly in the analysis model in order to achieve the goals of the study. Factors such trade policies, transportation cost and other transaction costs must be considered in order to assess complete and be accurate with price transmission analyses. If transportation costs are not assumed as constant this can cause rejections of the Law of One Price (Goodwin, 1990). Insulation of the country from the international prices is expensive and requires resources. If there is no intervention by governments on domestic prices the gap between the domestic and international prices should be slim. According to Mundlak and Larson (1990), in order to test this hypothesis they suggest using this "*simple law of the one price*" equation, where:

$$p_{1t} = p_{2t} + \varepsilon_t + \varsigma_t \tag{2}$$

In this equation, market one price $p_{1t}$ is expressed as a product of the price at market two $p_{2t}$, the nominal exchange rate is $E_t$ and the tax policy $S_t$.

According to Mundlak and Larson (1990), in the equation above the tax policy $S_t$ equals to *1+T* where *T* represents the tax rate. Due to the fact that Macedonian agriculture commodities are exported tax-free on the EU27 markets and the regional markets as well, the tax rate is equal to 0 and therefore will not be considered. Nevertheless, the factor of the exchange rates will be considered in this study using concerned national banks nominal exchange rates for the period of analysis.

However, the formulation above assumes that the product is homogeneous and domestic prices refer to the same product. Transport costs, marketing margins and other domestic non-tradable inputs are ignored. According to Mundalak and Larson (1990) this assumption is unrealistic and any interpretation should be modified accordingly. In the majority of the previous analysis in this field, transportation costs and other quality differences are assumed to be constant and are expressed as ones.

## 2.5 Market Integration

When investigating market integration in two spatially separated markets, factors that might influence the price transmission should be assumed. Accordingly, transportation costs are introduced. When prices are uttered in same currency and are given for the same commodity in two spatially separated markets $p_{1t}$ and $p_{2t}$, the Law of One Price and the Enke-Samuelson-Takayama-Judge model suggest that in any point of time the transporting costs *C* should be expressed as follows:

$$p_{1t} = p_{2t} + c$$

**(3)**

## 2.6 Possible relationship between prices

Investigating the relationships between prices is a common tool in market integration analysis. When investigating the price relationships and integration in two spatially separated markets using the equation given above there are three possible outcomes:

**Law of One price holds.** This is the case when the relationship between the two prices is following the equation given above. Therefore, these markets are considered to be integrated. Nevertheless, this case it's unlikely to occur, especially not in short run.

**Conclude absences of Integration.** This is the case when mutual distribution of two prices is established to be completely independent. Thus, there is great possibility to be no market integration and no price transmission.

**Conclude that there is market integration.** From spatial arbitrage in general is expected to confirm that the time series of prices for a homogeneous product will differ by the same

amount as the transfer costs. Therefore, the relationship between prices is identified as follows:

$$p_{2t} - p_{1t} \leq c$$

**(4)**

The relationship given above by Fackler and Goodwin (2001) illustrates the spatial arbitrage condition. This equation is categorized as weak form of the Law of One Price and represents an equilibrium condition. Equation (3) describes the strong form of the Law of One Price. There is high possibility examined prices to depart from this relationship. However, spatial arbitrage will cause the difference between the two prices to move in the direction of the transfer cost. Nevertheless, if spatial arbitrage condition is concluded then there is market integration. Therefore this integration is explained and evaluated by number of co-integration tests.

## 2.7 Co-integration

When two spatially separated price series are co-integrated they tend to co-move in long run according to a linear relationship. However, in the short run prices may drift apart, because shocks in one market may not be instantaneously transmitted to the other markets. Nevertheless, arbitration opportunities ensure that these variances from the long run equilibrium relationship are temporary.

The Granger (1981) concept of co-integration and the methods for estimating a co-integrated relation between prices or the system Engle and Granger (1987) and the Johansen (1994) approaches provide a framework for estimating and testing for long run equilibrium relationships between non stationary integrated variables.

## 2.8 Price Leadership

The problem of price leadership is inevitable problem. Researchers face this problem when researching the relationship between prices in market integration and in the supply chains. Literature and economic theory does not give suggestion about the direction of the relationship. However, some researchers choose one price to be exogenous. This price is determined outside the system. Regarding the market integration this is possible only if researcher suppose that one market is the leading price, sort of central market in geographical context. Therefore, this central market price will be exogenous.

The case in simultaneous systems is that there is a high possibility to be causation in both directions. The system is simultaneous and all prices respond to changes in the other prices in the system. Demand or supply shock in any of the markets will then transfer to other markets.

The causality of prices, price leadership and determination of central market can be tested by **Granger test of causality.** This test is used to determine the direction of shocks. If there is influence by market one on market two or vice versa.

## 2.9 Granger Causality

Co-integration and the error correction representation are significant because co-integration between two variables confirm that there is causality. According to Granger (1988) there is causality between them in at least one direction, definition of causality, the application and the relevance in context of market integration and price transmission demand extensive discussions. Causality tests are required because co-integration tests cannot determinate the direction of causation between the variables.

# 3 Method

In this research market integration and direction of price changes will be analyzed. Numerous studies use time series econometric analysis techniques to test the co-movement of prices. Development of these techniques includes co-integration and error correction models. Undoubtedly this will provide evidence of market integration and price transmission. With these techniques I look forward to investigate for: integration and direction of causality. This is essential to accomplish my objective. Time series models have small data requirements compared to other methodologies. They simply rely on price series only, which are easily obtainable for all of the concerned markets in this study. Therefore, the method with the techniques that will be used to apply on the planned time series in this research is available below (*See Figure 3*).
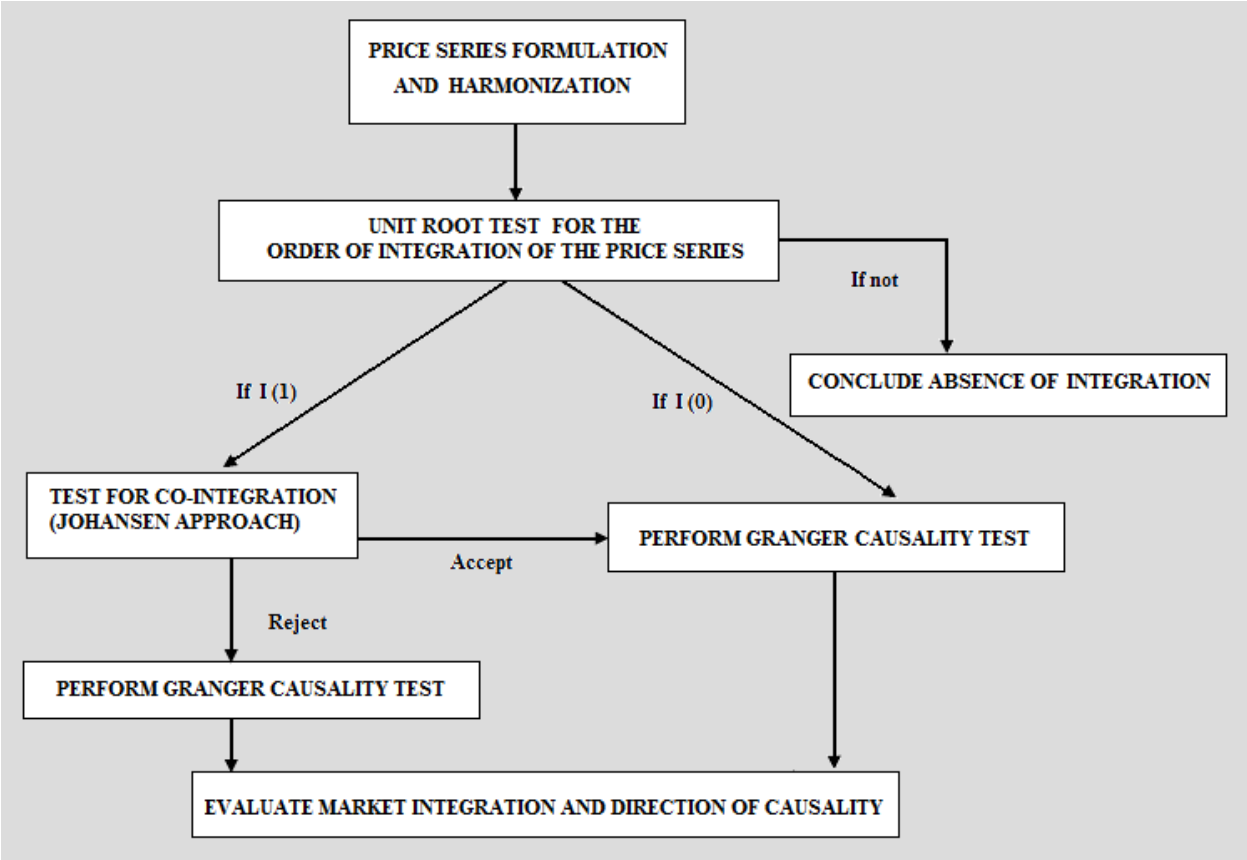


*Figure 3, Method used to assess market integration and price transmission between the markets.*

Please note that this scheme above is created in order to test the data of price series for the required components of the spatial price transmission between the concerned markets and how the tests are arranged is ad hoc.

