Asymmetric Price Transmission in the Greek Agri-Food Sector: Some Tests

Ioanna Reziti
Centre of Planning and Economic Research, Amerikis 11, 10672, Athens, Greece. E-mail: ireziti@kepe.gr

Yannis Panagopoulos
Centre of Planning and Economic Research, Amerikis 11, 10672, Athens, Greece. E-mail: ypanag@kepe.gr

ABSTRACT

This article employs a general-to-specific approach to analyze the price transmission mechanism between producers and consumers in the Greek agri-food sector. More specifically, the markets examined are vegetables, fruits and the whole food. Using cointegration techniques, two alternative dynamic models are estimated: an error correction model (ECM) and a LSE-Hendry general-to-specific model (GETS). The results indicate the existence of a long-run Granger–causality relationship running from producers to consumers in the vegetables market, while the opposite applies for food and fruits. In addition, asymmetric price transmission appears to apply for food and vegetables, but not for the fruit case. Both models agree upon the asymmetric nature of food and the symmetric nature of fruits but disagree for the case of vegetables. [JEL Classification: Q110, Q130] © 2008 Wiley Periodicals, Inc.

1. INTRODUCTION

Price is the primary mechanism through which the various stages of a market chain are linked. The speed with which price shocks are transmitted between producers and consumers and the extent of adjustment to such shocks constitute important factors reflecting the actions of market participants at different market levels. The transmission of producer price changes to consumer prices and vice versa depends greatly on the type of product. Products that are perishable and that undergo minimal processing, such as vegetables and fruits, are expected to have a relatively quick price transmission mechanism. Products that undergo a certain level of processing and are not perishable are expected to have a slower price transmission mechanism.

It is commonly thought that price transmission between different stages in the market chain is not symmetric.[1] This means that positive and negative price shocks are not transmitted in the same way.

[1]This view is strongly supported by the extensive study of Pelzman (2000) where in more than two-thirds of the cases price transmission was found to be asymmetric. More recently, Meyer and Cramon-Taubadel (2004) mentioned that symmetry is rejected in nearly one-half of all existing applications.

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When testing for asymmetric price transmission, there are a number of different methods available to the researcher. The choice of method depends on the data available and the types of questions that need to be answered. As a result, asymmetric price transmission has been studied by numerous authors using different econometric approaches.[2] Agricultural markets are considered as the central field for the implementation of price transmission analysis, especially for the U.S. and the U.K.[3]

The purpose of this article is twofold: first, to examine whether the Greek agricultural producer and consumer markets are integrated and second, to determine the nature of the price transmission mechanism in the Greek fruit, food, and vegetable markets by implementing the error correction model-Engle–Granger (ECM-EG) approach as well as the LSE-Hendry general-to-specific (GETS) approach. This last approach has not been used to test for asymmetric price transmission in agricultural product markets, which is in contrast to the alternative approaches of vector autoregressions (VAR) and the vector error correction model (VECM). However, the GETS approach has been used for the U.S. gasoline market to test for asymmetric price adjustment (Rao & Rao, 2005).

2. THE GREEK FOOD MARKET

Fruits and vegetables account for 32% of the gross value of Greece's crop production and constitute the products that contribute the most to the country's agricultural product trade balance. Domestic fruit and vegetables' production satisfy domestic demand,[4] while imports are minimal. Greek vegetable exports amount to 950–1,000 tones, 57% of which are being directed to third countries and 43% of which are directed to countries of the European Union.

Domestic market is mainly driven by the wholesalers or the chains of market stores. Producers are forced to negotiate with them on an individual basis and from a weak position. Given the lack of intervention by agricultural cooperatives, the current situation, under normal circumstances, leads to increased distribution costs and promotes capital flow to unnecessary intermediaries.[5]

On the other hand, the Greek retail food industry is characterized by sales concentration among major retail chains and geographical focus of retail activity in the urban areas and predominantly in the Attica region, which accounts for 55% of national retail sales. In Greece, there are about 3,100 supermarket stores. Two-thirds of these (2,010) belong to supermarket chains, while 687 are located in the Athens metropolitan area. Another notable feature of the Greek food retail sector is the existence of 112 "cash and carries," more than half of which belong to supermarket

[2]See the Literature Review on Price Transmission section.

[3]The number of studies on price transmission for the fruit and fresh vegetables' markets is small compared to that for the meat and dairy markets.

[4]Regarding vegetables, the most important product is tomatoes, which correspond to 43% of the vegetables production. Potatoes follow with 23%, cucumbers with 4%, peppers with 2.5%, and then onions, asparagus, etc. Regarding fruits, the most important product groups include citrus fruits (30% of fruit production), peaches-nectarines (24%), watermelons (16%), table grapes (9%), apples (7.7%), melons (4%), and pears (2.2%).

