

Towards better understanding of vegetable market functioning: the Lithuanian cases of fresh tomatoes and cucumbers

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Abstract

The efficiency of the EU vegetable market depends on the ability of member states to identify and solve market functioning problems of particular agricultural commodities. The objective is to investigate the vertical price transmission along the fresh tomato and cucumber supply chains in Lithuania. The study reports about the role of the Lithuanian tomato and cucumber production in the EU context and discusses main determinants of the current situation. Results of price transmission analysis show the presence of the long-run asymmetry within the studied value chains suggesting that the markets are not efficient; however, the market of cucumbers returns to an equilibrium quicker. Finally, the study confirms that in both cases there are long-term relationships between retail and farm prices, while the causality is running from farm to retail level in both markets.

Keywords

Agriculture, price transmission, market, vegetable

Introduction

Over the last decade, the focus on the vulnerable position of farmers and consumers became a fruitful research niche for many academics, whereas the latest renaissance of the price transmission topic was driven by 2007/2008 and 2010/2011 price spikes when the issue of fair pricing came to the political arena as an important element of welfare of the certain society groups. The widely discussed topics, shedding light on this problem, became price transmission and the phenomenon of asymmetry, which challenged a well-established traditional concept of the markup pricing along the supply chain.

Most of the academic studies on price transmission in agriculture could be classified in accordance with their research direction or even combine couple overlapping research purposes. The largest share of publications introduces the empirical research on price transmission and confirms market failures or the efficient functioning of supply chains applying different methodologies (Aguiar and Santana, 2002; Ahmed, 2018; Ait Sidhoum and Serra, 2016; Bakucs et al., 2007; Girapunthong et al., 2003; Jeder et al., 2017; Munyeka, 2014; Myae et al., 2006; Rezitis and Pachis, 2013, 2016). An important research direction includes explanatory studies. Main factors determining the deviation from the markup concept and undesired price behaviour are discussed by Bakucs et al. (2014), Bunte and Peerlings (2003), Pérez Mesa and Galdeano Gómez (2011), Santeramo and Von Cramon-Taubadel (2016), Ward (1982), and etc. Another research direction focuses on the generalisation of the previous theoretical and methodological developments or empirical research findings in order to analyse the advantages or disadvantages of the applied models or methodologies, map differences or similarities of agricultural commodity markets (Frey and Manera, 2007; Listorti and Esposti, 2012; Von Cramon-Taubadel, 2017). These studies contribute to the scientific discourse showing state-of-the-art of the research on price transmission and identifying prospective research directions. Finally, the most important research direction is dedicated to the development of theoretical models or techniques estimating important aspects of price transmission and market efficiency. These studies identify crucial estimation problems and improve the knowledge about the price transmission phenomenon (e.g., Parrott et al., 2001).

The aforementioned studies on fresh tomato and cucumber price behaviour provide contradicting results and allow to state that the case of every country is a valuable contribution to a better understanding of vegetable market failures. Therefore, this paper provides a contribution to the first

1
2 45 group of studies and improves the knowledge about the functioning of the EU vegetable market
3 46 enriching the previous research with the Lithuanian fresh tomato and cucumber supply chains, which
4 47 were omitted due to missing long-term price series.

5 48 The objective of the paper is to investigate the vertical price transmission along the fresh tomato and
6 49 cucumber supply chains in Lithuania. The research question is set as follows: Does vertical price
7 50 transmission of the Lithuanian fresh tomatoes and cucumbers have an impact on market efficiency?

8 51 The paper provides additional arguments for the discourse on the price transmission phenomenon
9 52 adding the Lithuanian case. This study fills the gap in the scarce research on price changes along the
10 53 cucumber supply chain, contributes to the better understanding of the EU vegetable market functioning.
11 54 Findings confirm the need of the further in-depth research and provide additional arguments for policy
12 55 makers mapping market functioning problems, which could result in welfare losses on farm or retail
13 56 levels.
14 57

15 58 **Research on vertical price transmission among tomato and cucumber supply chains**

16 59 One of the most recognisable publications on price transmission in the vegetable market belongs to
17 60 Ward (1982) who investigated the relationships of vegetable prices, including cucumbers and tomatoes,
18 61 between shipping point, wholesaler, and retailer levels in the USA and found both symmetric and
19 62 asymmetric behaviour. The study argued that the traditional price markup concept often failed to
20 63 explain the behaviour of prices along the supply chain of the analysed vegetables, and Ward (1982)
21 64 assumed that perishability could be an important factor contributing to asymmetric price transmission.