## 3.1 Method of data collection and harmonization

Monthly price data price series for several years is analyzed using the above mentioned techniques. Monthly price data for four different international markets, major importers of

Macedonian fresh tomatoes and the domestic market was obtained. These data was obtained from relevant, respected and accurate data sources. Sources such as: Agriculture Ministries, National Statistical Offices and other relevant organization such as agriculture marketing information systems of the concerning countries.

### 3.1.1 Domestic market data sources and availability

Statistical data regarding the retail market prices on the domestic market is provided by the National Statistical Office of The Republic of Macedonia, NSORM (Internet, NSORM, 2010, 1). Thus, in order to be accurate and relevant with my analysis this data was compared with the available data for the corresponding period of the Ministry for Agriculture, Forestry and Water Economy of The Republic of Macedonia, MAFWE (Internet, MAFWE, 2009, 1). The Macedonian monthly retail market prices data is available in the national currency and for the period of January 2004 – February 2010 (*See Appendix 2*).

### 3.1.2 International markets data sources and availability

Agro-Marketing Information System of Montenegro is the organization which is the source to collect data for analysis concerning the Serbian and Montenegro retail markets (Internet, AMSM, 2010, 1). Weekly tomato market prices for the period of January 2006 – February 2010 are available on this source. These prices, later in the process of data harmonization using the method of average price were transformed into monthly prices and used as such in the process of analysis. The Serbian retail market prices data is available in the national currency (*See Appendix 3*). Regarding the Montenegrin retail market prices, the statistical data was available uttered in the European common currency (*See Appendix 4*).

Kosovo's market information system in agriculture is the organization where monthly tomato price data on retail and wholesale markets in Kosovo was obtained for the period of August 2006 – February 2010 (Internet, FOODKS, 2010, 1). The price data is available uttered in European common currency so therefore any harmonization was not necessary in order to be used in the analysis (*See Appendix 5*).

Market Information System in Agriculture of Croatia is the organization where monthly tomato price data for the retail and wholesale markets in Croatia is accessible for the period of January 2003 – February 2010 (Internet, TISUP, 2010, 1). The available data is uttered in the Croatian national currency (*See Appendix 6*).

### 3.1.3 Method of data harmonization

As mentioned above, the monthly data regarding the domestic Macedonian retail market prices can be easily reached at the NSORM and is uttered in Macedonian national currency "MKD" by kilogram of product. This is not the case with all the different monthly international retail markets data. Some of the data is available uttered in the European common currency and other in the national currencies of the concerned countries. Therefore,

harmonization of the available statistical data is necessary to be carried out in order to be accurate and relevant when analyzing the time series. Domestic and international monthly retail market prices have been harmonized. Macedonian domestic retail market prices have been uttered into common European currency using the middle exchange daily rates for the national currency at the given period (See *Appendix 7*). The middle exchange rates are obtained by the National Bank of Macedonia (Internet, NBRM, 2010, 1).

Due to the fact that Kosovo and Montenegro retail market prices are monthly and uttered in common European currency Euro's, no harmonization what so ever is necessary in order to be analyzed. Nevertheless, regarding the Serbian and Croatian market prices harmonization was performed.

The Serbian market prices which are available in their own national currencies Dinar's were harmonized using their own National Bank nominal exchange rates for the given period (*See Appendix 8*).

In the case with Croatian prices which were available in their national currency Kuna, using their National Bank nominal exchange rates for the given period were harmonized and accordingly uttered into Euro *(See Appendix 9)*.

Thus, at this point all data was uttered into European common currency Euro, and ready to be analyzed.

## 3.2 Method of time series analysis

In this study I'm using time series econometric analysis techniques to test for price co-movement. These techniques are standard tool for analyzing spatial market relationships. Development of these techniques includes co-integration and error correction models. In order to reach my objective, test for market integration and price transmission between the domestic and international price series I'll be using the general-purpose computer statistical software package called STATA. This software allows me to perform different tests on the time series data. Tests are ordered ad hoc and will be applied as follows:

- Unit root test for order of co-integration. Market integration.

- Test for co-integration.

- Granger Causality test, direction of causality. Price leadership.

Using the computer software package an error correction mechanism is applied in order to be accurate when testing for long run relationships. First objective of the method presented above (*See figure 3*) is to provide evidence of market integration and co-movement of prices. The second objective is to prove or deny that changes in prices at one market $p_1$ are transmitted to the other market $p_2$, at all points of time. Therefore, the sequences of the tests that will be applied are as follows:

First step, for each pair of prices (one domestic and one international) I test for the order of integration for each price using unit root test. Literature suggests using the Augmented Dickey-Fuller ADF (Dickey and Fuller, 1979) or the Phillips Perron Unit root Test. Then, if discovered the series have a diverse order of integration then we conclude absence of integration, thus markets are not integrated.

Second step, if established that the price series are I(0) order then the Granger Causality test will be applied within a Vector Auto Regression (VAR) framework in order to test the causality between the concerned markets.

Third step, if the tests reveal that the series are integrated of the same order I(1) there are two possible tests that might be applied on price series. Researcher can test the null of non co-integration against the alternative hypothesis of one co-integrating vector applying the Johansen procedure (Johansen, 1994) or can test for the null of non co-integration following Engle and Granger (1987). Proof against the null of no co-integration is used to show that prices co-move and that markets are integrated. No test what so ever for restrictions on the co-integrating parameter estimate beta prime are performed because the assumptions about the extent of price transmission based on the range of this parameter are confusing. If discovered that the null of non co-integration is not rejected then can be concluded that the markets are not integrated, thereby we are not able to conclude the price transmission between the two markets.

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

Please note that all above testing does not identify any factors that affect the market integration or price transmission. Hence, it is not possible to determinate if price transmission and market integration are shaped by: transaction costs, policy intervention that insulates the domestic markets, or the market power. Only the market integration and the direction of price transmission are examined by this study. Therefore, in addition to this study before the results are reviled some qualitative information on the major factors that may obstruct the extent of transmission is given.

### 3.2.1 Phillips-Perron 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, will be analyzed. This test is used to test the null hypothesis that a time series is I(1). Therefore, conclude the order market integration. This test is built on the Dickey–Fuller test bases, but modified. The PP test model is: $y_t = c + dt + a\, y_{t-1} + e(t)$. Where, the $e(t)$ is 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 address the issue that the process producing data for $Y_t$ may have a higher order of autocorrelation than is admitted in the test equation, therefore making $Y_{t-1}$ endogenous. Please note, that in this unit root test, 3 lags will applied. The number of lags is determined by Akaike Information Criterion, AIC.

### 3.2.2 Test for Co-integration

If two prices in spatially separated markets $p_{1t}$ and $p_{2t}$ include stochastic trends and are integrated of the same order, the prices are considered to be co-integrated if:

$$p_{1t} - \beta p_{2t} = u_t \tag{5}$$

The $\beta$ is representing a co-integrating vector, at the same time the equation (5) is thought to be the co-integrating regression. The above relationship can be estimated by the Ordinary Least Squares (Engle and Granger, 1987) or by the Full Information Maximum Likelihood approach developed by Johansen (1991).