[5]Considering the cooperatives as a proxy of the marketing channel will enrich our information about the price transmission channel (see Equation (2) in Kinnucan and Forker, 1987).

chains. Finally, there is significant mergers and acquisitions activity in Greek retailing, especially in the food sector where the competition is intense. As a result, the largely fragmented food retailing sector in Greece (the five-firm concentration ratio in 1993 was 11%) has become increasingly concentrated with a 52.7% concentration ratio in 2002 (Department for Environment, Food, and Rural Affairs [DEFRA], 2004).

3. LITERATURE REVIEW ON PRICE TRANSMISSION

Numerous studies have examined asymmetric price transmission in agricultural markets using different econometric methods. The various studies have examined different products, geographic areas and time periods, with the majority of them focusing on the U.S. and U.K. meat and dairy sectors.[6] Most attempts have stemmed from the classical Houck (1977) specification; thereafter progressing to cointegration (Cramon-Taubadel, 1998) and to threshold autoregressive models (Goodwin & Harper, 2000).

Kinnucan and Forker (1987) followed Houck's method to examine price asymmetries for four dairy products in the U.S. Empirical results showed that price transmission in the dairy sector was characterized by asymmetry, so that increases in the farm price of milk were passed through to the retail level more fully than decreases in the farm price of milk. They pointed out that depending on the dairy product, price transmission elasticities of rising farm prices were larger than the corresponding elasticities associated with falling farm prices. They suggested that industry concentration, government intervention, and differential impacts of shifts in retail demand versus farm supply were among the principal causes that generated asymmetric price transmission in this sector.

Although market power has been identified as the main cause of imperfect price transmission in some cases, and is widely suspected as a cause in others, recent research shows that this does not always have to be the case. McCorriston, Morgan, and Rayner (2001) demonstrated that price changes can be greater or smaller than the competitive benchmark case, depending on the interaction between market power and returns to scale. They highlighted the possibility that returns to scale in the food sector may influence price transmission between stages in the food chain. Weldegebriel (2004) also argued that relative to the perfectly competitive benchmark, oligopoly and oligopsony do not necessarily coincide with imperfect price transmission, although they may. He concluded that any policy recommendations regarding the effects of market power on the degree of price transmission need to be based on a careful examination of the nature of the retail demand function and on the farm input supply function.

Palaskas (1995) upgraded Houck's specification by embedding an error correction term in his model, thus estimating a basic ECM. Regarding the ECM, Balke and Fomby (1997) and Enders and Granger (1998) showed that tests for unit roots and cointegration have low power in the presence of asymmetric adjustment because such tests implicitly assume symmetric and linear adjustment.[7] Therefore, Enders

[6]For a comprehensive review of estimating and testing for asymmetric price transmission, refer to Meyer and Cramon-Taubadel (2004).

[7]See Goodwin and Harper (2000) for the advantages of the threshold autoregressive model over the ECM proposed by Cramon-Taubadel (1998).

and Siklos (2001) proposed an extension to the standard ECM strategy, which appears in the literature as the threshold autoregressive (TAR) model. However, the TAR models have computational difficulties and impose ex-ante nontheoretical restrictions. Additionally, TAR models are aimed at testing for the presence of nonlinear transaction costs and, in general, for the existence of price bands where there is no transmission. Unfortunately, the above-mentioned models do not incorporate the positive and negative disaggregation of the data generation process (DGP).

It was Cramon-Taubadel and Loy (1997) and Cramon-Taubadel (1998) who actually introduced an asymmetric ECM[8] through an ex-ante disaggregation of the data.

A recent article by Meyer and Cramon-Taubabel (2004) provided a comprehensive discussion of the possible types and causes of asymmetric price adjustments together with a brief review of the relevant empirical results. Their main conclusion was that the existing literature is far from unified or conclusive and has often been largely method driven, with little attention given to the theoretical underpinnings and the plausible interpretation of results. They argued that there is still a considerable need for further research and that it would be premature to draw far-reaching conclusions for theory and policy on the basis of the work to date.

In the framework of the asymmetric ECM, Bachmeier and Griffin (2003) and Rao and Rao (2005) presented an alternative dynamic approach originating from the LSE-Hendry GETS approach. This specification differs from the ECM, based on the Engle–Granger two-step approach, in that it allows the short-run and long-run effects to be estimated simultaneously. In this way we have the advantage to obtain the long-run and short-run elasticities jointly.

The contribution of the present paper is the application of the LSE-Hendry GETS approach, taking into account the cointegrated properties of the variables. This approach is also compared with the widely used ECM-EG specification and is applied to the Greek agri-food market.