22 65 Few decades later, the similar study of the USA tomato prices was conducted by Girapunthong et al.
23 66 (2003), however, most of the findings contradicted to the previous results, and researchers assumed that
24 67 the role of perishability had reduced due to important structural changes improving both post-harvest
25 68 storage and supply chain management practices. The evidence of the one-way causality and the
26 69 leadership of producer prices were found, while Ward (1982) identified wholesalers as the main pricing
27 70 node. Retail prices reacted to the growth of wholesale prices faster than to fall, while conclusions of
28 71 Ward (1982) were contrary. At the same time, the later study showed that the behaviour of prices on
29 72 producer-retail level was symmetric. Parrott et al. (2001) also investigated the USA case of tomatoes
30 73 and found no evidence of market inefficiencies between shipping point and retail levels.

31 74 Later, Santeramo and Von Cramon-Taubadel (2016) investigated the link between the asymmetric
32 75 price behaviour and perishability in Italy. They looked for the long- and short-run price adjustments
33 76 and concluded that for more perishable products, including tomatoes, price transmission was
34 77 symmetric.

35 78 The issues of the long-run price transmission and volatility in the Spanish tomato supply chain were
36 79 analysed by Ait Sidhoum and Serra (2016). They found an evidence of the long-run relationship
37 80 between prices and slow adjustment of retail prices to the equilibrium assuming that the situation could
38 81 be explained by market power at the downstream level.

39 82 Aguiar and Santana (2002) investigated the impact of market concentration and perishability on the
40 83 asymmetric price behaviour and concluded that in case of the Brazilian tomato market both factors
41 84 were less important than inflation, which empowered even actors without market power to transmit
42 85 price increases faster than decreases. The asymmetric price behaviour and the causality from farm to
43 86 retail were found.

44 87 Bunte and Peerlings (2003) investigated the short-run price transmission effects on welfare of
45 88 stakeholders along the Dutch cucumber supply chain. Findings suggested that changes of market power
46 89 and supply shocks on oligopoly and oligopsony markets influenced the asymmetric behaviour and
47 90 determined the welfare of stakeholders.

1
2 91 The similar methodological framework was employed to investigate the effects of the short- and
3 92 long-run price transmission in Hungary (Bakucs et al., 2007), Limpopo Province (Munyeka, 2014), and
4 93 Tunisia (Jeder et al., 2017). Results showed that in case of Hungary and Tunisia prices were
5 94 determined on the level of the downstream market, while in Limpopo Province the market power was
6 95 on farm level. The long-run asymmetric behaviour was found as a common feature of the analysed
7 96 chains, but the short-run price transmission in Limpopo Province was symmetric.

8 97 The long- and short-run effects of price changes among the Greek tomato (Rezitis and Pachis, 2013,
9 98 2016) and cucumber (Rezitis and Pachis, 2016) supply chains were investigated applying different
10 99 states of price volatility. According to studies, the behaviour of prices along the chains of cucumbers
11 100 and tomatoes differed significantly, and findings questioned the impact of the Common Market
12 101 Organization on the domestic supply chains of different fruits and vegetables in EU member states. The
13 102 tomato market under the low volatility regime was efficient, while in the state of high volatility
14 103 behaved asymmetrically, and the retail price led the producer price in the long-term period. The
15 104 cucumber supply chain demonstrated a symmetric behaviour and the feedback between retailer and
16 105 producer prices both in the short- and long-run in the high volatility state, while the asymmetric
17 106 behaviour and the influence of producer prices on the consumer price level in the long run
18 107 characterised the state of the low volatility.

19 108 Ahmed (2018) investigated the Egyptian fresh tomato supply chain and found that price increases
20 109 were transmitted better than decreases on both producer–wholesaler and wholesaler–retailer levels.
21 110 Results suggested that the retail sector exercised a market power contributing to the asymmetric price
22 111 behaviour and transmitting price increases more fully than decreases.

23 112 To conclude, the conducted empirical studies on vertical price transmission along fresh tomato and
24 113 cucumber supply chains covered a wide geographic area and focused on different supply chain
25 114 stakeholders, data quality and frequency, research periods and econometric techniques. However, these
26 115 empirical studies did not make a coherent and clear picture with complementary findings, but rather
27 116 confirmed the importance of the individual case studies for the better understanding of the vegetable
28 117 market functioning.