$p_{1t}$ and $p_{2t}$ are considered to be co-integrated if there is 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 of no co-integration by applying unit root tests on the parameter $u_t$. Well-known statistics unit root tests are the Augmented Dickey Fuller Test and the Phillips-Perron Test. On the other hand, Johansen (1994) is suggesting 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 $u_t$ and $\beta$ using the **likelihood ratio tests.**

Since the parameter $u_t$ is stationary, prices will contain stochastic trends that have a long-run proportionality. The co-integrating parameter $\beta$ is measuring the long-run equilibrium relationship between them. If there is a case where this parameter equals to one than this reflects proportionality of unity and means that the price transmission is complete.

If two spatial markets are integrated, the changes in prices at market one at certain time $p_{1t}$ will cause the price changes in market two at certain time $p_{2t}$, or vice versa, Granger causality provides additional evidence to which direction the price transmission is occurring.

### 3.2.3 Granger Test of Causality

When market integration test is concluded, concept of co-integration has 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 are analyzed, therefore, $p_{1t}$ and $p_{2t}$ are co-integrated and the Vector Error Correction Mechanism (VECM) can be described as:

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

**(6)**

In the equation above the parameters $v_{1t}$ and $v_{2t}$ represent the *iid* disturbances with zero mean and constant set variance. The operator $\Delta$ symbolize 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 $p_{1t}$ and $p_{2t}$ next to their differenced terms $\Delta p_{1t}$ and $\Delta p_{2t}$ is main. Parameters included in the matrices $A_2 \ldots A_k$, measure the short run effects. On the other hand, the co-integrating parameter $\beta$ describes the long run equilibrium relationship between the two markets prices.

The vector $\begin{pmatrix} \alpha_1 \\ \alpha_2 \end{pmatrix}$ includes the parameter $0<|\alpha i|<1$, $i=1,2$ which are generally known as error correction coefficients. This coefficients measure the degree of corrections of the errors that the market initiates by adjusting $p_{1t}$ and $p_{2t}$ 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 $a_1$ and $a_2$ in the VECM presented by equation (5). In more details, if in equation:

$a_1=0$, $a_2\neq0$, $p_2$ cause $p_1$ in the long run,
$a_2=0$, $a_1\neq0$, $p_1$ cause $p_2$ in the long run,
$a_1\neq0$, $a_2\neq0$, the both series cause each other in the long run.

Please note that this test provide only evidence of the direction of causality, but not the factors that influence.

# 4 Data Presentation

In this chapter the monthly retail prices for the several years which are collected from relevant sources regarding the domestic and four international markets are presented. Additional information about the concerned countries markets, the data sources, and price movement throughout the years is provided as well.

## 4.1 Domestic tomato market

As stated above, the Macedonian domestic tomato retail market prices for the past six years were collected from the National Statistical Office of the Republic of Macedonia. This source provides monthly data from all national and city retail markets for vegetable across the entire country. Macedonian market is quite small, approximately 2 million people, therefore during the most part of the year and people appetite is satisfied generally by domestic production of vegetable. Nevertheless, during the winter period there are insignificant imports especially from Turkey which is the largest exporter in the region and top exporter in the world. This data prices were transferred into common European Currency "Euro", therefore accordingly to be analyzed with other international price series. Prices tend to fluctuate during the year depending of the supply and demand. When examining the oscillations of Macedonian monthly retail market prices for the past 6 years presented in the chart below, I can comment that prices are quite stable. Oscillations are insignificant over the years (*See Chart 3*).
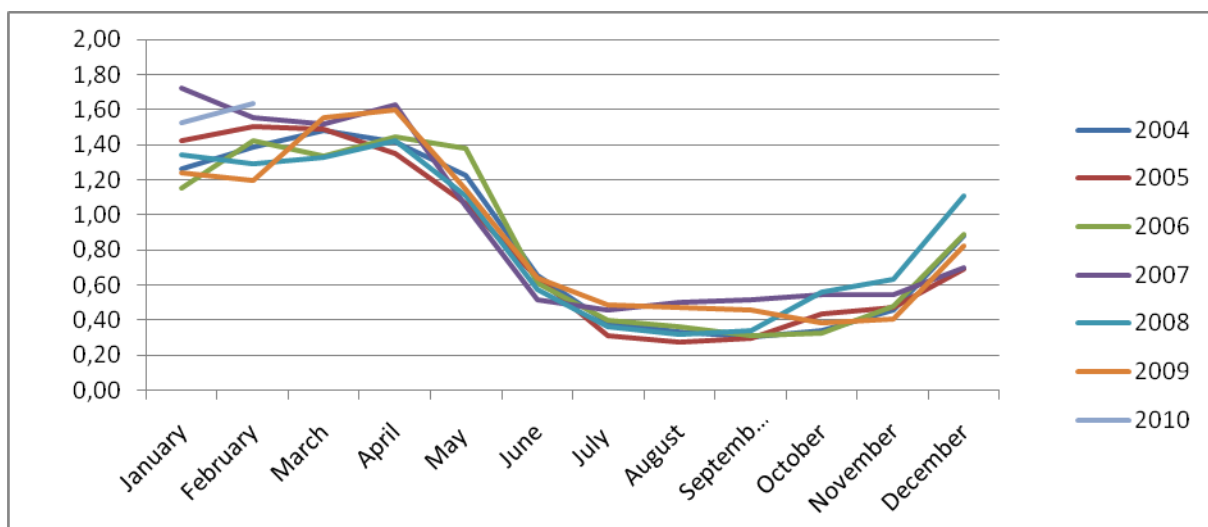


***Chart 3, Source***: *NSORM, Monthly Fresh Tomato Retail Market Prices in Macedonia for the period of January 2004 - February 2010.*

## 4.2 International Tomato Markets

As mentioned earlier, by international markets in the study are considered four regional markets, neighbors and large importers of Macedonian tomatoes. These markets consume more or less 80% of the total annual exports of Macedonian tomatoes. Large markets in comparison to Macedonian market. This four markets make approximately 20million people

market which is a great opportunity for Macedonian export potentials. Prices are available in monthly data for several years, thus, have been harmonized and uttered in common European Currency "Euro" so can be accurately analyzed. Countries properties and monthly retail market prices movement has been presented below.

### 4.1.1 Serbian Tomato Market

Data about the retail markets prices throughout Serbia and Montenegro was collected from the Agro-Marketing Information System of Montenegro, a respected source with accurate data. Weekly prices were available for three regions of Serbia: South, Central and Vojvodina. Serbian tomato market is among the largest in the South East European region, absorbing the largest part of the Macedonian exports of tomatoes. Serbia is a large country with approximately 10 million inhabitants and very important market for Macedonian tomato exporters and vegetable exporters in general. Over the years Serbia and Macedonia have signed many free trade agreements regarding exports and imports of goods, vegetables were among. As pointed out earlier, prices tend to fluctuate. During the year prices change depending of the supply and demand on the market. Same as the case of Macedonian monthly average retail prices, Serbian monthly retail prices have significantly low oscillations throughout the years (*See Chart 4*).
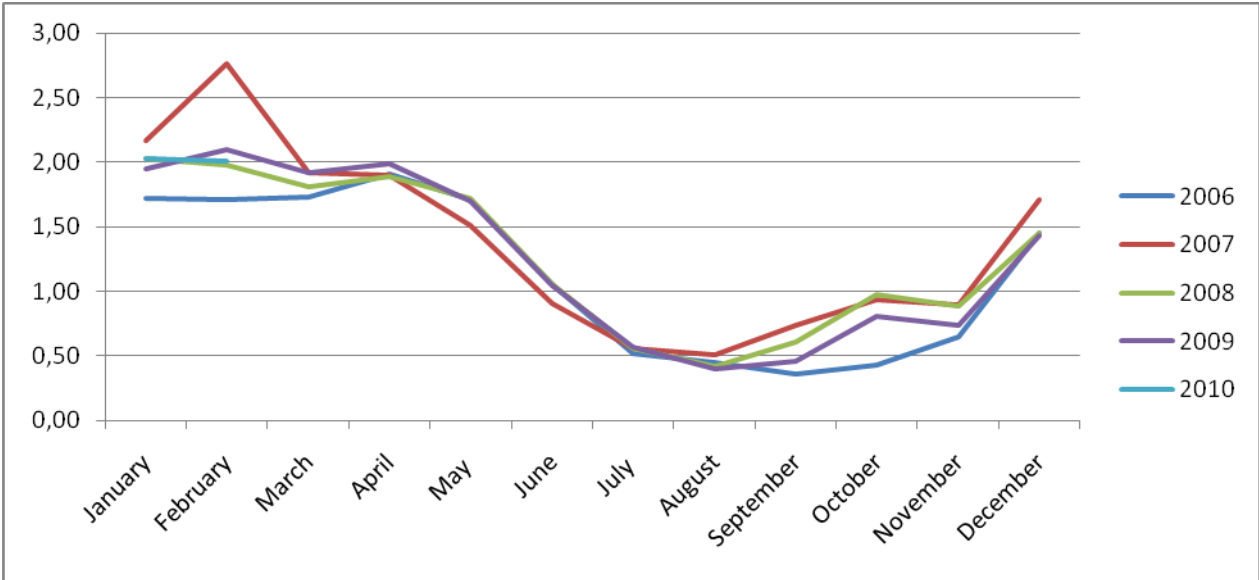