4. MODEL SPECIFICATION

Before testing the symmetry hypothesis for the Greek food market, the cointegrated properties of the data should be examined. More specifically, the existence of cointegration between consumer and producer prices should be verified. Otherwise, the implementation of the GETS and ECM-EG remains incomplete.

Furthermore, because we operate in a bivariate environment, we should examine (using cointegration techniques) not only the existence of such a relationship but also the direction (of the transmission mechanism) of such a potential causality.

On the basis of this reasoning, we intend to separate our econometric methodology into three parts. First, using the Johansen and Juselius' (1990) methodology, we will examine the existence of causality between the implemented variables (whether the number of cointegrated vectors (r) is 0, 1 or 2). Then, with the help of a two-step Granger–Engle (1987) methodology, we will clarify the direction of

[8]The asymmetric ECM is a historical evolution of the Houck's simple dynamic specification.

this causality. In the final stage, we will test the symmetry of the examined bivariate relationship.

4.1. The Cointegration Issue

In the first step of our econometric approach, we examine the existence of cointegration between the two variables in our VAR system. In simple words, we search for the existence of the number of cointegrated vectors, r, within Johansen and Juselius' (1990) framework. Using their technique, we implement a k-dimensional VAR of the following form:

$$P_t = \mu + \sum_{j=1}^{k} \Pi_i P_{t-1} + e_t. \tag{1}$$

where P_t is a (2×1) vector of the producer and consumer prices (PP and PC, respectively)[9] and e_t are Gaussian residuals. The VAR in Equation 1 can be reparameterized into a VECM form:

$$\Delta P_t = c + \Pi P_{t-1} + \sum_{j=1}^{k-1} B_j \Delta P_{t-j} + \varepsilon_t \tag{1a}$$

where Π is a (2×2) matrix of long-run and adjustment parameters, B_j is a (2×2) matrix of the short-run parameters, ε_t is the vector of i.d.$(0, \Sigma)$ and j is the number of lags.

Following Johansen's procedure, the co-integration relationship between prices was examined under Equation 1, where each price is a function of its own lagged values and the lagged values of the other price series.[10] The trace and maximum eigenvalue statistics are used to determine the rank of Π and to reach a conclusion on the number of co-integrating equations, r, in our bivariate VAR system.[11]

4.2. The Two-Step Granger–Engle VAR Issue

In the second stage of our approach, we have to define the direction of causality between the two variables. Therefore, we will implement a complete dynamic

[9]Moreover, for the reader's information, with the help of the Augmented D.F. methodology, we have seen that PP&PC are I(1) and that the error term among the two variables is I(0). This last point proves the existence of long-run cointegration among the two variables.

[10]At this stage we favour the Granger (1997) view of the general to specific approach in the DGP of the ECM. However Johansen's results from 1a are very sensitive to the lag length selection (k). Therefore we apply five (5) different lag length selection criteria for our estimated causalities. These are: the sequential modified LR test statistic (LR), the Final prediction error test (FPE), the Akaike information criterion (AIC), the Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ). It is important to mention here that in some cases the five tests disagree on the optimal lag length. Then we proceed to a sub-optimal lag length selection by following the majority of the criteria's decision.

[11]As Lutkepohl and Reimers (1992) mention, "for $r = 1$ [the] two variables Z_t, X_t are co-integrated in the sense of Granger and Engle (1987). If $r = 0$ then $\Pi = 0$ and the [bivariate] system is stationary in first differences. At the other extreme, if $r = 2$, Π is nonsingular and the system is stationary in levels (without taking differences)".

Granger–Engle VECM [VECM (n)] test of the following form:

$$\Delta PP_t = \mu_1 + \sum_{i=1}^{n1} \beta_{pp} \Delta PP_{t-i} + \sum_{i=0}^{n2} \beta_{pc} \Delta PC_{t-i} + \pi_1 Z_{t1-1} + e_{t1} \quad (2a)$$

and

$$\Delta PC_t = \mu_2 + \sum_{i=0}^{n1} \beta_{pp} \Delta PP_{t-i} + \sum_{i=1}^{n2} \beta_{pc} \Delta PC_{t-i} + \pi_2 Z_{t2-1} + e_{t2} \quad (2b)$$

The options which are now available are as follows:

(a) $\pi_1 \neq 0$, $\pi_2 \neq 0$ (a *feedback* long-run relationship between the two variables)
(b) $\pi_1 = 0$, $\pi_2 \neq 0$ (PP_t in the long-run *causes* PC_t)
(c) $\pi_1 \neq 0$, $\pi_2 = 0$ (PC_t in the long-run *causes* PP_t)

For testing the three alternative options, a weak exogeneity test will be implemented according to Johansen's (1992) methodology.