29 118 30 119 **Development of tomato and cucumber production**

31 120 The paper introduces the situation of the Lithuanian tomato and cucumber production and the role of
32 121 this agricultural production **in the EU context, focuses** on the analysis of vertical price transmission of
33 122 fresh tomatoes and cucumbers in the Lithuanian market. The analysis of changes in tomato and
34 123 cucumber production relies on data collected on November 23, 2018, from online databases of
35 124 Statistics Lithuania and Eurostat.

36 125 Tomatoes play a significant role in the EU agriculture and this vegetable is included in a daily ration
37 126 of many EU citizens. According to Eurostat, in 2017, tomatoes covered 241.3 thousand hectares (ha) of
38 127 the EU harvested area, and production accounted for 17,426.6 thousand tonnes. The EU area occupied
39 128 by tomatoes decreased by 7.0% in the year 2017 as compared to 2010, while the harvested production
40 129 increased by 18.2%.

41 130 Cucumber production in the EU agriculture was less important, but the development trends were
42 131 similar. According to Eurostat, this vegetable covered 31.9 thousand ha of the EU harvested area in
43 132 2017, and the corresponding loss of area was 12.4%, compared to the year 2010. In 2017, the
44 133 production amounted to 2,301.2 thousand tonnes, however, this indicator showed an increase of 9.8%
45 134 over the period analysed.

46 135 Table 1 illustrates the contribution of Lithuanian tomato and cucumber production to the EU
47 136 agriculture. According to Eurostat, the average yields of these vegetables in top five producing
48 137 countries and Lithuania differ significantly. Furthermore, the average yields of these vegetables for EU

member states were growing over the last decade. The yield situation and competitive advantages of EU member states depended on many factors. Climate issues, farming structure and ability to invest in improved vegetable varieties, greenhouse production, supplemental lighting and heating, targeted use of nutrients and water were among the most important aspects of success.

Table 1. Top five tomato and cucumber producing countries in the EU and Lithuania in 2017

Rank	Area (%)	Rank	Harvested production (%)
Tomatoes			
1	Italy (38.40)	1	Italy (31.98)
2	Spain (25.22)	2	Spain (29.63)
3	Slovenia (9.20)	3	Portugal (10.03)
4	Portugal (8.65)	4	Netherlands (5.22)
5	Greece (5.52)	5	Poland (5.15)
12	Lithuania (0.23)	20	Lithuania (0.07)
Cucumbers			
1	Poland (28.80)	1	Spain (27.57)
2	Spain (23.44)	2	Poland (19.6)
3	Romania (17.05)	3	Netherlands (17.39)
4	Greece (5.89)	4	France (6.66)
5	Italy (5.61)	5	Greece (5.15)
7	Lithuania (3.38)	16	Lithuania (0.81)

Source: own elaboration on the basis of Eurostat data (2018-11-23).

Lithuanian tomatoes and cucumbers are mainly produced on farmer and family farms with a dominant share of outdoor planting, while agricultural companies and enterprises, characterised by higher yields, occupy less than 3.0% of the harvested area. According to Statistics Lithuania, the comparison of the harvested area for the period 2010–2017 allows identifying the remarkable shrinking of the tomato production area from 0.7 to 0.6 thousand ha and the cucumber production area from 1.6 to 1.2 thousand ha.

It is important to note that only 11.2% of Lithuanian tomatoes were planted under glass or high accessible cover in 2017, while for cucumbers the share of such production accounted for 49.8%. During the period from 2010 to 2017, a slight decrease of tomato production under glass and highly accessible cover is noticeable. On the contrary, the cucumber indoor production demonstrated a small increase. This feature of Lithuanian tomato and cucumber production is one of the most important explaining low yields.

A significant gap is observable comparing average yield and average outdoor yield. In 2017, these figures for tomatoes were 212.1 and 98.5 kg per ha respectively, while for cucumbers – 160.5 and 65.9 kg per ha. The modest share of agricultural companies and enterprises demonstrated higher average yields than farmer and family farms, because they were able to invest in glasshouse cultivation and scientific innovations.

Material and methods

Research data

The study of price transmission is based on the average retail and commercial farm prices for the period from 2010 to 2017 (Figure 1). The data from the SE ‘Agricultural Information and Rural Business Centre’ was used.

