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CENTRE OF PLANNING AND ECONOMIC RESEARCH

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ABSTRACT

This paper employs a general to specific approach to analyze the price transmission mechanism between producer and consumer in the Greek food sector. More specifically, the examined markets are the vegetables, the fruits and the whole food sector. 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 that a long-run relationship exists between producer and consumer for the three markets. The direction of Granger-causality runs from producer to consumer for vegetables while for food and fruits run from consumer to producer. Both models agree on the asymmetric price transmission in the fruits market. On the contrary, for the food and vegetable markets the two models disagree on the nature of the price transmission mechanism.

1. Introduction

Price is the primary mechanism by which various stages of a market are linked. The extent of adjustment and speed with which price shocks are transmitted among producer and consumer is an important factor reflecting the actions of market participants at different market levels. The transmission of the producer price changes to the consumer one and the reverse depends, greatly on the type of product. Products that are perishable and 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. Therefore, the degree of price transmission can provide a rough assessment of categorizing the market functioning in a predictable way.

Moreover, another common belief is that price transmission between different stages in the market chain is not symmetric. This means that the positive and negative price shocks between the two stages may not transmitted in the same way. There are a number of different methods available to the researcher when testing for asymmetric price transmission. The choice of method depends on the data available and the types of questions that need to be answered. Therefore, asymmetric price transmission has been studied by numerous authors using different econometric approaches[1].

Agricultural markets are considered as the central field for the implementation of the price transmission analysis, especially in the US and UK[2].

This paper is intend to contribute to the empirical literature because the Greek food market is lacking applications in the context of price transmission between producers and consumers for a variety of products. Especially, Greek fresh vegetables and fruits markets, despite their inefficient marketing system, have not been investigated previously even for symmetric price adjustment. The purpose of this paper is two-fold: first to examine if the two markets (producers and consumers) are integrated; and second to determine the nature of the price transmission particularly in

[1] From the classical OLS Wolffram (1971) and Houck (1977) specification to the cointegration approach of Von Cramon-Taubadel (1998) and to the threshold autoregressive models of Goodwin and Harper (2000). However, the most widely used method for testing asymmetric price transmission in agricultural economics literature is the conventional error correction model of Von Cramon-Taubadel (1998).

[2] Although studies on price transmission for the market of fruits and fresh vegetables are not many compared with those in meat and dairy markets.

fruits, food and vegetable markets by implementing the ECM-EG approach as well as the LSE-Hendry general to specific (GETS) approach. This last approach is not widely used in the agricultural literature under the context of asymmetric price transmission, compared to the alternatives of vector autoregressions (VAR) and the vector error correction (VECM). On the contrary, the GETS approach has been used in the US gasoline market to test for asymmetric price adjustment (Rao, 2005).

The paper is organized as follows: the next section describes the Greek food market. Section 3 reports some previous empirical studies. Section 4 describes the methodological framework. Section 5 analyses the empirical findings and the final section concludes with the main results.

2. The Greek food market

The cultivation of fruits and vegetables represents a 26% of the cultivated land and a 36% of the irrigated land of the country. These cultivations participate at 32% in the configuration of the gross value of crop production and these are the products that contribute mostly in configuring the trade balance of agricultural products. The Greek production amounts 7.5 million tones, out of which 4 million tones are vegetables and 3.8 million tones are fruits. This corresponds to 9.2% of the total European production.

Domestic fruit and vegetables production satisfies domestic demand[3]. Thus, imports are minimal. Greek vegetable exports to third countries and European countries amount at 950-1000 tones, a 57% being directed to third countries and a 43% to countries of the European Union. Greek exports of fresh fruits lack a systematic approach and proper organization regarding the supply of big wholesale and retail centers of Europe.

The internal market is mainly driven by the wholesalers or the chains of market stores. Producers are forced to negotiate with them on an individual base and from a weak position. Given the lack of essential intervention from agricultural

[3] Regarding vegetables, the more important product is tomato which corresponds to 43% of vegetables production. Potatoes follow with a 23%, cucumbers with 4%, peppers with 2.5% and then onions, asparaguses etc. Regarding fruits, the most important team of products are the citrus fruits of (30% of fruit production), peaches-nectarine (24%), watermelons (16%), table grapes (9%), apples (7.7%) melons (4%) and pears (2.2%).

cooperatives, the current situation leads to an increase of distribution costs and promotes capital flow to unnecessary, under normal circumstances, intermediaries.
Today the following main vegetables marketplaces can be identified:

- The central vegetables market of Athens and Thessalonica, supplying mainly professionals of open markets, local groceries, fruits stores and market stores. Fruits distribution from producers to wholesalers is done through direct sale to the wholesaler in a determined price, or through sale of products via the wholesaler on behalf of the producer, under an agreed commission.
- The open air or accommodated areas of wholesale sales, supplying professional salesmen, small local groceries, fruit stores and mainly wandering salesmen.
- The open air markets where the bigger volume of fresh vegetables (70%) is being distributed. The number of open air markets increases rapidly over time, as this is the only way of direct products distribution without the involvement of intermediaries
- The big wholesale shops or chains of food stores which are supplied the products primarily from the producers themselves and less from the central market.
- The wandering salesmen which in their majority work without a legal permit.

The common organization of the market for fruits and vegetables was reformed in 1996 to enable producers to meet market expectations and consumer desires more closely in terms of quantity, quality and prices. The Regulation (EC) No 2200/96 seeks to boost the role of producer organizations (POs), reduce structural surpluses and encourage a gradual reduction in quantities of products withdrawn from the market, in particular by setting up operational funds managed by the POs with the view to improving product quality and marketing.

The retail industry is characterized by sales concentration among major retail chains, geographical focus of retail activity in the urban areas and predominantly to the Attica region accounting 55% of national retail sales, loss of competitive advantage by independent retailers and extensive development of the franchising sector. There was fluctuation as regards the number of retail businesses. The number of outlets increased from 169,181 in 1999 to 174,280 in 2003. In 2003 the number of food retailers decreased at a faster pace than non-food outlets while the latter represented around 66% of total retail outlets. The turnover of food and beverage industries in Greece in 2001 was 6.45 billion euro, accounting for 25.6% of the total industry sales. The 1100 largest domestic food and beverage industries reported gross profits amounting to approximately 3 billion euro in 2001.

In Greece there are about 3,100 supermarkets. Of the nation's total, 2,010 of them belong to supermarket chains, 687 of which are located in the Athens metropolitan area. Another notable feature of the Greek retail sector is that more than half of the "cash and carries" recently established belong to supermarket chains. There are 112 cash and carries throughout the country. In this sector, 4 companies dominate with a total of 68 outlets. Out of their total sales, 51.6% is for grocery items, 19.7% goes to toiletries, 22.5% goes to beverage and 6.2% is for miscellaneous. Finally, there is significant mergers and acquisition activity in Greek retailing, especially in the retail food sector where the competition is intense.

3. Previous studies on asymmetric price transmission

Numerous studies have examined price transmission in agricultural markets using different empirical methods. The studies have also examined different products, geographic areas and time periods. Additionally, the majority of studies on price transmission have been focused in the US and UK meat sector[4]. In line with the Von Cramon-Taubadel and Meyer (2000) methodology we could group these studies in the following way: When the approach was based on the segmentation of the input price variable into increases and decreasing components, an OLS method was implemented (see Ward, 1982; Kinnucan and Forker, 1987). On the other hand, when the approach was based on cointegration techniques usually authors ended up either with an asymmetric error correction model (see Von Cramon-Taubadel and Loy, 1996 and Von Cramon-Taubadel, 1998) or with a threshold cointegration model (see Goodwin and Holt, (1999); Enders and Granger, (1998); Goodwin and Harper, (2000); Meyer (2003); Serra and Goodwin (2003)) or with a momentum threshold model (see Enders and Siklos, 2001).

Apart form the methodology classification we can now exploit the aforementioned studies according to the examined markets and the asymmetry results.

[4] For a more comprehensive literature see Meyer and von Cramon-Taubadel (2004)

Specifically, Ward (1982) used US data for various fresh vegetables in different cities. His results provided some evidence of asymmetric transmission in the direction of wholesale to retail: price decreases at the wholesale are transmitted more often to the retail level than the wholesale price increases. Zachariasse and Bunte (2003) examined price transmission for Dutch potato and found asymmetric price transmission as well. They actually found that retailers follow negative price shocks at the farm level, but not positive price shocks. This is a case where farmers benefit from the existing asymmetry. Hassan and Simioni (2001) investigate the existence of price transmission between shipping-point and retail prices for French fresh vegetable, tomatoes and chicory, by using threshold cointegration methods. In the majority of the examined cases price transmission appears to be symmetric.