Following this, we will move to the third step, which is concerned with the existence of asymmetry in the examined relationship.

4.3. The Issue of Asymmetry [ECM-EG Versus GETS Approach]

In this stage, we have already decided on the direction of causality between the examined variables (assume that PC causes PP), and we move to the final step that includes two tests: (a) the estimation for the existence of *asymmetries* in the examined market with the help of an asymmetric ECM-EG model, as well as with the help of the LSE-Hendry (*GETS*) model; and (b) the comparison of the results between the two EC approaches concerning the asymmetry.

The *OLS* asymmetric model could be presented (data decomposed) in the following form:[12]

$$\begin{aligned} \Delta PP_t = &\mu_1 + \sum_{i=0}^{n2} \beta_{PC}^{-} \Delta PC_{t-i}^{-} + \sum_{i=1}^{n1} \beta_{PP}^{-} \Delta PP_{t-i}^{-} + \pi_1^{-} Z_{t1-1} \\ &+ \sum_{i=0}^{n3} \beta_{PC}^{+} \Delta PC_{t-i}^{+} + \sum_{i=1}^{n4} \beta_{PP}^{+} \Delta PP_{t-i}^{+} + \pi_2^{+} Z_{t1-1} + \varepsilon_t. \end{aligned} \quad (3)$$

As Rao and Rao (2005) indicated, the plus (+) superscript on the coefficients and the variables is relevant when changes in the variables are positive, while the minus (−) superscript is relevant when changes in the variables are negative. More analytically, for any positive change ($\Delta PC > 0$) in the independent variable of Equation (3), we expect a corresponding reaction of all positive coefficients (β^{+}) plus the coefficient of the speed of adjustment (π^{+}). On the other hand, the corresponding

[12]The reverse model will be implemented when it is proven, in the first stage, that PP causes PC. Moreover, if in the two step cointegration methodology it turns out that a feedback relationship exists between the two variables (PC and PP), then a simultaneity bias question will be raised concerning farm and retail prices. However, in our empirical results we faced no such problem.

negative coefficients (β^- and π^-) will be "engaged" in any negative change of the independent variable ($\Delta PC<0$) of Equation (3).[13]

The GETS asymmetric model could be presented in the following form:

$$\begin{aligned}\Delta PP_t = &\sum_{i=0}^{j2} \beta_{PC}^- \,\Delta PC_{t-i}^- + \sum_{i=1}^{j1} \beta_{PP}^- \,\Delta PP_{t-i}^- \\ &+ \theta^-(PP-\varphi_0-\varphi_1 PC-\varphi_2 T)_{t-1} + \sum_{i=0}^{j3} \beta_{PC}^+ \,\Delta PC_{t-i}^+ + \sum_{i=1}^{j4} \beta_{PP}^+ \,\Delta PP_{t-i}^+ \\ &+ \theta^+(PP-\varphi_0-\varphi_1 PC-\varphi_2 T)_{t-1} + \xi_t \end{aligned} \tag{4}$$

where θ^- and θ^+ are the speed of adjustment coefficients in the GETS asymmetric model in the negative and positive case respectively.[14]

In addition, the EC term (Z_{t-1}) of the OLS estimation 3 has been substituted by an equation at the levels. Moreover, as Rao and Rao (2005) say, model 4 can be tested by rearranging the GETS asymmetric model in the following way:

$$\begin{aligned}\Delta PP_t = &\gamma_0 + \gamma_1 \mathrm{T} + \sum_{i=0}^{j2} \beta_{PC}^- \,\Delta PC_{t-i}^- + \sum_{i=1}^{j1} \beta_{PP}^- \,\Delta PP_{t-i}^- \\ &+ \theta^-(PP-\varphi_1 PC)_{t-1} + \sum_{i=0}^{j3} \beta_{PC}^+ \,\Delta PC_{t-i}^+ + \sum_{i=1}^{j4} \beta_{PP}^+ \,\Delta PP_{t-i}^+ \\ &+ \theta^+(PP-\varphi_1 PC)_{t-1} + \xi_t. \end{aligned} \tag{4a}$$

The choice between the two models 4 and 4a will depend on the performance and plausibility of the estimations. In addition, the existence of *asymmetry*, in both EC dynamic models, will be tested by the implementation of the Wald χ^2- test for the hypothesis that $\pi^+ = \pi^-$ in Equation (3) as well as the hypothesis that $\theta^+ = \theta^-$ in Equation (4) or (4a).

In contrast with the models discussed by Cramon-Taubadel and Meyer (2000), the additional benefit of Equation (4a) is the direct estimates of the short-run elasticities (β_{PC}^- and β_{PC}^+) as well as the long-run price transmission elasticity φ_1.