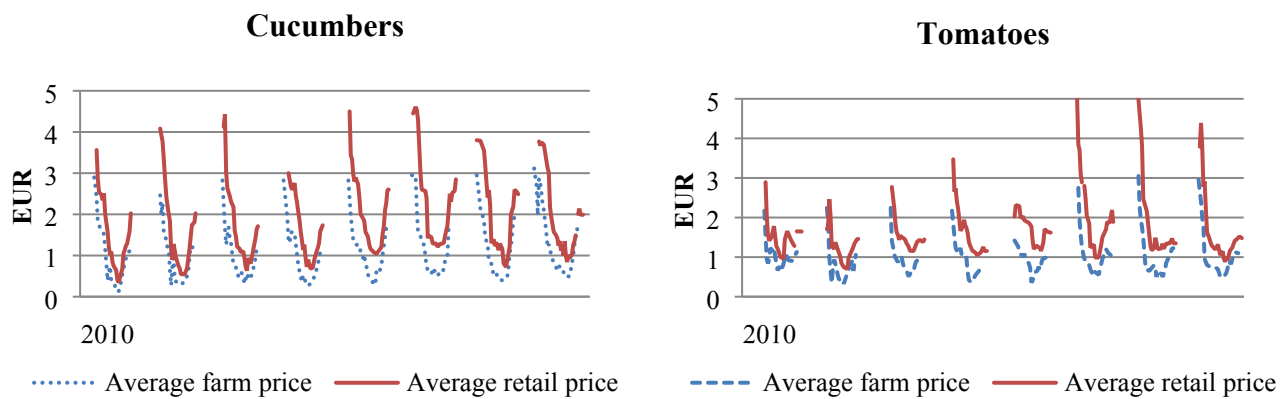


Figure 1. Average cucumber and tomato prices: farm and retail levels

Source: own elaboration based on data from SE 'Agricultural Information and Rural Business Centre'.

The average retail price covers only fresh tomatoes and fresh short-fruit cucumbers of the Lithuanian origin. The weekly average retail price is derived from the dominant Lithuanian supermarkets in seven counties. Weekly average prices on Lithuanian farms are not collected, and the study relies on the average price, which is calculated from the weekly announced minimum and maximum prices on Lithuanian farms, as a proxy of the average farm price. Unfortunately, the statistics on average farm price is available only on monthly basis; however, for the analysis of fresh vegetables a weekly frequency is more desirable as a higher level of the aggregation corrupts the outlook and hides visibility of the certain processes.

Figure 1 demonstrates that data availability depends on seasons. The beginning of the season for fresh vegetables is characterized by high prices, which decline sharply and demonstrate a slight growth at the end of the season. These price fluctuations could be explained by swelling production costs which compensate unfavourable weather conditions.

Remarkable changes of season duration are observed if we compare availability of fresh tomatoes on farms for the analysed period. Thus, some vegetable farms moved towards the cultivation throughout the year.

Methodological research framework

The analysis of vertical price transmission is conducted applying a framework of econometric techniques, which explore the relations between farmer and retailer prices. The study uses logarithmic transformations of prices in order to solve typical statistical problems (Brooks, 2008).

First, the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) is conducted to classify each price series into stationary and non-stationary. Results of this test help to select appropriate research techniques. The ADF test is run twice: including a constant and selecting a trend specification with an intercept. If the null hypothesis (H_0) of the unit root presence is not approved, price series are stationary. Data stationarity is an important property allowing to avoid spurious regression implementing further steps of the analysis.

Second, the Johansen co-integration test (Johansen 1991; Johansen 1995) is run to verify if farm and retail prices in the selected supply chains move together or demonstrate different development trends in a long run. The Johansen test combines results of Trace and Max-Eigen tests and verifies the H_0 investigating the presence of the selected number of co-integrated vectors.

Engle and Granger (1987) state that the co-integrated variables mean the presence of the co-integrated vector. If prices on farm and retail levels are stationary and co-integrated, the co-integrated

vector could be presented as the ECM. An important contribution to the development of this technique was done by Johansen (1988, 1991, 1995).

Third, the ECM for farm and retail prices is applied (similar to described in Von Cramon-Taubadel (2017)). The equation shows short-term relationships between prices on farm and retail levels and demonstrates the speed of recovery to the general equilibrium in the long-term period. The latter is measured applying error correction term (ECT). The ECT indicates the time of price return to the initial equilibrium. This figure must be negative and statistically significant to ensure the validity of the co-integration.