***Chart 4, Source***: *AMSM, Monthly Fresh Tomato Retail Market Prices in Serbia for the period of January 2006 - February 2010.*

By my interpretation, the chart above represent quite stable price throughout the years. Prices fluctuations along the years are more or less evenly.

### 4.1.2 Montenegro Tomato Market

The Agro-Marketing Information System of Montenegro was the source where data was gathered regarding the vegetable markets in Montenegro. This is the identical source as the Serbian case. Tomato retail market prices throughout the Montenegro are gathered. This is a

respected and accurate source of data. Montenegro, Serbia and Kosovo use to be one market but since a decade ago they have separated to three independent markets. These markets are very important markets regarding Macedonian vegetable exports. Montenegrin market today represent small market comparing to other markets in Europe, but still very important for Macedonian tomato vegetable exports. This is the case, because of the fact that Montenegro has large sea coast and tourist numbers are increasing during the summer season throughout the recent years. Consequently, during the summer period there is an increased demand of fresh products such as tomatoes. This is a great opportunity for the fresh vegetable supply sector in Macedonian. Montenegro is a very prospect market where suppliers from Macedonia can bust their exports. Weekly market prices were available for seven regions of Montenegro: Bar, Podgorica Velika, Podgorica Zelena, Nikshic, Berane, Bjelo Polje and Cetinje. Then, using data from these seven vegetable markets throughout Montenegro, the average monthly tomato retail price is formulated. The price oscillations during the year are result of the supply and demand of the markets. By my observations prices in Montenegro throughout the years have relatively low oscillations. Prices are more or less stable, except when summer season ends then small price fluctuations occur (*See Chart 5*).
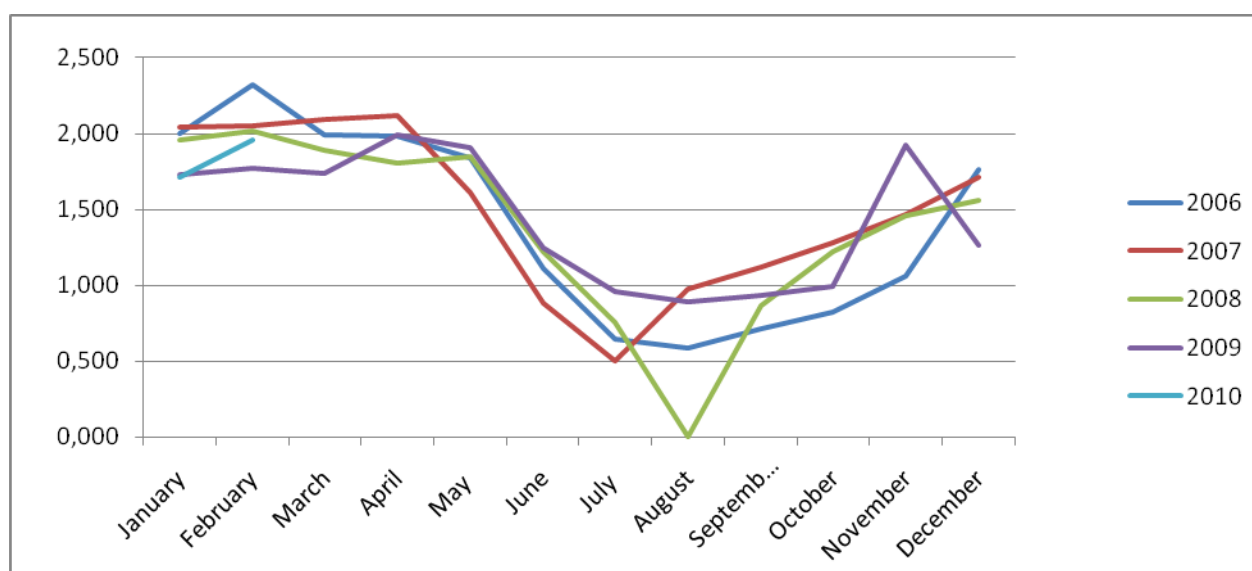


***Chart 5, Source****: AMSM, Monthly Fresh Tomato Retail Market Prices in Montenegro for the period of January 2006 - February 2010.*

### 4.1.3 Kosovo Tomato Market

This market along with the Serbian and Montenegrin markets use to be part of a same market just a decade ago. More or less is the same size as the Macedonian market, but with high demand of fresh vegetable due to fact that agriculture production was demolished and is an imports dependent market. This is a real opportunity for Macedonian export industry to increase their fresh products exports, because of the closeness of the market. Price data source is the market information system of the Republic of Kosovo, relevant and respected source. Market wholesale and retail price information is collected by this organization, both average and maximum prices for each product. Data prices for fresh tomatoes are available from the

vegetable markets from seven regions in Kosovo, thus an average monthly price is formed then. These regions are: Gjilan, Gjakova, Mitrovica, Peja, Ferizaj/Uroshevac, Prizren and Prishtina. By my observations the gathered price data revealed that prices in Kosovo tend to oscillate quite bit during the years, especially at the end of the summer period and the pre-winter period. Probably this is the case because of the fact that the market is more dependent of imports in this period of the year. However, these oscillations are not significant and prices are not fluctuating significantly throughout the years (*See Chart 6*).
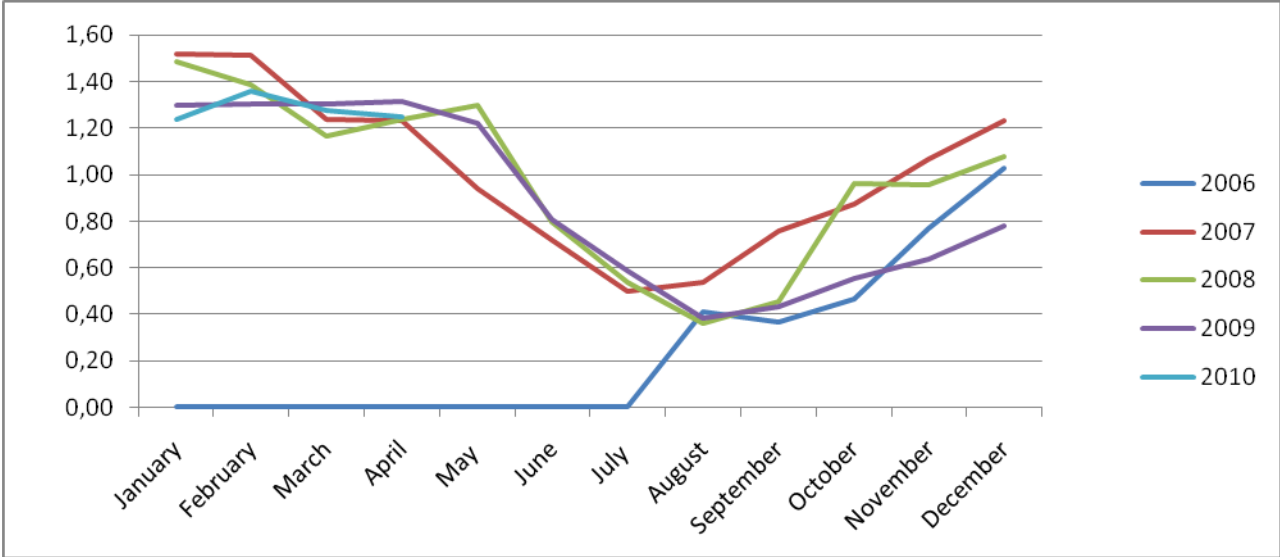


**Chart 6, Source**: *FOOD KS, Monthly Prices for Fresh Tomato on Retail Markets in Kosovo for the period of August 2006 - February 2010.*

Please note that the blue line which represents the price data for the year of 2006 in the above chart is equal to 0 throughout the period of January until July, due to reason that price data was not available for this period of time. Consequently, this period was not included in the study.