Finally, on the question of which dynamic model is more appropriate, we use the Davidson and MacKinnon (1981) test for the non-nested hypothesis (*J*-test).

5. DATA

Monthly data on producer and consumer price indices for food, fruits, and vegetables were collected covering the period from 1995 through 2004. In all cases, producer prices were obtained from the agricultural price indices (PPI) provided by the National Statistical Service of Greece (NSSG). Consumer prices were obtained from the consumer price index (CPI) figures, also provided by the NSSG. Although it would be advisable to eliminate the "imports effect" from the CPI in the examined

[13]In econometric terms, the corresponding "activation" will be triggered in Equation (3) with the help of dummy variables (e.g., DUM). More specifically, all positive coefficients will take the value of one (1) when a positive change in the independent variable takes place and zero (0) otherwise (1-DUM).

[14]This model is tested according to the nonlinear least squares (NLLS) methodology.

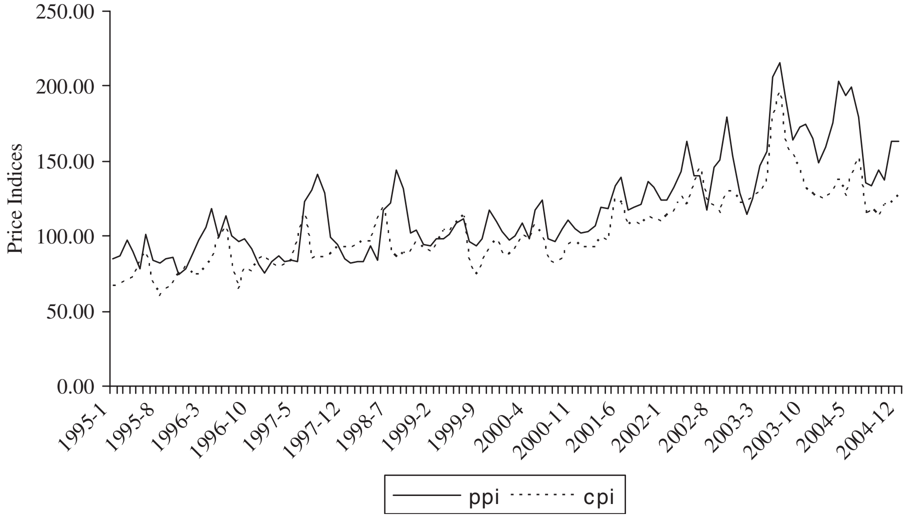

Figure 1 Fruit prices for producer (ppi) and consumer (cpi), 1995–2004.

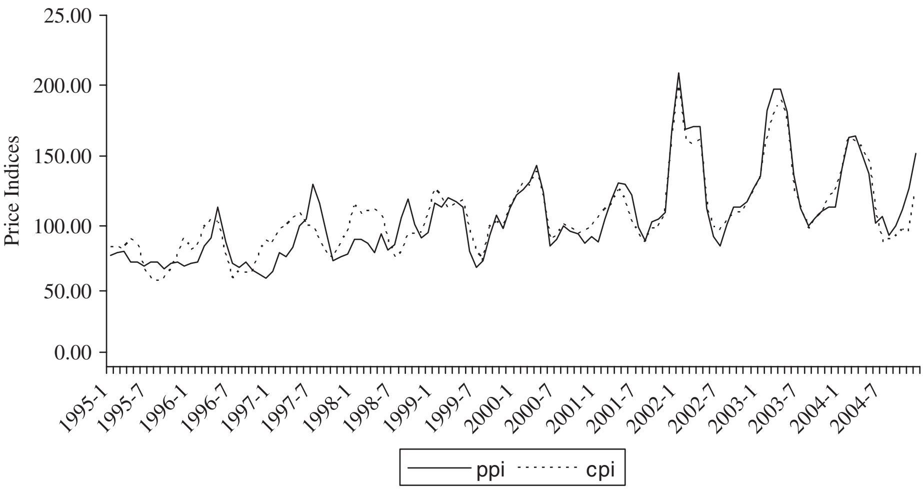

Figure 2 Vegetable prices of producer (ppi) and consumer (cpi), 1995–2004.

markets, monthly data on imports of food, fruits, and vegetables are not available from the NSSG.[15]

Finally, the producer and consumer price indices for the three categories are presented in Figures 1, 2, and 3, where it can be observed that fruit and vegetable prices are more volatile than food prices with a higher volatility in the last three years.

[15]Based on data of the NSSG, in 2004, the import penetration of food accounts for 22% of the total apparent consumption. Additionally, exports of fruits and vegetables account for 15% of the trading production.