In addition, a large literature exists on price transmission with respect to the meat and dairy markets. Von Cramon-Taubadel (1998) examined the German pork market with an non-symmetric error correction model. He found evidence of asymmetric price transmission between wholesale and producer prices.

Abdulai (2002) examined the Swiss pork market with the help of the threshold cointegration methodology. That method allow Abdulai to test whether "increases in producer prices that lead to declines in marketing margins are passed more quickly to retail prices than decreases in producer prices that result in increases in the marketing margins."(Abdulai 2002, p.679). The results indicated that price transmission between the producer and retail levels is asymmetric.

Goodwin and Holt (1999) and Goodwin and Harper (2000) investigated linkages among farm, wholesale, and retail markets for the US beef and pork sector. They found that price interrelationships existed between wholesale and retail prices rather than between farm and wholesale prices. Their results reveal important asymmetries.

The last part of this section is linked to long-run relationship for the meat prices in the UK. More specifically, Palaskas (1995) did not find a relationship between producer and consumer pig meat prices, and Dawson and Tiffin (1997) report an absence of a long-run relationship for beef and pork prices in the same country. The results of McCorriston, Lloyd, Morgan and Rayner (1999) show lack of cointegration for UK beef, lamb and pork prices. However, the study of Tiffin and Dawson (2000) indicates the existence of a long-run relationship for the lamb but with causality running from retail to producer.

This empirical work concerns the Greek food market and in econometric terms is similar to the dynamic specification of Von Cramon-Taubadel and Loy (1996), where a spatial asymmetric price transmission on world wheat market was tested. However, in our work we are going to extend this approach by implementing Rao and Rao (2005) econometric methodology which is based on the LSE-Hendry general to specific approach.

4. The econometric methodology

Our study is not only focused on simply the existence or non-existence of asymmetries in price transmission. Since we are operating in a bivariate environment where the interrelationship between consumer and producer in the Greek food market is seek, we first of all should know (using co-integration techniques) the existence of such relationship as well as the direction (of the transmission mechanism) of such potential causality.

In line with this reasoning, we are intending to separate our econometric methodology in three parts. In the first part, using the Johansen and Juselius (1990) methodology we will examine the existence of causality between the implemented variables (whether r = 0, 1 or 2). Then, with the help of two-step Granger–Engle (1987) methodology we will clarify the direction of causality and at the final stage we will test the symmetry of the examined bivariate relationship.

4.1. The co-integration issue

Commencing from the first step of our econometric methodology we are trying to examine first the existence of co-integration between two variables[5] in our VAR system. In simple words, we are searching for the existence of the number of co-integrated equations, r, inside the Johansen's framework. Therefore, using the Johansen's technique (Johansen and Juselius, 1990), a *k*-dimensional VAR is Vector Autoregressive Model (VAR) was implemented of the following form :

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[5] Assume that a P_t (2×1) vector exists which contains two variables, PP and PC, which stands for the producer and the consumer price respectively in our study. Moreover, for the reader's information, with the help of the Augmemted D.F. methodology we have seen that PP & PC ~ I(1) and that the error term among the two variables, according to the Engle & Yoo (1987) critical values, are integrated of order zero (ε ~ I(0)). This last point proves the existence of long run cointegration among the two variables.

$$P_t = \mu + \sum_{j=1}^{k} \Pi_i P_{t-1} + e_t \qquad (1)$$

where for this study P_t is a (2×1) vector of the two prices, , e_t are Gaussian residuals. The VAR in (1) can be reparameterized into a Vector Error Correction (VECM) form:

$$\Delta P_t = c + \Pi P_{t-1} + \sum_{j=1}^{k-1} \mathrm{B}_j \Delta P_{t-j} + \varepsilon_t \qquad (1a)$$

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, Σ) and j is the number of lags.

Following the 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[6]. 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[7].

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 a complete dynamic Granger–Engle Vector Error Correction [VECM (n)] type has to be implemented of the following form:

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

and

$$\Delta PC_t = \mu_2 + \sum_{t=0}^{n1} \beta_{pp} \Delta PP_{t-i} + \sum_{t=1}^{n2} \beta_{pc} \Delta PC_{t-i} - \pi_2 Z_{t2-1} + e_{t1} \qquad (2b)$$

The options which are available for debate here is weather :

(a) $\pi_1 \neq 0, \pi_2 \neq 0$ (a *feedback* long run relationship between the two variables)

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[6] At this stage we favour the Granger (1997) view of the general to specific approach in the DGP of the E.C. modeling for the. However the 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 that in some cases the five tests disagree about the optimal lag length. Then we choose a sub-optimal lag length criterion by following the majority of the criteria's decision.

