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TRANSMISSION BETWEEN RETAIL AND PRODUCER PRICES FOR MAIN VEGETABLE CROPS IN TUNISIA

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Abstract

Recently in Tunisia, vegetables prices increased rapidly, especially green pepper, tomato and potato. The sharp rise in prices led to the deterioration of consumer's purchasing power and the depletion of their food basket. Since price is the mechanism linking the different stages of the production chain, information on price transmission and causality can provide guidance on the actions to be taken by the actors. The results of the price transmission show a long-term relationship between retail prices and producer prices. The important role played by intermediaries influences the symmetric transmission mode. In the case of tomatoes, the transmission is asymmetric and the causality has gone from retail to producer prices, whereas for potatoes the transmission is symmetrical and the causality of production prices towards the retail price. For green pepper the transmission is also symmetrical and the causality is from retail price to the production price. The transmission depends on the causality but it also depends on the supply of the market and if the product is storable or not. Actions to be undertaken by the actors must concentrate on the control and transparency of commercial transactions along the food chain. Prices regulation must be placed on the wholesale level and not on the level of the producers in order to clear the margin of intermediaries and avoid the shortage of certain products in markets.
Keywords: *Price transmission, market, retailers, producer, vegetables, Tunisia*
JEL Codes: Q02, Q11, Q13, Q18

1. Introduction

In Tunisia, vegetables play an important role in agricultural production. The sown agricultural lands are around 150,000 ha/year, which corresponds to 3% of the agricultural area and 37% of irrigated areas of the country. The total annual vegetable production is 2.5 million tons. Economically important species are mainly: tomato, pepper, potato, watermelon, melon and onion. By themselves, these vegetables occupy around 76% of total vegetable crops areas and represent about 82% of vegetable production (Agricultural Investment Promotion Agency, 2015).

Some vegetables such as potato, tomato and green pepper constitute an important part of a Tunisian diet. The strategy of Tunisian agricultural marketing aims to maintain the production of vegetables in domestic markets in order to ensure the necessary supply, avoid shortage and control prices. Despite this strategy, a rapid price increase is found after the revolution. It has led to unbalanced markets and unorganized circuit development with increasing numbers of intermediaries.

At the same time, it should be noted that vegetable marketing is highly risky due to wide yield and price variation. It needs a quick disposal because of the perishable nature of vegetables. For all these reasons, marketing system of vegetables need an alert attention to production and marketing aspects. So, having information on prices and on markets helps decision-makers to take the precautionary measures necessary to restore market equilibrium and limit the profit margins of intermediaries.

The objective of this paper is to analyze the nature of price transmission of vegetables crops along the supply chain from the producer to wholesalers in Tunisia horticultural markets, and to propose recommendations for decision-makers in order to control the marketing chain and market equilibrium.

2. Marketing and Pricing for Vegetables in Tunisia

In Tunisia, The predominant marketing chain for vegetable crops is the conventional circuit: Producer – wholesalers - retailers - Consumer. However other intermediaries may be added to this circuit such as collectors, who buy the production directly from small producers on site, carriers which can be private or service companies that transport the products to the wholesale market on behalf of the producer and dealers who supply retailers from the wholesale market. The multitude of operators and intermediaries currently generate additional costs and do not allow transparency in prices (Laajimi & Gasmi, 2007).