### 4.1.4 Croatian Tomato Market

The source for the Croatian monthly tomato price data is the Croatian Market Information System in Agriculture known as TISUP. This organization is a centralized system for agriculture data collection and processing. Accordingly, the processed information by this organization is later distributed to market participants, national and international, for usage in different analyses. Emphasis is put mainly on data prices of agricultural and food products, starting from year 2003 till present day. Using this data researcher can conduct a continuous market analysis. Croatian market along with the Serbian market is one of the largest in the South east region of Europe. Roughly three times larger than the Macedonian market is very valuable for the domestic agriculture export sector. Same as the case with the Montenegrin market, during the summer season the demand on the Croatian market is very high. This is the reason, due to the reason that many tourists come to visit one of the longest sea coasts in Europe. This fact makes this market very interesting during this time of the year. Market supply and demand is fluctuating generating price oscillations. However, in this case when

observing the available monthly price data I have discovered that there is no price oscillation what so ever throughout the years. Prices are very stable throughout the years (*See Chart 7*).
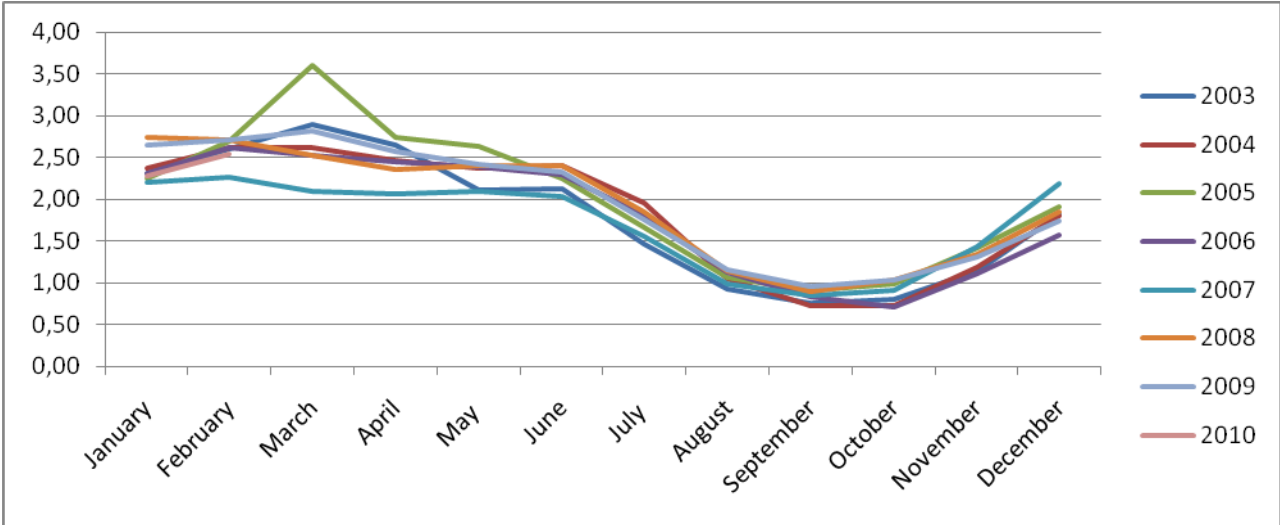


***Chart 7, Source****: TISUP, Monthly Prices of Fresh Tomatoes on Retail Market in Croatia for the period of January 2003 - February 2010.*

# 5 Data Analysis Results

In this chapter information about the prices analysis and the results from the performed tests will be revealed. Price series have been tested using the computer software package in order to be accordingly analyzed. According to the method, the unit root test on the price series was the first to be applied in order to test for markets correlation and integration.

## 5.1 Phillips-Perron Test Results

Phillips-Perron test that a variable has a unit root. The null hypothesis is that the variable contains a unit root, and the alternative is that the variable was generated by a stationary process. The sources for the prices series used in the unit root test are listed together with the full results from Phillip Perron (PP) tests for the each of the price series are available in the tables bellow.

| Type of series and source | PP tests | Levels | | | | | |
|---|---|---|---|---|---|---|---|
| | | Test statistic / drift | | | Test statistic / drift & trend | | |
| RM retail price NSORM | Zt | -2.65* | | | -2.66* | | |
| | Z(rho) | -14.58* | | | -14.76* | | |
| KS retail price FOODKS | Zt | -2.68* | | | -2.67* | | |
| | Z(rho) | -14.11* | | | -14.15* | | |
| | | With drift | | | With drift & trend | | |
| Critical values | | 1% | 5% | 10% | 1% | 5% | 10% |
| Phillips Peron Zt | | -3.63* | -2.95* | -2.61* | -4.21* | -3.53* | -3.19* |
| Phillips Peron Z(rho) | | -18.42* | -13.08* | -10.56* | -24.8* | -19.27* | -16.46* |

**Table 1,** *PP Unit root test results for price series of tomato retail markets in Macedonia and Kosovo (July 2006 – February 2010)*
*Statistically significant at 1%

| Type of series and source | PP tests | Levels | | | | | |
|---|---|---|---|---|---|---|---|
| | | Test statistic / drift | | | Test statistic / drift & trend | | |
| RM retail price NSORM | Zt | -3.57* | | | -3.52* | | |
| | Z(rho) | -25.52* | | | -25.15* | | |
| CRO retail price TISUP | Zt | -3.6* | | | -3.56* | | |
| | Z(rho) | -25.33* | | | -25.24* | | |
| | | With drift | | | With drift & trend | | |
| Critical values | | 1% | 5% | 10% | 1% | 5% | 10% |
| Phillips Peron Zt | | -3.55* | -2.91* | -2.59* | -4.10* | -3.48* | -3.17* |
| Phillips Peron Z(rho) | | -19.31* | -13.48* | -10.84* | -26.48* | -20.21* | -17.12* |

**Table 2,** *PP Unit root test results for price series of tomato retail markets in Macedonia and Croatia (January 2004 – February 2010)*
*Statistically significant at 1%

| Type of series and source | PP tests | Levels | |
| --- | --- | --- | --- |
| | | Test Statistic / drift | Test statistic / drift & trend |
| RM retail price NSORM | Zt | -2.89* | -2.81* |
| | Z(rho) | -17.28* | -16.89* |
| SRB retail price AMSM | Zt | -2.95* | -2.89* |
| | Z(rho) | -17.31* | -17.01* |

| | | With drift | | | With drift & trend | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Critical values | | 1% | 5% | 10% | 1% | 5% | 10% |
| Phillips Peron Zt | | -3.59* | -2.93* | -2.6* | -4.16* | -3.5* | -3.18* |
| Phillips Peron Z(rho) | | -18.83* | -13.27* | -10.68* | -25.57* | -19.72* | -16.75* |

*Table 3, PP Unit root test results for price series of tomato retail markets in Macedonia and Serbia (January 2006 – February 2010)*
*Statistically significant at 1%

| Type of series and source | PP tests | Levels | |
| --- | --- | --- | --- |
| | | Test statistic / drift | Test statistic / drift & trend |
| RM retail price NSORM | Zt | -2.89* | -2.81* |
| | Z(rho) | -17.28* | -16.89* |
| MN retail price AMSM | Zt | -3.06* | -2.97* |
| | Z(rho) | -17.52* | -17.07* |

| | | With drift | | | With drift & trend | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Critical values | | 1% | 5% | 10% | 1% | 5% | 10% |
| Phillips Peron Zt | | -3.59* | -2.93* | -2.6* | -4.16* | -3.5* | -3.18* |
| Phillips Peron Z(rho) | | -18.83* | -13.27* | -10.68* | -25.57* | -19.72* | -16.75* |

*Table 4, PP Unit root test results for price series of tomato retail markets in Macedonia and Montenegro (January 2006 – February 2010)*
*Statistically significant at 1%

Basing my results of the Phillips-Perron test, with and without a deterministic trend, I can conclude that there is insufficient evidence to reject the null hypothesis of non-stationary prices for all of the differenced price series. Means, variances and covariances are changing over time. Difference in all performed tests is statistically significant, representing that all price series are non-stationary. Consequently, by observing the results the null hypothesis is rejected implying that all the variables in the model are bound together in the long run indicating that all price series are in integration order I(1).