The next important step is the analysis of the Granger causality (Granger, 1969). The Granger causality test allows exploring the presence of the causality between farmer and retailer and the nature of the price feedback along the supply chain. For the each vegetable two H_0 are set in order to answer the question whether there is a stakeholder with the leading role in price setting or market functions efficiently.

Finally, the analysis of price transmission symmetry is conducted. Von Cramon-Taubadel (2017) reports on currently applied research in this area and provides some methodological basis. The results of these studies show whether price shocks have an impact on market efficiency. The asymmetric price behaviour means a deviation from the price markup concept and transmission problems along the supply chain.

This study deploys the method of the consistent momentum threshold autoregressive model (MTAR) described by Enders and Siklos (2001). MTAR catches 'possibility of asymmetrically 'sharp' movements' (Enders and Granger, 1998: 304), while the previous threshold autoregressive models empowered the analysis of deep fluctuations.

At the first stage MTAR confirms or rejects the H_0 of no cointegration between variables. If the presence of the long-term period relation between prices of farmer and retailer is proved, the second H_0 tests for the presence of symmetry.

Results

The application of the selected price transmission estimation framework is related to the nature of price series. First, the ADF test results are examined (Table 2).

Table 2. Results of ADF test for cucumber and tomato price series

Exogenous: Constant	<i>t</i> -statistic		Prob
	Cucumbers*		
	LFARMC	LRETAILC	
ADF test statistic	-5.16	-4.59	0.00 ¹
Test	1% level	-3.46	0.00 ¹
critical	5% level	-2.87	0.00 ¹
values:	10% level	-2.57	0.00 ¹
Trend specification: intercept only	LFARMC	LRETAILC	
ADF test statistic	-5.53	-5.09	<0.01 ²
Test	1% level	-4.95	<0.01 ²
critical	5% level	-4.44	<0.01 ²
values:	10% level	-4.19	<0.01 ²
Exogenous: Constant	Tomatoes**		Prob
	LFARMT	LRETAILT	
	ADF test statistic	-7.50	
Test	1% level	-3.46	0.00 ¹
critical	5% level	-2.87	0.00 ¹

values:	10% level	-2.57	-2.57	0.00 ¹
Trend specification:				
intercept only		LFARMT	D(LRETAILT)	
ADF test statistic		-7.96	-13.96	<0.01 ²
Test	1% level	-4.95	-4.95	<0.01 ²
critical	5% level	-4.44	-4.44	<0.01 ²
values:	10% level	-4.194	-4.19	<0.01 ²

¹ MacKinnon (1996) one-sided p -values.

² Vogelsang (1993) asymptotic one-sided p -values.

* Lag Length: 1 (Automatic (SIC), maxlag = 15).

** Lag Length: 0 (Automatic (SIC), maxlag=14).

Source: own elaboration.

Results confirm that in case of the exogenous constant the H_0 of unit root presence could be rejected for farm and retail price series in both tomato and cucumber supply chains, because the absolute values of the ADF test statistic are higher than test critical values, while results are significant at 1.0% level.

The ADF test with trend specification, which includes only the intercept, also rejects the H_0 , however, the retail price series of tomatoes become stationary only in first differences. Thus, farm and retail price series are stationary and the further analysis will not result in spurious regressions.

Empirical results show that in both examined markets of tomatoes and cucumbers all tested variables have been identified as stationary in the first difference. Prices are integrated of first order. Thus, the tests use the first difference to ensure that the findings are valid as seasonality does not affect the time series and also assist in prevention of the spurious regression.

The next step verifies the presence of relations between prices in both supply chains in the long run (Table 3). The Johansen co-integration test under linear deterministic trend shows that for both vegetables the first H_0 (no co-integration between farm and retail prices in first differences) is rejected. These results are supported by Trace and Max-Eigen statistic values, which are higher than critical values. The p -values confirm that results are significant at 1.0% level.

According to Trace and Max-Eigen tests, the second H_0 (there is at least 1 co-integrating vector between farm and retail prices in first differences) is also rejected. The results of the Johansen co-integration tests confirm the presence of 2 co-integrating vectors at 1.0% significance level.