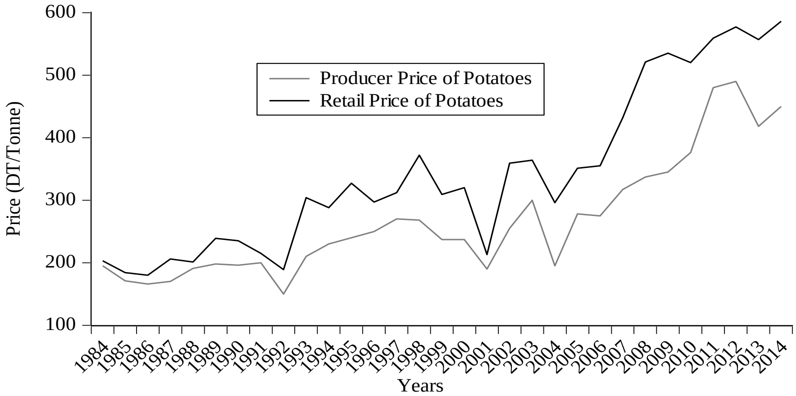
For commercialization in the domestic market incurs costs for the interveners consist mainly of transport costs, taxes and charges. A transport cost varies from 15 to 20 Tunisian Dinars per Ton (TD/Ton) for regional markets. These costs can reach 50 Tunisian Dinars per Ton for products brought from the south and center to the capital city. In some cases, the carrier requires payment to the cashier (1Tunisian Dinars per case transported), thus increase the cost of transportation. The taxes and charges on the wholesale market are about 12.5% according the information collected on the central market of Tunisia in 2014.

For the price evolution between 1984 and 2014 at constant prices[1]according to National Observatory of Agriculture data, the graphical examination prices indicate that producer and retail prices increase and decrease simultaneously. Figure 1 shows the presence of a significant drop in production and details prices of green pepper in 1998. Concerning potato, the Figure 2 shows average fluctuations with a trend towards increase from 2008, On the other hand for tomatoes, Figure 3 shows fluctuations with a large difference between the retail and producers prices (National Observatory of Agriculture, 2015). The common point between these data is the presence of a marketing margin between the retail price and the production price. This marketing margin varies according to crop, it is important for the case of tomato and green pepper and it is average for potato. Variability in price series shows market instability.

[1] The nominal price data was deflated to 1984 in terms of the Tunisian consumer price index

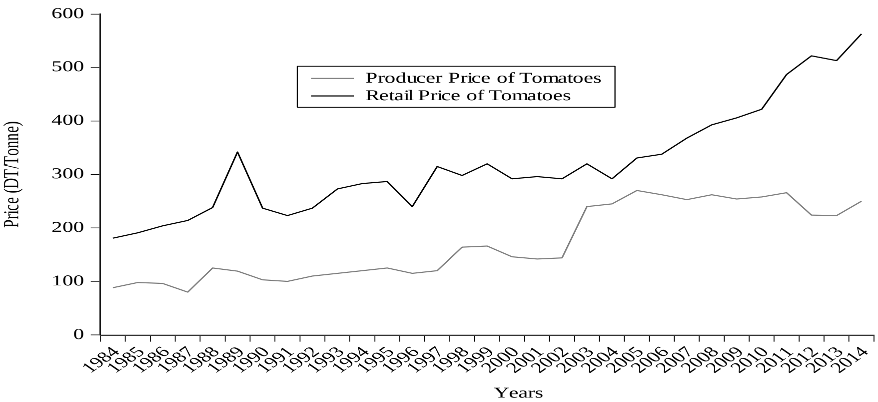
Source: Own presentation using data of National Observatory of Agriculture

Figure 1. Producer and Retail Prices of Green Peppers at Constant Prices



Source: Own presentation using data of National Observatory of Agriculture

Figure 2. Producer and Retail Prices of Potatoes at Constant Prices



Source: Own presentation using data of National Observatory of Agriculture

Figure 3. Producer and Retail Prices 0f Tomatoes at Constant Prices

3. Methodology

The data used in this analysis is price series between two years 1984 and 2014 of three agricultural products: Tomato, Green pepper and Potato. These data are collected from the base data of National Observatory of Agriculture. The data is transformed into logarithm to interpret the coefficients associated to the explanatory variables as elasticity if the long-term relationship exists. The software Eviews was used for the econometric analysis.