[7] As Lutkepohl and Reimers (1992) say, "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 Π = 0 and the [bivariate] [bivariate] system is stationary in first differences. At the other extreme end, if r = 2, Π is nonsingular and the system is stationary in levels (without taking differences)".

(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 we described in advance a weak exogeneity test will be implemented according to the Johansen (1992) methodology.

After the clarification of the second step we will move to the third one which is the existence of asymmetry in the examined relationship.

4.3 The issue of asymmetry [*ECM-EG* vs *GETS* approach]

In this stage we have already decided the direction of causality between the examined variables (assume that PC causes PP) and we move in the final step which contains two things:

1. 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.
2. The comparability of the results between the two EC approaches concerning the asymmetry.

The *OLS* asymmetric model could be presented (data decomposed) in the following model[8] :

$$\Delta PP_t = \mu_1 + \sum_{t=0}^{n2} \beta_{PC}^{-} \, \Delta PC^{-}{}_{t-i} + \sum_{t=1}^{n1} \beta_{PP}^{-} \, \Delta PP^{-}{}_{t-i} - \pi_1^{-} \, Z_{t1-1} +$$

$$+ \sum_{t=0}^{n3} \beta_{PC}^{+} \, \Delta PC^{+}{}_{t-i} + \sum_{t=1}^{n4} \beta_{PP}^{+} \, \Delta PP^{+}{}_{t-i} - \pi_1^{+} \, Z_{t1-1} + \varepsilon_t \qquad (3)$$

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

[8] The reverse model will be implemented when it is proven at the first stage that PP *causes* PC. Finally, both models will be tested when a *feedback* relationship exists at the first stage between the two variables.

negative coefficients ($\Delta PC<0$) will be "engaged" in any negative change of the dependent variable of equation 3 [9].

On the other hand, the *GETS* asymmetric model could be presented in the following form :

$$\Delta PP_t = \sum_{t=0}^{j2} \beta_{PC}^{-} \, \Delta PC^{-}{}_{t-i} + \sum_{t=1}^{j1} \beta_{PP}^{-} \, \Delta PP^{-}{}_{t-i} +$$

$$+ \ \theta^{-} (PP - \varphi_0 - \varphi_1 PC - \varphi_2 T)_{t-1} +$$

$$+ \sum_{t=0}^{j3} \beta_{PC}^{+} \, \Delta PC^{+}{}_{t-i} + \sum_{t=1}^{j4} \beta_{PP}^{+} \, \Delta PP^{+}{}_{t-i} +$$

$$+ \ \theta^{+} (PP - \varphi_0 - \varphi_1 PC - \varphi_2 T)_{t-1} + \xi_t \qquad (4)$$

where θ^{-} and θ^{+} are the speed of adjustment coefficients in the *GETS* asymmetric model in the positive and negative case respectively[10].

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 & Rao (2005) says, model 4 can be tested by rearranging the *GETS* asymmetric model in the following way :

$$\Delta PP_t = \gamma_o + \gamma_1 T + \sum_{t=0}^{j2} \beta_{PC}^{-} \, \Delta PC^{-}{}_{t-i} + \sum_{t=1}^{j1} \beta_{PP}^{-} \, \Delta PP^{-}{}_{t-i} +$$

$$+ \ \theta^{-} (PP - \varphi_0 - \varphi_1 PC)_{t-1} +$$

$$+ \sum_{t=0}^{j3} \beta_{PC}^{+} \, \Delta PC^{+}{}_{t-i} + \sum_{t=1}^{j4} \beta_{PP}^{+} \, \Delta PP^{+}{}_{t-i} +$$

$$+ \ \theta^{+} (PP - \varphi_1 PC)_{t-1} + \xi_t \qquad (4a)$$

The choice between the two models (4 and 4a) will depend by 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

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[9] In econometric terms the corresponding "activation" will be triggered in equation 3a with the help of dummy variables (e.g. DUM). More specifically, all positive coefficients will take the value of 1 when a positive change in the dependent variable will take place and zero otherwise (1-DUM).
[10] This model is tested according to the Non-Linear Least Squares (N.L.L.S.) methodology.

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.

Finally on the question of which dynamic model fits better with the data, we can use the *adjusted R^2* performance as an indication to that.