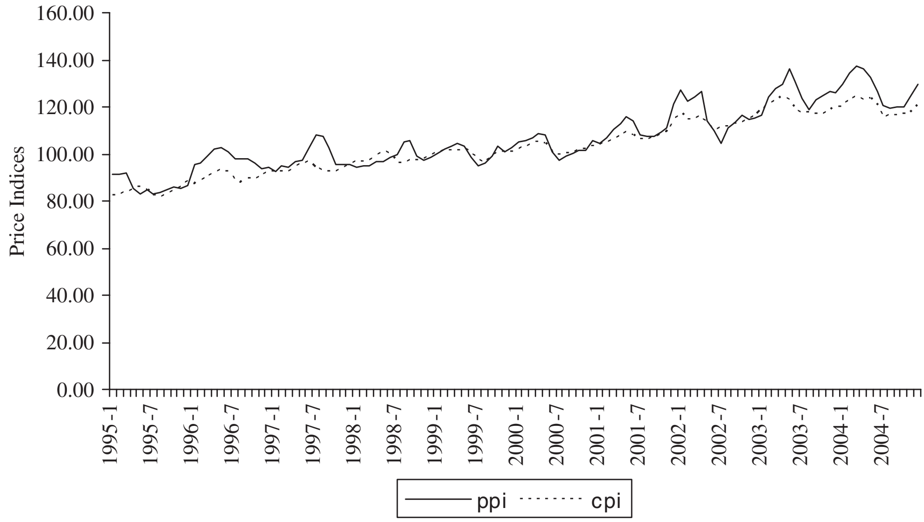

Figure 3 Food prices of producer (ppi) and consumer (cpi), 1995–2004.

6. THE EMPIRICAL RESULTS

Table 1 presents the results of the Johansen and Juselius (1990) procedure. According to the eigenvalue and trace tests in all the bivariate cases, there is a unique cointegrated vector ($r = 1$). This means that there is strong evidence that the producer price and the consumer price are cointegrated in all markets. Additionally, in the underlying VAR, Granger causality is tested by a weak exogeneity test in order to assess the direction of the price transmission process along the supply chain. The Granger causality results indicate the role of price leadership in the markets. In the case of food and fruits markets, the test shows that the CPI Granger causes the producer price index. In contrast, in the case of vegetables, the consumer prices react to the producer price changes. This implies that producer price is the leading one in the vegetable market. In the former case (food and fruits), the intuitive economic explanation lies in the lack of institutional organisation by the producers, which weakens their market power. In the latter case (vegetables), the perishable nature of the products substitutes for the producers' lack of power and operates in their favour.

We now turn to the question of the existence of asymmetry in these three markets. Table 2 demonstrates the price adjustment equations in the food market, implementing both the ECM-EG and GETS equations.[16] First of all, the asymmetric adjustment coefficients π^+ and π^- for the ECM-EG and θ^+ and θ^- for the GETS are well determined and significant. In both models, the negative and positive coefficients are not close to each other. This result was verified by the Wald test, which rejects the symmetric price transmission.

In the case of fruits (Table 3), both models produce adjustment coefficients that are very similar to each other. This is an indication of symmetry in the price transmission mechanism in the fruit market. This result has been verified

[16]Only the statistically significant variables are reported in the Tables.

TABLE 1. Johansen Tests for Pair-Wise Co-Intregration and Restrictions on the VECM

				Weak exogeneity		Causality results
No. of Lags	Rank	Max. Eigenvalue	Trace	Price 1 H0: $\pi_{11}=0$	Price 2 H0: $\pi_{21}=0$	Food prices
(2)	r = 0	25.79*	27.46*	23.64** [0.000]	1.89 [0.169]	PP ← PC
	r ≤ 1	1.66	1.66			
						Fruit prices
(7)	r = 0	22.72*	24.37*	9.44* [0.002]	3.18 [0.074]	PP ← PC
	r ≤ 1	1.65	1.65			
						Vegetable prices
(6)	r = 0	32.53*	37.56*	3.92** [0.048]	2.68 [0.101]	PP → PC
	r ≤ 1	5.02	5.02			

*Significant at the 1% level. Critical values: 18.63 and 6.65 at the 1% level for the Maximum eigenvalue test; 20.04 and 6.65 at the 1% level for the Trace test.
**Significant at the 5% level with critical value 3.84.