Table 3. Results of the Johansen test for cucumber and tomato prices

	Hypothesized	Eigenvalue	Trace Statistic	Critical
	No of cointegrations			Value (0.05)
Cucumbers	None *	0.29	97.48	15.49
	At most 1 *	0.09	21.39	3.84
	Hypothesized	Max-Eigen Statistic	Critical Value (0.05)	Prob**
	No. of cointegrations			
	None *	76.09	14.26	0.00
	At most 1 *	21.39	3.84	0.00
Tomatoes	Hypothesized	Eigenvalue	Trace Statistic	Critical
	No. of cointegrations			Value (0.05)
	None *	0.31	112.35	15.49
	At most 1 *	0.17	37.87	3.84
	Hypothesized	Max-Eigen Statistic	Critical Value (0.05)	Prob**
	No. of cointegrations			
	None *	74.48	14.26	0.00

At most 1 *	37.87	3.84	0.00
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* H_0 is rejected.
 **MacKinnon-Haug-Michelis (1999) p -values.
 Lags interval (in first differences): 1 to 1.
 Source: own elaboration.

The ECM estimates the speed of adjustment of prices to the new long-run equilibrium. The ECM results for cucumbers and tomatoes are provided in Table 4.

Table 4. ECMs for cucumbers and tomatoes

Cucumbers		Tomatoes	
Cointegrating equation 1		Cointegrating equation 2	
LRETAILC(-1)	1.00	LRETAILT(-1)	1.00
LFARMC(-1)	-0.80 (0.03) [-29.73]	LFARMT(-1)	-0.47 (0.07) [-6.59]
D2013(-1)	-0.11 (0.03) [-3.44]	D2011(-1)	-0.08 (0.07) [-1.06]
C	-0.56	C	-0.40
Error Correction: D(LRETAILC)		Error Correction: D(LRETAILT)	
ECT	-0.47 (0.06) [-8.02]	ECT	-0.24 (0.04) [-6.18]

Source: own elaboration.

According to the results in Table 4, in the equation for cucumbers, the ECT amounts to -0.47. The figure is both negative and statistically significant. This means that 47.1% of the disequilibrium remains dissipated before the start of the next period. The absolute value of t -statistic (-8.0) is higher than critical. Thus, results are statistically significant and the equation for cucumbers is valid. The ECT for tomatoes is negative and statistically significant, it amounts to -0.24. This means that the retailer price will recover at the speed of 24.4%. The value of t -statistic (-6.2) for tomatoes is statistically significant.

Furthermore, it should be noted that the adjustment speed for tomatoes is 24.4%, while for cucumber – 47.1%. This means that the speed of market recovery towards equilibrium after a shock has occurred differs almost twice, and the market of cucumbers recovers to the long-run equilibrium faster.

The pairwise Granger causality tests allow to analyse whether the farm price in the short run helps to predict the retail price, and vice versa. Hence, for the each of the selected vegetables we investigate two H_0 (Table 5).

Table 5. The Granger causality test for cucumber and tomato prices (2 lags)

	The investigated H_0	F-Statistic	Prob.
Cucumbers	LFARMC does not Granger cause LRETAILC	93.18*	0.00
	LRETAILC does not Granger cause LFARMC	0.74	0.48
	LRETAILT does not Granger cause LFARMT	0.04	0.96
	LFARMT does not Granger cause LRETAILT		

1			
2	LFARMT does not		
3	Granger cause	33.78*	0.00
4	LRETAILT		

5 288 * H_0 is rejected.

6 289 Source: own elaboration.

7 290

8 291 Results show the same causality direction for tomato and cucumber supply chains. In case of
 9 292 cucumbers we cannot reject the H_0 that farm prices do not cause retail prices. As a result, we can see
 10 293 one-way direction of the Granger causality from farm to retail.

11 294 In the Lithuanian tomato market the same behaviour of prices as in cucumber market is observed.
 12 295 The H_0 that farm prices does not Granger cause retail prices cannot be rejected. This market also has
 13 296 one-way causality and a stakeholder leading prices in the short term period. In case of tomatoes prices
 14 297 go from farm to retail level too.

15 298 At the final stage of our analysis, the possibility of asymmetric linkages between the each price pair
 16 299 in the long run time horizon is examined. Firstly, we examine whether the co-integration and
 17 300 asymmetry exist.