3.1. Theoretical background

The marketing margin represents marketing costs such as transport, storage and processing. It is the difference between the retail (R_p) and the producer price (F_p) :

$$R_p = F_p + M_m \quad (1)$$

M_m, the marketing margin is composed of an absolute amount and a percentage or mark-up of the retail price (Tomek and Robinson, 2003):

$$M_m = \alpha + \beta * R_p \quad (2)$$

Where $\alpha \geq 0$ and $0 \leq \beta < 1$

If the market is perfectly competitive, then $\beta = 0$, the margin becomes the constant α, which can be interpreted as the marginal cost. Using logarithmic data in margin model marketing, the long-run elasticity between prices is easily interpretable. If prices are determined at producer level, the mark-up model is used:

$$lnR_p = \alpha_1 + \varepsilon_{F_p} lnF_p \quad (3)$$

Where, ε_{F_p} represents price transmission elasticity from the producer price (F_p) towards the consumer price (R_p). If $\varepsilon_{F_p} = 1$, we have perfect transmission, and thus mark-up will be $(e^{\alpha_1} - 1)$. $0 < \varepsilon_{F_p} < 1$ indicates that transmission between the two prices is not perfect.

If however, prices are determined at consumer level, then the use of mark-down model is appropriate:

$$lnF_p = \alpha_2 + \varepsilon_{R_p} lnR_p \quad (4)$$

Where, ε_{R_p} represents price transmission elasticity from the consumer price (R_p) towards the producer price (F_p). If $\varepsilon_{R_p} = 1$, the transmission is perfect and thus mark-down will be equals $(1 - e^{\alpha_2})$. Imperfect transmission results if $\varepsilon_{F_p} > 1$.

3.2. Testing for Units Roots

Over time most macroeconomic time series are not stationary, i.e. they contain unit roots and their mean and variance are not constant. The use of estimation methods (OLS) is not recommended because statistical inference can result in biased estimates and/or spurious regressions. In the pertinent literature there are a large number of unit root tests available (Maddala & Kim, 1998).

Even though many individual time series contain stochastic trends (i.e. they are not stationary at levels), in the long run many of them tend to move together, suggesting the existence of a long-run equilibrium relationship. Two or more non-stationary variables are cointegrated if there are one or more linear combinations of the stationary variables. This implies that the stochastic trends of the variables are linked over time, moving towards the same long-term equilibrium (Bakucs, 2007).

To study the stationary series, three models were tested:

Model 1: $\Delta y_t = \rho y_{t-1} - \sum_{j,j=2}^{p} \Delta y_{t-j+1} + \varepsilon_t$ *(a)*
Model 2: $\Delta y_t = \rho y_{t-1} - \sum_{j,j=2}^{p} \Delta y_{t-j+1} + \alpha + \varepsilon_t$ *(b)*
Model 3: $\Delta y_t = \rho y_{t-1} - \sum_{j,j=2}^{p} \Delta y_{t-j+1} + \alpha + \beta_t + \varepsilon_t$ *(c)*

Where Δy_t is the first order autoregressive process of price series. These three models are estimated by Ordinary Least Squares (OLS) and tested the null hypothesis $H0: |\rho| = 1$ against the alternative hypothesis $H1: |\rho| < 1$. If *H0* is accepted in one of these models, then the series is not stationary (Niyitanga, 2009).

3.3. Cointegration Test

The two most widely used cointegration tests are the Engle-Granger two-step method (Engle and Granger, 1987) and Johansen's multivariate approach (Johansen, 1988). The Johansen cointegration procedure is based on estimating the following Vector Error Correction Model (VECM):

$$\Delta R_{p_t} = \alpha_1 \Delta Z_{t-1} + \cdots + \alpha_{k-1} \Delta Z_{t-k+1} + \pi Z_{t-k} + \mu_t \quad (5)$$

Where $Z_t = \left[R_{p_t}, R_{p_t}\right]'$, a (2×1) vector containing the retail and producer prices, both integrated of order one, $\alpha_1, \dots, \alpha_{\alpha+1}$ are vectors of the short-run parameters, π is (2×2) matrix of the long-run parameters, μ_t is the white noise stochastic term.

$$\pi = \alpha\beta' \quad (6)$$

Where matrix α represents the speed of adjustment to disequilibrium and β' is a matrix which represents up to (n-1) cointegrating relationships between the non-stationary variables. Trace and maximum Eigen-value statistics are used to test for cointegration. Once (5) is estimated it can proceed to test for weak exogenous variable equals zero.