TABLE 2. Asymmetric Price Adjustment Equations for Food

	Asymmetric ECM-EG equation OLS		Asymmetric GETS equation NLLS	
Regressor	Coeff.	t-ratio	Coeff.	t-ratio
Intercept	0.002	0.42	−0.02	−0.69
ΔPC_t^+	0.864	3.00	1.052	3.20
ΔPC_{t-1}^+	—	—	0.249	2.61
ΔPC_t^-	0.917	3.54	1.160	3.49
ΔPC_{t-1}^-	0.394	3.05	0.423	3.21
ΔPC_{t-3}^-	0.724	2.88	0.702	2.79
π^+	−0.139	−1.73	—	—
π^-	−0.398	−4.70	—	—
θ^+	—	—	−0.154	−1.89
θ^-	—	—	−0.419	−4.85
φ_1	—	—	1.020	131.96
	$R^2 = 0.45$ Adjusted $R^2 = 0.42$		$R^2 = 0.46$ Adjusted $R^2 = 0.42$	

OLS equation in the first stage ECM-GE

$$PP_t = -0.05 + 1.02\ PC_t$$
$$(-0.32)\ (30.33)$$

Wald test for symmetry

Hypothesis 1: $\pi^+ = \pi^-$ $\chi^2(1) = 4.767\ (0.029)$

Hypothesis 2: $\theta^+ = \theta^-$ $\chi^2(1) = 5.044\ (0.024)$

Note. Monthly data for 1995–2004.

TABLE 3. Asymmetric Price Adjustment Equations for Fruits

	Asymmetric ECM-EG equation OLS		Asymmetric GETS equation NLLS	
Regressor	Coeff.	t-ratio	Coeff.	t-ratio
Intercept	−0.002	−0.18	−0.034	−0.61
ΔPC_t^+	0.503	2.89	0.587	2.82
ΔPC_{t-12}^+	0.280	2.83	0.272	2.71
ΔPC_t^-	0.554	3.94	0.631	3.99
ΔPC_{t-1}^-	−0.389	−2.74	−0.416	−2.91
ΔPC_{t-1}^-	0.429	3.09	0.449	3.21
π^+	−0.254	−3.14	—	—
π^-	−0.418	−3.73	—	—
θ^+	—	—	−0.263	−3.29
θ^-	—	—	−0.434	−3.78
φ_1	—	—	1.049	30.85
	$R^2 = 0.41$ Adjusted $R^2 = 0.37$		$R^2 = 0.42$ Adjusted $R^2 = 0.37$	

OLS equation in the first stage ECM-GE

$$PP_t = 0.45 + 0.93\ PC_t$$

(1.70) (16.30)

Wald test for symmetry

Hypothesis 1: $\pi^+ = \pi^-$ $\quad \chi^2(1) = 1.400\ (0.237)$

Hypothesis 2: $\theta^+ = \theta^-$ $\quad \chi^2(1) = 1.523\ (0.217)$

Note. Monthly data for 1995–2004.

by the Wald test for symmetry where the null hypothesis is accepted by both models.

Table 4 presents the results concerning the price adjustment mechanism in the vegetables market. All adjustment coefficients are statistically significant. In the ECM-EG model, the symmetry hypothesis is accepted, while the GETS equation rejects the symmetry. Additionally, the results of the non-nested test for vegetables are presented in the bottom of Table 4. The results conclude that the GETS model prevails the ECM. This superiority of asymmetry is also claimed by Ward (1982), who suggested that retailers may be hesitant to raise the prices of perishable goods for fear that they could end up with spoiled stock.

Moreover some clarifications, regarding the link between the econometric procedure we implemented and economic theory, are required. More specifically, *causality* traces the starting point of the examined "market chain," i.e., whether we "mark up" from the producer to the consumer or we "mark down"[17] from the consumer to the producer. This starting point can give an advantage in the "chain" which nevertheless is linked with the market structure. More specifically, in the Greek food and fruit markets, the price transmission flows from the consumer to the

[17]See Tiffin and Dawson (2000) for the definitions of "mark up" and "mark down."

TABLE 4. Asymmetric Price Adjustment Equations for Vegetable

	Asymmetric ECM-EG equation OLS		Asymmetric GETS equation NLLS	
Regressor	Coeff.	t-ratio	Coeff.	t-ratio
Intercept	0.014	1.44	0.455	3.34
ΔPC^+_{t-1}	0.208	2.72	0.225	3.05
ΔPC^+_{t-6}	−0.183	−2.73	−0.183	−2.89
ΔPC^+_t	0.506	5.55	0.632	6.21
ΔPC^-_{t-1}	0.559	6.22	0.290	2.29
ΔPC^-_t	0.765	8.79	0.918	9.15
ΔPC^-_{t-1}	0.230	2.84	−0.253	−2.47
ΔPC^-_{t-6}	−0.190	−1.96	—	—
π^+	−0.297	−3.49	—	—
π^-	−0.217	−2.78	—	—
θ^+	—	—	−0.310	−4.92
θ^-	—	—	−0.278	−4.47
φ_1	—	—	0.680	7.79
	$R^2 = 0.72$		$R^2 = 0.76$	
	Adjusted $R^2 = 0.71$		Adjusted $R^2 = 0.74$	