## 5.2 Co-integration Test Results

Due to the fact that the results from the Phillips-Perron test didn't give enough significant evidence to reject the null hypothesis of non-stationary and price are non stationary, the next test to execute on the each pair of the price series is the test for co-integration. Price series are non-stationary and therefore using the Johansen approach (1994) I test for the number of co-integrations to confirm. I run the vector auto regression on each pair of the price series. Then, using the vector error correction model available in the software program I formulate the error correction mechanism and run the Johansen test to test for the trace statistics which will

reveal the level of co-integration between the prices series. This trace test is testing for the null hypothesis, in order to show that there are *r* co-integration vectors or not. Results are presented in the tables below.

| 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 | |

***Table 5**, Johansen test for co-integration results for the price series. Number of co-integration vectors, Macedonia and Kosovo.*

| **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 | |

***Table 6**, Johansen test for co-integration results for the price series. Number of co-integration vectors, Macedonia and Croatia.*

| **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 | |

***Table 7**, Johansen test for co-integration results for the price series. Number of co-integration vectors, Macedonia and Serbia.*

| **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** | |

***Table 8**, Johansen test for co-integration results for the price series. Number of co-integration vectors, Macedonia and Montenegro.*

*Indicates statistically significant

Results given above, from the conducted Johansen test (Johansen, 1994) provide sufficient evidence for the alternative of one co-integrating relationship, indicating that the domestic and international markets are co-integrated. The trace statistics tests supply evidence of at least one co-integration vectors with all pairs of price series, one domestic and one international. Applying this Johansen procedure, researchers test for the null of non co-integration against the alternative hypothesis of one co-integrating vector. Thus, in this case the null of non co-integration hypothesis by this Johansen trace test is rejected suggesting that co-integration is positive. The results demonstrate statistically significant co-integration between Macedonian domestic retail market and Croatian. Following the Serbian tomato retail market which is relatively high co-integration with Macedonian are the Montenegro and Kosovo markets which show good evidence of co-integration as well.

## 5.3 Granger Causality Test Results

Due to the fact, that 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, I test each pair of the price series for the Granger causality. Consequently, expect to provide enough evidence that the price changes in domestic market are influenced by international prices changes. The results from the conducted Granger Causality tests on the each of the price series are available below (*See Table 9*).

| 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** |

*Table 9,* *Granger causality test results for each pair of price series.*
*Indicates statistically significant fitness between price series
**Indicates statistically insignificant causality direction

By the results provided above there is statistically significant evidence that price changes at all of the international markets are filtered to the domestic market. This is the case, due to the reason that the goodness of fit measure which is illustrated in the F statistics column as a fit test is representing high fitness among the price series. Results demonstrate high fitness between price series in Macedonia and Croatia, following by Kosovo, Serbia and Montenegro. Thus, the probability factor that Macedonia is influencing international markets is insignificant statistically which lead me to conclusion that this fitness is result of international markets filtering to the domestic. Finally, I can say that in this case the hypothesis is rejected according the above illustrated test results for each of the price series, indicating statistical significant that all international prices cause the domestic market prices in long term.

# 6 Conclusions

In this chapter conclusions about the research in general are given. Test results conclusions and implications are comprehended. As stated in previous chapter, the first statistic test of unit root was performed on each of the price series and the conclusion is that there is not insufficient evidence to reject the null hypothesis of non-stationary prices. Consequently, I have statistically concluded that all of the price series are non-stationary and in integration order of $I(0)$. Due to this reason, the next step was the test for the number of co-integration among price series using the Johansen approach. In this co-integrating test the results show 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 mean that the two prices drift apart in long run, because they are driven by stochastic trends which are not proportional. Therefore, I can conclude that there are statistical indicates that some changes in one price, in this case the international market price may be to a certain degree transmitted to the domestic Macedonian market price. Especially, this is case with the Croatian and Serbian markets because test results on price series have shown statistically sufficient indicates that these markets are in higher order of co-integration with the domestic Macedonian market. Finally, the last test to be performed on the each of the price series was the price causality test. This was the case due to the reason that there is no statistically sufficient evidence to prove the direction of causality and the price leadership with the Johansen approach. Analyzing the Granger Causality test results on each pair of the price series, one international and the domestic, I can conclude that there is statistically sufficient evidence that price changes in international market have certain statistical influence on domestic market price changes. Therefore, I believe that due to the reason that this research objective is to prove the market integration and if there is influence by international markets when forming domestic prices conducting this last test and presenting statistically sufficient evidence my master thesis objective is achieved. As stated in literature, demand and supply theory is an organizing principle that explains movement of prices and changes in prices of homogenous goods sold to perfectly competitive and integrated markets. The economic suggestion of this study is that statistically Macedonian domestic market is integrated to the regional and international markets. Leading to conclusion, that supply and demand fluctuations and change in prices at international markets are filtered to certain degree to the domestic. Please note that the degree of influence is matter of different research and analyzing other elements of spatial price transmission between the concerned markets. The difference in prices between domestic and international is equal to the transfer costs, especially in the case with Serbian and Croatian markets, which is leading me to conclude that domestic export sector is focused to grater markets. Fresh products such as tomatoes have fast rate of price transmission among perfectly competitive markets such as the case in this research. This is expected. Larger markets like Serbian and Croatian have significant statistical influence in price formation at the domestic market. This is the case due to the nature of the tomato industry, the unique supply chain from producer to consumer, the nature of the domestic export sector and the large players that have huge influence in the industry at the international markets in general, and particularly in this region. Consequently, this is leading me to conclusion that Macedonian market is not

influenced by any governmental policies and price formulation is driven only by the supply and demand fluctuations. Policies in neighboring countries might create level of market imperfection. In such case the impact on domestic farmers and the entire industry in general will be tremendous. Thus, suggestion to farmers is rapid advanced technology implementation, lowering costs, change quickly in order to adapt to current situations and etc. Even though the prices don't decline rapidly and there is stable relationship between prices in Macedonia and other international markets, if you are a tomato producer the suggestion is to improve your production and produce at lower prices for minimum cost in order to get the best price for your production. As a final point, I would like to add that this study results are fairly typical. Similar problems that have been studied by researchers in the field and which are found in literature (Gardner) imply that consumers often complain that the retail prices increase additionally when input prices are increasing, contrary they decrease when costs are declining. As answer to this reaction wide range of customized empirical mechanism such as this particular model used in this particular study try to explain whether or not price transmission exists, are the markets integrated and if prices at one market are influenced by other markets. Some researchers go further with their studies, analyzing for other components of the price transmission such as: degree, asymmetry, seasonality, etc.

# 7 Further Research

I believe that this study gives the research bases for other researchers that are interested in price transmission to continue testing the spatial price transmission between different international tomato markets and the Macedonian domestic market. Analysis can be performed in order to determinate the speed, the dynamics and the asymmetry of the price transmission between the markets. Other international markets may be included in the further research. The research can be conducted such to investigate all elements of price transmission between Macedonian domestic market and other various international markets. Markets such as the EU 27 individual markets, US market or other important world tomato markets can be included in further research. Researchers can also analyze the price movement, seasonality of price changes, direction of causality and check for integration between markets to comprehend the competitiveness of Macedonian tomato market. In order researcher to check for seasonality of price changes and to investigate what season price fluctuates the most price series data for additional years should be used. The price series data in this study is for several years, if researcher wants to obtain a real picture about the seasonality of prices perhaps will have to use few decades of price series in order to obtain accurate and valuable results.