The terms of vector α (factor loading matrix) measure the speed at which the variables adjust towards the long-run equilibrium after a price shock. The terms α vector of the weakly exogenous variable equals zero. To find the direction of the Granger causality between the two price series, restrictions are tested on the terms α vectors. If however, the true data generating process contains various regime shifts, then the Johansen test is likely not to reject the no-cointegration null hypothesis.

3.4. Asymmetric Error Correction Model

With the development of cointegration techniques, attempts were made to test asymmetry in a cointegration framework. Von Cramon-Taubadel (1998) proposed an error correction model of the form:

$$\Delta R_{p_t} = \sum_{j=1}^{k}(\beta_j^{+} D^{+} \Delta F_{p_{t-j+1}}) + \sum_{j=1}^{l}(\beta_j^{-} D^{-} \Delta F_{p_{t-j+1}}) + \varphi^{+}ECT_{t-1}^{+} + \varphi^{+}ECT_{t-1}^{+} + \sum_{j=1}^{p}\Delta R_{p_{t-j}} + \gamma_t \quad (7)$$

The error correction term, (ECT), is in fact the long-run (cointegration) relationships residual:

$$ECT_{t-1} = \mu_{t-1} = R_{p_{t-j}} - \lambda_0 - \lambda_1 F_{p_{t-1}} \quad (8)$$

λ_0 and λ_1 are coefficients. The error correction term is then segmented into positive and negative phases (ECT_{t-1}^{+} and ECT_{t-1}^{+}) , such that;

$$ECT_{t-1} = ECT_{t-1}^{+} + ECT_{t-1}^{+} \quad (9)$$

Using VECM model as in (7), both short-run and long-run symmetry hypothesis can hence be tested using standard tests. Valid interface requires one price to be mildly exogenous regarding both the long and short run with respect to the parameters in (7) (Hansen and Seo,2002).

4. Results and Discussion

4.1. Unit Root and Cointegration tests

The Augmented Dickey-Fuller (ADF) tests statistics were performed for all series used in the analysis of the wholesale prices and producer prices for the crops: pepper, tomato and potato. The unit root tests were estimated in natural logarithm both in levels for three options models: model (a) ” intercept”, model (b) “intercept and trend” and model (c) “none” , in order to test for non stationary in levels of the variables and the order of integration. These tests applied to the price series shows that all level price series have a unit root, they are non-stationary (Table 1). The results of this test show that whatever the model used for each price series, the calculated values of the Dickey-Fuller statistic increased exceed the critical values. It is therefore necessary to conduct the study of the stationary first difference series to determine their order of integration.

Table 1. Augmented Dickey-Fuller Unit Root Test in levels

Model	Augmented Dickey-Fuller Unit Root Test					
	Green pepper (P)		Tomato (T)		Potato (PT)	
	F_p	R_p	F_p	R_p	F_p	R_p
Model (a)	-0.92	-1.35	-0.92	-0.97	-0.01	-0.98
Model (b)	-3.34	-2.82	-3.51	-3.26	-4.06	-4.78
Model (c)	0.71	2.03	1.37	2.08	1.98	1.45

Note*:* Test critical values: -3.67 for model 1; -4.29 for model 2; -2.64 for model 3.

The model with constant and trend is the best specification for all price ranges. It is noted that all price series are significantly stationary in first differences. This allows to conclude that all price series under analysis are integrated of order 1, and shows a priori that there is a risk of cointegration (long term relationship) (Table 2).

Table 2. Augmented Dickey-Fuller Unit Root Test in First Differences

Type de module	Augmented Dickey-Fuller Unit Root Test	
	F_p	R_p
Green pepper (P)	-6.40	-7.66
Tomato (T)	-5.71	-5.71
Potato (PT)	-8.71	-8.20

Note : Test critical values: -4.03 (significance 1%) Pepper (P);-4.32 (1%) ; Tomato (T) ; -4.30% (de 1%) Potato.

Unit root tests on the selected vegetables' deflated producer and retail prices reveal that all price series are non-stationary. Therefore we in turn apply cointegration and Vector Error Correction methods to analyze the producer-retail price transmission for potatoes, tomatoes and green pepper prices. Table 3 presents the results of the cointegration analysis for the non-stationary price pairs.