OLS equation in the first stage ECM-GE

$PC_t = 0.94+0.80\ PP_t$

(5.35) (20.98)

Wald test for symmetry

Hypothesis 1: $\pi^+ = \pi^-$ $\chi^2(1) = 0.494$ (0.483)

Hypothesis 2: $\theta^+ = \theta^-$ $\chi^2(1) = 4.40$ (0.036)

J-test (non-nested Hypothesis)

GETS (H_0) vs ECM (H_0) $\chi^2(1) = 2.75$ (0.097)

ECM (H_0) vs GETS (H_1) $\chi^2(1) = 6.75$ (0.009)

Note. Monthly Greece data for 1995–2004.

TABLE 5. Elasticity Estimates

		Short-Run Elasticities		Long-Run Elasticities	
Market	Variables	ECM	GETS	ECM	GETS
Food	ΔP^+_t	0.864	1.052	1.02	1.02
	ΔP^-_t	0.917	1.160		
Fruits	ΔP^+_t	0.503	0.587	0.93	1.049
	ΔP^-_t	0.554	0.631		
Vegetables	ΔP^+_t	0.506	0.632	0.80	0.68
	ΔP^-_t	0.765	0.918		

TABLE 6. Results of Asymmetry Tests

Market	ECM-EG	GETS
Food	Asymmetry	Asymmetry
Fruits	Symmetry	Symmetry
Vegetables	Symmetry	Asymmetry

producer, while in the vegetable market, it runs in the opposite direction. This implies that the food and fruit markets are marked down, while vegetables are marked up. In addition, asymmetric price transmission appears for food and vegetables but not in the case of fruit. Both models agree upon the asymmetric nature of food and the symmetric nature of fruits but disagree for the case of vegetables (Table 6).

Finally, elasticity measures for increases and decreases in the causal prices in both the short and long run are presented in Table 5. The GETS model provides short run elasticities greater than those of the ECM. In addition the decreasing price, elasticities in both models are greater than the increasing ones. Moreover, the long-run elasticities are greater than the short-run, which is similar to the elasticities' results of Bernard and Willett (1996), supporting the view that full price adjustment takes some months. In the long run, both models produce demand-driven elasticities ranging from 0.93 to 1.05. Similarly, Kinnucan and Forker (1987, p. 290; Table 4) reported demand transmission elasticities from 0.75 to 1.50. On the contrary, in the case of vegetables, our elasticity results differ from the corresponding supply driven elasticities of Kinnucan and Forker.

7. CONCLUDING COMMENTS

This article explores the price transmission mechanism between producers and consumers in the Greek agri-food sector. Specifically, we examined the fruit and vegetable markets and the whole food sector using monthly price data. The analysis is done using two alternative dynamic models: ECM and LSE-Hendry GETS.

Empirical results show that both models agree on asymmetric price transmission for food and symmetric transmission for fruits. However, in the case of vegetables, the ECM finds symmetry, while the GETS finds asymmetry.

It should be noted that the causality and symmetry tests implemented here are not by themselves sufficient to conclude upon the market power hypothesis and should therefore be interpreted with caution. In order to assess the existence and degree of market power in the Greek agri-food sector, one would also have to take into account the role of additional variables—such as government intervention through price support, marketing costs (see Kinnucan & Forker, 1987) and exogenous shocks (Lloyd, McCorriston, Morgan, & Rayner, 2006)—in the determination of agri-food product retail demand and farm supply. Thus, a possible direction for future research is the study of the issue of market power in the Greek agri-food sector, taking into account the role of such variables.

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Ioanna Reziti *received a BA in Economics from the University of Athens in 1987 and a MA in Econometrics from the University of Manchester in 1990. She has also received her Ph.D. in Agricultural Economics from the University of Manchester in 1994. Her current research is in agro-food industries and market analysis. Among this, other interests are agricultural policy, applied microeconomic analysis, and rural development. Since 1995, she is a research associate at Centre of Planning and Economic Research, Athens, Greece.*

Yannis Panagopoulos *received a B.Sc. in Economics from the University of Piraeus in 1987, a Diploma in Economics from the University of Warwick, an M.B.A. in Finance from the Athens Laboratory of Business Administration (A.L.B.A.), and a D.Phil. in Economics from the University of York, U.K. His current research interests are Post Keynesian monetary policy, Capital Adequacy in the Banking System, and applied econometrics. He is a research associate at Centre of Planning and Economic Research, Athens, Greece.*