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**Personal messages**

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# Appendix 1:



*Source: MyMacedonia.net (Internet, MM, 2010, 1), Map of the Republic of Macedonia*

# Appendix 2:

| Monthly prices of tomatoes on retail markets (MKD/kg) | | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|------|------|
| | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sept** | **Oct** | **Nov** | **Dec** |
| **2004** | 77,33 | 84,71 | 90,91 | 86,82 | 74,91 | 40,26 | 23,61 | 20,58 | 18,55 | 20,96 | 27,05 | 53,98 |
| **2005** | 87,45 | 92,16 | 91,33 | 82,86 | 65,47 | 39,2 | 18,93 | 16,64 | 17,98 | 26,76 | 28,07 | 42,41 |
| **2006** | 70,60 | 87,08 | 81,64 | 88,37 | 84,30 | 37,32 | 24,27 | 22,16 | 18,87 | 19,98 | 29,22 | 54,33 |
| **2007** | 105,17 | 94,90 | 93,05 | 99,62 | 64,32 | 31,36 | 27,89 | 30,44 | 31,42 | 33,18 | 33,15 | 42,96 |
| **2008** | 82,19 | 79,25 | 81,27 | 87,18 | 67,63 | 35,19 | 22,07 | 19,43 | 20,96 | 34,05 | 38,89 | 67,81 |
| **2009** | 76,14 | 73,65 | 95,44 | 97,82 | 70,09 | 39,27 | 29,66 | 28,82 | 27,95 | 23,64 | 24,72 | 50,34 |
| **2010** | 93,45 | 100,58 | | | | | | | | | | |

*Source: National Statistical Office of the Republic of Macedonia (Internet, NSORM, 2010, 1). Macedonian monthly retail market prices data uttered in the national currency for the period of January 2004 – February 2010*

# Appendix 3:

| Monthly prices of tomatoes on the retail market in Serbia (DIN/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
| 2006 | 150,00 | 150,00 | 150,00 | 165,00 | 150,00 | 90,83 | 42,93 | 38,33 | 29,57 | 34,15 | 51,34 | 115,00 |
| 2007 | 170,83 | 220,83 | 156,66 | 153,33 | 122,50 | 71,68 | 44,68 | 40,40 | 58,35 | 72,50 | 75,85 | 135,83 |
| 2008 | 168,00 | 165,00 | 148,60 | 151,50 | 141,65 | 83,20 | 42,75 | 31,75 | 46,75 | 83,25 | 79,40 | 128,25 |
| 2009 | 183,75 | 196,50 | 181,75 | 189,00 | 160,80 | 97,50 | 53,40 | 37,00 | 42,50 | 75,00 | 70,00 | 137,66 |
| 2010 | 200,00 | 200,00 | | | | | | | | | | |

*Source: Agro-Marketing Information System of Montenegro (Internet, AMSM, 2010, 1).*

# Appendix 4:

| Monthly prices of tomatoes on retail market in Montenegro (EUR/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | January | February | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
| 2006 | 2,000 | 2,320 | 1,996 | 1,985 | 1,837 | 1,113 | 0,642 | 0,588 | 0,717 | 0,827 | 1,058 | 1,760 |
| 2007 | 2,044 | 2,055 | 2,090 | 2,115 | 1,608 | 0,885 | 0,500 | 0,972 | 1,120 | 1,278 | 1,470 | 1,712 |
| 2008 | 1,957 | 2,020 | 1,892 | 1,802 | 1,850 | 1,225 | 0,756 | 0.805 | 0,865 | 1,224 | 1,457 | 1,560 |
| 2009 | 1,727 | 1,775 | 1,735 | 1,990 | 1,905 | 1,250 | 0,960 | 0,892 | 0,934 | 0,997 | 1,926 | 1,262 |
| 2010 | 1,713 | 1,954 | | | | | | | | | | |

*Source: Agro-Marketing Information System of Montenegro (Internet, AMSM, 2010, 1).*

# Appendix 5:

| Monthly average prices of tomatoes on retail markets in Kosovo (EUR/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | January | February | March | April | May | June | July | August | September | October | November | December |
| 2006 | / | / | / | / | / | / | / | 0,41 | 0,37 | 0,46 | 0,77 | 1,03 |
| 2007 | 1,52 | 1,51 | 1,24 | 1,23 | 0,94 | 0,72 | 0,50 | 0,54 | 0,76 | 0,88 | 1,07 | 1,24 |
| 2008 | 1,49 | 1,39 | 1,17 | 1,24 | 1,30 | 0,80 | 0,54 | 0,36 | 0,45 | 0,96 | 0,95 | 1,08 |
| 2009 | 1,30 | 1,31 | 1,30 | 1,31 | 1,22 | 0,81 | 0,59 | 0,38 | 0,43 | 0,55 | 0,64 | 0,78 |
| 2010 | 1,24 | 1,36 | | | | | | | | | | |

*Source: Market information system – Republic of Kosovo, Monthly retail market prices for the period of August 2006 – February 2010 (Internet, FOODKS, 2010, 1).*

# Appendix 6:

| Monthly prices of tomatoes on retail markets in Croatia (KUN/kg) | | | | | | | | | | | |
|------|---------|----------|-------|-------|-------|-------|-------|--------|-------|------|-------|-------|
|      | January | February | Mar   | April | May   | June  | July  | August | Sept  | Oct  | Nov   | Dec   |
| 2003 | 17,33   | 19,75    | 22,23 | 20,05 | 15,89 | 16,07 | 10,98 | 6,94   | 5,68  | 6,11 | 8,64  | 13,97 |
| 2004 | 18,29   | 20,03    | 19,62 | 18,49 | 17,66 | 17,71 | 14,45 | 7,77   | 5,32  | 5,46 | 8,99  | 13,64 |
| 2005 | 17,03   | 20,25    | 26,85 | 20,28 | 19,24 | 16,39 | 12,13 | 7,83   | 6,76  | 7,24 | 10,46 | 14,10 |
| 2006 | 17,05   | 19,23    | 18,45 | 17,89 | 17,38 | 16,66 | 13,08 | 8,14   | 6,10  | 5,26 | 8,20  | 11,54 |
| 2007 | 16,27   | 16,69    | 15,42 | 15,31 | 15,40 | 14,84 | 11,38 | 7,19   | 6,24  | 6,67 | 10,49 | 16,00 |
| 2008 | 20,03   | 19,65    | 18,36 | 17,16 | 17,40 | 17,39 | 13,40 | 8,22   | 6,33  | 7,42 | 9,56  | 13,29 |
| 2009 | 19,45   | 20,19    | 20,91 | 19,10 | 17,74 | 16,98 | 12,87 | 8,47   | 7,00  | 7,44 | 9,59  | 12,73 |
| 2010 | 16,64   | 18,50    |       |       |       |       |       |        |       |      |       |       |

*Source: Agriculture Market information system in Croatia, Monthly prices of tomatoes on retail markets in Croatia (KUN/kg), (Internet, TISUP, 2010, 1).*