Table 3. Cointegration Tests

Model	Lag length	H0	Trace test		λ_{max} (max Eigen value) test	
			Test statistic	5% critical value	Test Statistic	5% critical value
Green pepper prices	1	r = o	16.66	15.49	16.32	14.26
		r ≤ 1	0.33	3.84	0.33	3.84
Tomatoes prices	0	r = o	16.87	15.49	16.49	14.26
		r ≤ 1	0.37	3.84	0.37	3.84
Potatoes prices	0	r = o	22.68	15.49	18.11	14.26
		r ≤ 1	4.56	3.84	4.56	3.84

4.2. Transmission Symmetry and Causality Tests

After cointegration analysis, transmission symmetry and causality tests are determined by using Vector Error Correction Models. Table 4 shows that all the vegetables accept both the symmetrical price transmission null-hypothesis on a short and long-run. Only tomato prices are asymmetric. Generally, competitive pricing supposes that transmission elasticity equals 1, and the prices on two market levels are only linked by a constant absolute margin. Table 4 shows through the causality test that the producer price repercussed on the retail price for the case of potato. This indicates that farmers do not simply accept prices but also can influence market prices. Tomato and green pepper prices reveal significant seasonality, rather large transmission elasticities, and causality flowing from the retail to the producer level. Therefore, tomato and green pepper producers tend to accept rather than determine prices, and industry prices are determined by downstream market levels (processors, wholesalers, retailers).

For all vegetables in this study short-run, price transmission is symmetric, but in the tomato market long-run price transmission is asymmetric. It therefore follows that the tomato market is not competitive and efficient. Thus, processors, wholesalers and retailers, can exercise market power, and instantly transmit producer price increases, while only slowly and partially transmitting producer price decreases. In most of the time, the Price transmission is explained by information costs theory. It locally induces imperfect asymmetries where retailers are able to exert their power in the local market (Weldegebrie, 2004). For perishable goods specially tomato, Wholesalers and retailers may be reluctant to increase prices because it risk a lower demand and ultimately it is being left with spoiled product, this is a specific problem related of perishable goods like same vegetables (Ward, 1982). The adjustment costs may underlie asymmetric price and it involve re-pricing and declaration of a new price depending on the scarcity of supply on the market against a large temporary demand. Finally, the exercise of oligopoly power can encourage asymmetric price transmission (Goodwin, 2006).

Table 4. **Causality, Elasticity and Symmetry Transmission Tests**

	Potatoes	Tomatoes prices	Green pepper prices
Elasticity of transmission	0.61	1.23	1.42
Price causality	$F_p \rightarrow R_p$	$R_p \rightarrow F_p$	$R_p \rightarrow F_p$
Long-run transmission symmetric tests	F(1,29)= 1.29*	F(1,29)= 0.025*	F(1,28)= 1.80*
	Symmetric	Asymmetric	Symmetric
Short-run transmission symmetric tests	F(1,29)=8.88*	F(1,29)= 3.75*	F(1,28)= 9.43*
	Symmetric	Asymmetric	Symmetric

Note: *Simulated critical values for 5% significance level.

5. Conclusion and Recommendations

The paper examined the prices transmission of vegetable crops in Tunisia, tomatoes, green peppers and potatoes. The producers of tomatoes and green peppers accept rather than to determine prices, only the tomato market presents asymmetries of short and long prices transmission. This transmission is important indicating the rise in retail price is fast transmitting towards the production price while the drop is transmitted relatively low. This asymmetric transmission of tomato prices is mainly tied to supply but also depends on other factors such as the wage rate; the regions specialized in production, the transport cost and the temporary pressure of demand (Weliwita & Govindasamy, 1997).

These results show that downstream actors have an influence on price, supply and demand, which will have an impact on the price of production, particularly for tomatoes and green peppers. On the other hand, for potato crop, the guiding price is the producer price and the price transmission in the short and long term is symmetrical but it remains low. In an imperfect market, this transmission will lead to an imbalance between supply and demand. In this case, intermediaries will benefit from a large margin of trade and exercise a power over the market price. To avoid this market dysfunction, the decision maker is invited to control the marketing circuit and price on the market. Today it is important to limit the high variability of prices through a content control and a severe penalty for all kinds of illegal marketing chains in order to limit any form of oligopoly on the market.