18 301 Table 6 presents the empirical results that obtained from the MTAR model. The H_0 of no co-
 19 302 integration ($H_0: \rho_1=\rho_2=0$) is rejected for all price pairs (tomatoes and cucumbers) as the F -joint values
 20 303 amount to 6.8 and 13.9 respectively. The results evidence stable long run relationships between the
 21 304 examined agricultural commodities and suggest that the markets of farmers and retailers are indeed co-
 22 305 integrated.

23 306

24 307 **Table 6.** Results of MTAR model for cucumber and tomato prices

	Cucumbers		Tomatoes	
	Coefficient	Std. Error	Coefficient	Std. Error
29 Above threshold	-0.36	0.10	-0.14	0.07
30 Below threshold	-0.08	0.10	-0.34	0.06
31 Threshold Value	0.00		0.00	
32 F -equal	5.92	(2.79)*	4.78	(3.70)*
33 T -max value	-0.83	(-2.14)*	-2.00	(-1.99)*
34 F -joint (phi)	6.77	(5.87)*	13.93	(6.46)*

35 308 Source: own elaboration

36 309

37 310 Since the co-integration exists, we therefore test for asymmetry. Results indicate that the H_0 of
 38 311 symmetry ($H_0: \rho_1=\rho_2$) is rejected in all price pairs as the F -equal values are 5.9 and 4.8 respectively.
 39 312 Price transmission – in the long run – appears to be asymmetric since negative shocks are transmitted
 40 313 with higher intensity than positive-type shocks. Thus, the examined markets cannot be characterized as
 41 314 efficient.

42 315

43 316 Discussion

44 317 According to the results of the price transmission analysis, the Lithuanian fresh tomato and
 45 318 cucumber markets suffer from market efficiency problems. The Granger causality test identified one-
 46 319 way causality direction from farmer to retailer in the analysed Lithuanian markets. Girapunthong et al.
 47 320 (2003) and Munyeka (2014) also found similar results supporting one-way causality from upstream
 48 321 levels, while Jeder et al. (2017) concluded that the direction was from retail to farm level.

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2 322 The results contradict to Reztis and Pachis (2013) findings showing two-way causality in tomato
3 323 supply chain. It should be noted that the later research conducted by Reztis and Pachis (2016)
4 324 evidences that the results of the Granger causality test could differ under different volatility regimes
5 325 and switch from two-way to one-way direction. As a result, the selected methodological framework and
6 326 data could lead to different outcomes.

7 327 The Granger causality test cannot be used for the prediction of the price development in the future,
8 328 but the findings explain short-run relations between prices in the past. In the Lithuanian tomato and
9 329 cucumber markets, the price leadership is on producer level. Thus, the welfare of farmers is not
10 330 discriminated.

11 331 The study of price transmission, employing MTAR model, also evidences in favour of the
12 332 inefficient functioning of tomato and cucumber markets in the long run. These results contradict to the
13 333 findings of Parrott et al. (2001) and Gaetano Santeramo and Von Cramon-Traubel (2016) who found no
14 334 confirmation of asymmetric behaviour in the USA and Italian tomato markets. However, the
15 335 Lithuanian case of asymmetric price transmission in tomato market is not unique and corresponds to
16 336 the findings of researchers in Hungary (Bakucs et al., 2007), Tunisia (Jeder et al., 2017), the USA
17 337 (Ward, 1982), Egypt (Ahmed, 2018), Brazil (Aguiar and Santana, 2002), and etc.

18 338 According to the previous studies, some countries combine both symmetric and asymmetric price
19 339 behaviour. The results depend on the selected for the analysis stakeholders' level (Girapunthong et al.,
20 340 2003; Munyeka, 2014; Reztis and Pachis, 2016) or price transmission research horizon (Reztis and
21 341 Pachis, 2016). The conducted studies evidence both negative and positive asymmetry (Ahmed, 2018;
22 342 Girapunthong et al., 2003; Reztis and Pachis, 2016; Ward, 1982) and provide limited possibility to
23 343 make a coherent picture of the phenomenon. Thus, the feature of perishability cannot be a main
24 344 explanatory factor for asymmetric price behaviour and other characteristics of the particular markets
25 345 are important.