# Appendix 7:

| Monthly Exchange rates - National Bank of Macedonia (MKD / 1 EUR) | | | | | | | | | | | |
|------|---------|---------|---------|---------|----------|---------|---------|---------|----------|---------|---------|-----------|
|      | Jan     | Feb     | Mar     | April   | May      | June    | July    | Aug     | Sep      | Oct     | Nov     | Dec       |
| 2004 | 61,2892 | 61,2790 | 61,2932 | 61,2987 | 61,26378 | 61,3099 | 61,3068 | 61,2892 | 61,33944 | 61,468  | 59,4877 | 61,44140  |
| 2005 | 61,4286 | 61,3590 | 61,4175 | 61,3885 | 61,41712 | 61,3119 | 61,2015 | 61,2329 | 61,22449 | 61,187  | 59,2053 | 61,20455  |
| 2006 | 61,2839 | 61,2179 | 61,1969 | 61,1625 | 61,16862 | 61,167  | 61,167  | 61,1688 | 61,17321 | 61,181  | 61,1798 | 61,19541  |
| 2007 | 61,1801 | 61,1905 | 61,1728 | 61,1753 | 61,17293 | 61,1739 | 61,177  | 61,1712 | 61,17668 | 61,182  | 61,2048 | 61,22896  |
| 2008 | 61,3375 | 61,3231 | 61,2139 | 61,3726 | 61,22805 | 61,1739 | 61,1836 | 61,1782 | 61,17057 | 61,197  | 61,4101 | 61,401177 |
| 2009 | 61,3997 | 61,4078 | 61,4125 | 61,3478 | 61,40107 | 61,2647 | 61,1949 | 61,1713 | 61,1656  | 61,168  | 61,1695 | 61,177816 |
| 2010 | 61,1798 | 61,4224 |         |         |          |         |         |         |          |         |         |           |

*Source: National Bank of the Republic of Macedonia, middle exchange rates (Internet, NBRM, 2010, 1)*

| Monthly prices of tomatoes on retail markets (EUR/kg) | | | | | | | | | | | |
|------|---------|----------|-------|-------|------|------|------|--------|------|---------|----------|----------|
|      | January | February | March | April | May  | June | July | August | Sept | October | November | December |
| 2004 | 1,26    | 1,38     | 1,48  | 1,42  | 1,22 | 0,66 | 0,39 | 0,34   | 0,30 | 0,34    | 0,45     | 0,88     |
| 2005 | 1,42    | 1,50     | 1,49  | 1,35  | 1,07 | 0,64 | 0,31 | 0,27   | 0,29 | 0,44    | 0,47     | 0,69     |
| 2006 | 1,15    | 1,42     | 1,33  | 1,44  | 1,38 | 0,61 | 0,40 | 0,36   | 0,31 | 0,33    | 0,48     | 0,89     |
| 2007 | 1,72    | 1,55     | 1,52  | 1,63  | 1,05 | 0,51 | 0,46 | 0,50   | 0,51 | 0,54    | 0,54     | 0,70     |
| 2008 | 1,34    | 1,29     | 1,33  | 1,42  | 1,10 | 0,58 | 0,36 | 0,32   | 0,34 | 0,56    | 0,63     | 1,10     |
| 2009 | 1,24    | 1,20     | 1,55  | 1,59  | 1,14 | 0,64 | 0,48 | 0,47   | 0,46 | 0,39    | 0,40     | 0,82     |
| 2010 | 1,53    | 1,64     |       |       |      |      |      |        |      |         |          |          |

# Appendix 8:

| National Bank of Serbia Exchange rates (DIN /1 EUR) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  | **January** | **February** | **March** | **April** | **May** | **June** | **July** | **Aug** | **Sept** | **Oct** | **Nov** | **Dec** |
| **2006** | 87,120 | 87,516 | 86,901 | 86,350 | 87,638 | 86,000 | 83,000 | 84,600 | 82,000 | 79,920 | 78,650 | 79,000 |
| **2007** | 79,000 | 79,990 | 81,574 | 80,725 | 81,206 | 79,025 | 79,528 | 79,890 | 78,861 | 77,240 | 84,754 | 79,236 |
| **2008** | 82,772 | 83,464 | 82,315 | 80,130 | 82,430 | 78,978 | 76,994 | 76,444 | 76,597 | 84,991 | 89,195 | 88,601 |
| **2009** | 94,101 | 93,802 | 94,778 | 95,240 | 94,716 | 93,442 | 93,193 | 93,074 | 93,011 | 93,435 | 94,758 | 95,889 |
| **2010** | 98,462 | 99,634 | | | | | | | | | | |

*Source: National Bank of Serbia, foreign currency exchange official middle rates in "DIN" for "Euro", for selected dates (Internet, NBS, 2010, 1).*

| Monthly prices of tomatoes on retail market in Serbia (EUR/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  | **January** | **February** | **March** | **April** | **May** | **June** | **July** | **Aug** | **Sept** | **Oct** | **Nov** | **Dec** |
| **2006** | 1,72 | 1,71 | 1,73 | 1,91 | 1,71 | 1,06 | 0,52 | 0,45 | 0,36 | 0,43 | 0,65 | 1,46 |
| **2007** | 2,16 | 2,76 | 1,92 | 1,90 | 1,51 | 0,91 | 0,56 | 0,51 | 0,74 | 0,94 | 0,89 | 1,71 |
| **2008** | 2,03 | 1,98 | 1,81 | 1,89 | 1,72 | 1,05 | 0,56 | 0,42 | 0,61 | 0,98 | 0,89 | 1,45 |
| **2009** | 1,95 | 2,09 | 1,92 | 1,98 | 1,70 | 1,04 | 0,57 | 0,40 | 0,46 | 0,80 | 0,74 | 1,44 |
| **2010** | 2,03 | 2,01 | | | | | | | | | | |

# Appendix 9:

| Monthly average exchange rates - National bank of Croatia (KUN/ 1 EUR) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | January | Feb | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
| **2003** | 7,504 | 7,586 | 7,664 | 7,559 | 7,541 | 7,539 | 7,498 | 7,513 | 7,496 | 7,591 | 7,609 | 7,674 |
| **2004** | 7,693 | 7,654 | 7,505 | 7,507 | 7,427 | 7,377 | 7,371 | 7,369 | 7,411 | 7,543 | 7,554 | 7,548 |
| **2005** | 7,562 | 7,517 | 7,461 | 7,395 | 7,328 | 7,313 | 7,305 | 7,348 | 7,431 | 7,386 | 7,375 | 7,390 |
| **2006** | 7,378 | 7,327 | 7,326 | 7,315 | 7,273 | 7,255 | 7,246 | 7,276 | 7,386 | 7,393 | 7,344 | 7,355 |
| **2007** | 7,367 | 7,363 | 7,357 | 7,396 | 7,330 | 7,329 | 7,292 | 7,312 | 7,313 | 7,321 | 7,340 | 7,315 |
| **2008** | 7,327 | 7,267 | 7,267 | 7,266 | 7,255 | 7,247 | 7,230 | 7,196 | 7,126 | 7,158 | 7,141 | 7,197 |
| **2009** | 7,363 | 7,431 | 7,427 | 7,418 | 7,358 | 7,303 | 7,319 | 7,323 | 7,315 | 7,245 | 7,284 | 7,292 |
| **2010** | 7,291 | 7,305 | | | | | | | | | | |

*Source: Croatian National Bank, foreign currency nominal exchange rates "Kuna" for "Euro", for the concerned dates (Internet, CNB, 2010, 1).*

| Monthly prices of tomatoes on retail markets in Croatia (EUR/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | January | February | March | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
| **2003** | 2,31 | 2,60 | 2,90 | 2,65 | 2,11 | 2,13 | 1,46 | 0,92 | 0,76 | 0,80 | 1,14 | 1,82 |
| **2004** | 2,38 | 2,62 | 2,61 | 2,46 | 2,38 | 2,40 | 1,96 | 1,05 | 0,72 | 0,72 | 1,19 | 1,81 |
| **2005** | 2,25 | 2,69 | 3,60 | 2,74 | 2,63 | 2,24 | 1,66 | 1,07 | 0,91 | 0,98 | 1,42 | 1,91 |
| **2006** | 2,31 | 2,62 | 2,52 | 2,45 | 2,39 | 2,30 | 1,81 | 1,12 | 0,83 | 0,71 | 1,12 | 1,57 |
| **2007** | 2,21 | 2,27 | 2,10 | 2,07 | 2,10 | 2,02 | 1,56 | 0,98 | 0,85 | 0,91 | 1,43 | 2,19 |
| **2008** | 2,73 | 2,70 | 2,53 | 2,36 | 2,40 | 2,40 | 1,85 | 1,14 | 0,89 | 1,04 | 1,34 | 1,85 |
| **2009** | 2,64 | 2,72 | 2,82 | 2,57 | 2,41 | 2,33 | 1,76 | 1,16 | 0,96 | 1,03 | 1,32 | 1,75 |
| **2010** | 2,28 | 2,53 | | | | | | | | | | |