Other than marketing factors, environmental factors have considerable effects on price variability. In particular with the phenomenon of climate change, the scarcity of water resources has become a major constraint for irrigated crops. This scarcity will affect agricultural production and supply in the market; it is one of the factors of the increase in prices of certain agricultural products in years of drought. Developing an adequate strategy to adapt to climate change in terms of water resources is a crucial point to ensure the availability of irrigation water, maintain agricultural production and supply on the market.

To maintain the market perfect, the decision maker must avoid the shortage of certain products on the market in order to keep a constant margin for the intermediaries. In this case, the decision maker must take the downstream price at the market level and must not upstream at the producer level to maintain market equilibrium and consumer purchasing power.

The works in agricultural economics research is needed to further investigate the relevance and instability of the prices of agricultural products which are essential to the daily food of Tunisian citizens. Recent literature suggests that retailer's prices vary more than producer prices, and the consumer basket is also adjusted in the event of rising food prices. More micro-data analyses are needed in order to evaluate the consequences of agricultural markets volatility on consumers, especially on the poorest households. Additional variables should be introduced in the price transmission analysis, including the competitively and the cointegration of markets in the agri-food sector which might give insight to a deeper understanding price transmission along the chain marketing.

6. Recommendations for Future Research

Future studies should expand the analysis by including longer monthly price series on different local markets. It may also be interesting to use econometric methods that take account of asymmetric adjustment, impulse responses and market cointegration in data analysis.

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References

Agricultural Investment Promotion Agency (2015). Study of investment incentives and development of vegetable production under greenhouses. Final synthesis report. June 2015.

Bakucs, L. Z. (2007). Price transmission in the Hungarian vegetable sector. *Studies in Agricultural Economics*, 106, 23-40.

Engle, R. F., & Granger, C. W. J. (1987). Cointegration and error correction: Representation, estimation and testing. *Econometrica*, 55, 251–276.

Goodwin, B. (2006). Spatial and Vertical Price Transmission Meat Markets. Paper presented at the Market Integration and Vertical and Spatial Price Transmission in Agricultural Markets Workshop, University of Kentucky.

Hansen, B. E., & Seo, B. (2002). Testing for two-regime threshold cointegration in vector error correction models. *Journal of Econometrics*, 110, 293–318.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, 12, 231–254.

Laajimi, A. & Gasmi, A. (2007). Analyse de la transmission par les prix dans les filières «pêches» et «pommes» en Tunisie. *New Medit*, 6, 4-11.

Maddala, G. S. & Kim, In-Moo (1998). Unit Roots, Cointegration, and Structural Change. Cambridge and New York: Cambridge University Press, 1999.

National Observatory of Agriculture (2015). Statistical Annual Report of Tunisia agricultural. Accessed November, 2015 from the site internet of National Observatory of Agriculture ONAGRI. http://www.onagri.nat.tn/uploads/statistiques/annuaire-statistique-2014.pdf

Niyitanga, F. (2009). Etude du lien entre prix agricole à la production et prix de consommation dans l'ex province de Butare, Rwanda, *TROPICULTURA*, 27,110-114.

Tomek, W. G. & Robinson, K. L. (2003). Agricultural Product Prices. Ithaca: Cornell University Press, 2003.

Von Cramon-Taubadel. (1998). Estimating asymmetric price transmission with the error correction representation: An application to the German pork market, *European Review of Agricultural Economics*, 25, 1-18

Ward, R. W. (1982). Asymmetry in Retail, Wholesale, and Shipping Point Pricing for Fresh Vegetables. *American Journal of Agricultural Economics*, 64,205-212.

Weldegebrie, H. T. (2004). Imperfect price transmission: is market power really to blame? *Journal of Agricultural Economics*, 55, 101-114.

Weliwita, A & Govindasamy, R. (1997). Supply response in the north-eastern fresh tomato market: cointegration and error correction analysis. *Agricultural and Resource Economics Review*, 26, 247-255.