26 346 The presentation of the typical research results (for the similar markets, supply chain levels or
27 347 countries) is complicated. For example, Reztis and Pachis (2016) show that cucumber and tomato
28 348 price behaviour depends on the volatility regime. In the short- and long-run, the regime-dependent
29 349 response of the selected stakeholders in the same country could demonstrate both symmetric and
30 350 asymmetric behaviour. The aforementioned results confirm the importance of the flexible legislation
31 351 framework for the Common Agricultural Policy allowing to react to the diversity of market problems in
32 352 the EU member states.

33 353 The generalisation of the previous studies allows identifying the desired directions for the further
34 354 research. First, the analysis could include more supply chain levels in order to study the relations
35 355 between different stakeholders and identify the intermediary responsible for the inefficient price
36 356 behaviour. Second, study conducted by Reztis and Pachis (2016) shows that the results could depend
37 357 on the selected regime. The regime-dependent study could also provide important findings for the
38 358 policy makers and help to improve the functioning of the market. However, it is important to note that
39 359 the price situation is often determined by both internal and external trade policies (Anderson, 2009).
40 360

41 361 Conclusion

42 362 In Lithuania, the production of tomatoes and cucumbers is shrinking. Although this type of farming is
43 363 supported by the Common Agricultural Policy, unfavourable climate conditions combined with the
44 364 farm structure make domestic production less competitive in the EU market. The current support
45 365 (direct payments and market measures) could be accompanied by additional investments in glasshouses
46 366 and combined with the production-specific knowledge transfer allowing to increase yields.

47 367 The investigation of vertical price transmission shows possible market efficiency drawbacks.
48 368 Although a long-term horizon relationship between the examined prices in both markets was found, the
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2 369 results report about different recovery speed to the long run equilibrium. The ECT for tomatoes is -
3 370 0.24, while for cucumbers – -0.47. This finding shows that the market of cucumbers recovers to the
4 371 equilibrium faster than tomato market and gives a signal for scientists to conduct a more detail research
5 372 explaining the main determinants of such price behaviour.

6 373 Study also finds the evidence of the asymmetric price behaviour in tomato and cucumber markets,
7 374 because negative shocks are transmitted better than positive. Asymmetric price transmission might
8 375 have significant effects on the distribution of welfare and policy implementation. As asymmetry was
9 376 found to be present within the examined markets of tomatoes and cucumbers for the period studied it
10 377 shows that the current legislation is ineffective to ensure a perfectly competitive market.

11 378 Outcomes of the Granger causality test show the similar causality direction for tomato and
12 379 cucumber supply chains. In case of tomatoes and cucumbers we can see one-way direction of the
13 380 Granger causality from farm to retail. Thus, the direction is favourable for the welfare of farmers as
14 381 they can impact price development on the market in the short run.
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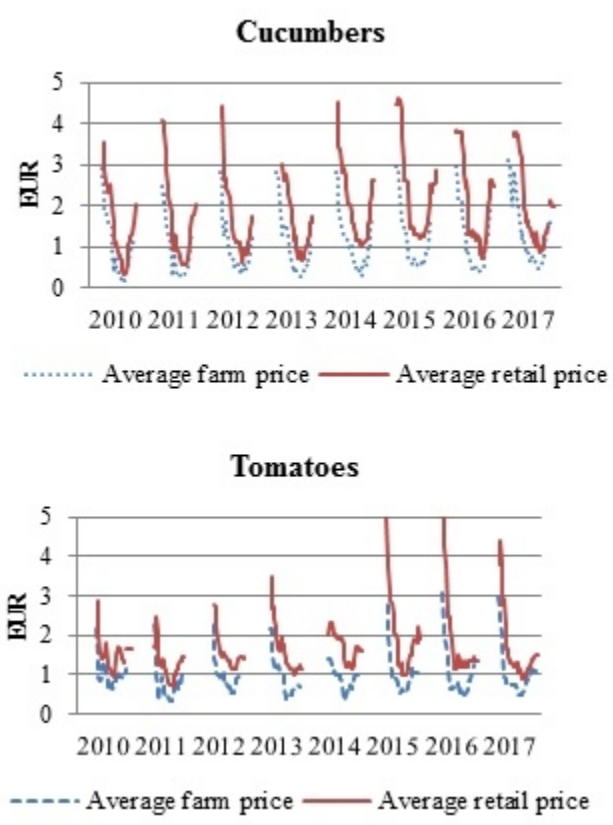


Figure 1. Average cucumber and tomato prices: farm and retail levels
Source: own elaboration based on data from SE 'Agricultural Information and Rural Business Centre'.

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