5. The empirical results

Monthly price data on producer and consumer for food, fruits and vegetables were collected covering the 1994 through 2004 period. Actually, in all cases, producer prices were obtained from the Agricultural Price Indices (PPI) provided by the National Statistical Service of Greece. Consumer prices were obtained from the publication of the Consumer Price Index (CPI) provided by the National Statistical Service of Greece. 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 prices have the highest variability and food prices the lowest.

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, the test for Granger causality is demonstrated by a weak exogeneity 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 consumer price index Granger-causes the producer price index. On the contrary 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.

We are now turning to the question of asymmetry existence in these three markets. Table 2 demonstrates the price adjustment equations in the food market implementing both the ECM-EG and GETS equations[11]. 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 the case of the ECM-EG model the negative and positive coefficients are close to each other. This result was verified by the Wald test

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

for symmetry. On the contrary, in the case of GETS model the two coefficients are not similar. This is an indication of asymmetry in the price transmission mechanism in the fruit market. This result is also verified by the Wald test for symmetry where the null hypothesis is rejected (χ^2 (1)=6,830, p=0,009). Moreover, due to the higher negative coefficient we infer that the downward adjustments of prices, from the consumer to the producer, are transmitted faster than the upward one.

Table 3 reports the results for the price adjustment equations in the fruit market. In this case all the adjustment coefficients are statistically significant with the exception of the π^+ coefficient. In addition the Wald test statistic indicates the rejection of the null hypothesis of symmetry in both models.

Finally, Table 4 presents the results concerning the price adjustment mechanism in the vegetables market. Like in the case of Table 2 all adjustment coefficients are statistically significant. Analytically speaking, in the ECM-EG model the symmetry hypothesis is accepted while GETS equation rejects the symmetry.

6. Concluding comments

This paper examines the price transmission mechanism between consumer and producer in three markets of the Greek economy: The vegetables, the fruits and the food markets. The absence of past empirical analysis regarding the nature of price transmission in the Greek food sector is the initiative for the work reported in this paper.

In the food market, which is the prime market, the price transmission flows from the consumer to the producer whistle in the segmented vegetables and the fruit market runs to the opposite direction. In this market (food) the existence of asymmetry is expressed through the greater speed of adjustment of the negative shocks than the positive one. This brings forward the ability of the intermediaries to exploit their market power on the producer shoulders. More analytically, when prices at the consumers markets are falling intermediaries have the power to reduce the producer prices in order to retain their own profit margins. On the contrary, at the positive consumer price shocks the intermediaries do not react so quickly since their profit margins are not squeezed. The same results appear for the case of the fruit market.

Regarding the vegetables market the price transmission flows from the producer to the consumer and both models (ECM-EG and GETS) reject symmetry. In this case, although the intermediaries power is not denied, the profit margin of the market is relatively small. So there is not a big incentive for the intermediaries to exercise their power. Therefore the vegetables market operates in a more efficient way than the other two.

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Figure 1. Fruit prices for producer and consumer (%) :1995-2004

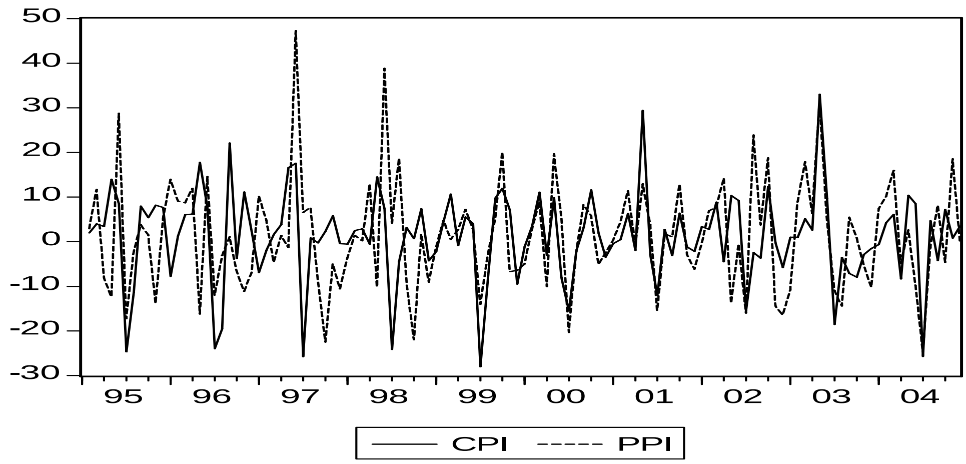

Figure 2. Vegetable prices of producer and consumer (%):1995-2004

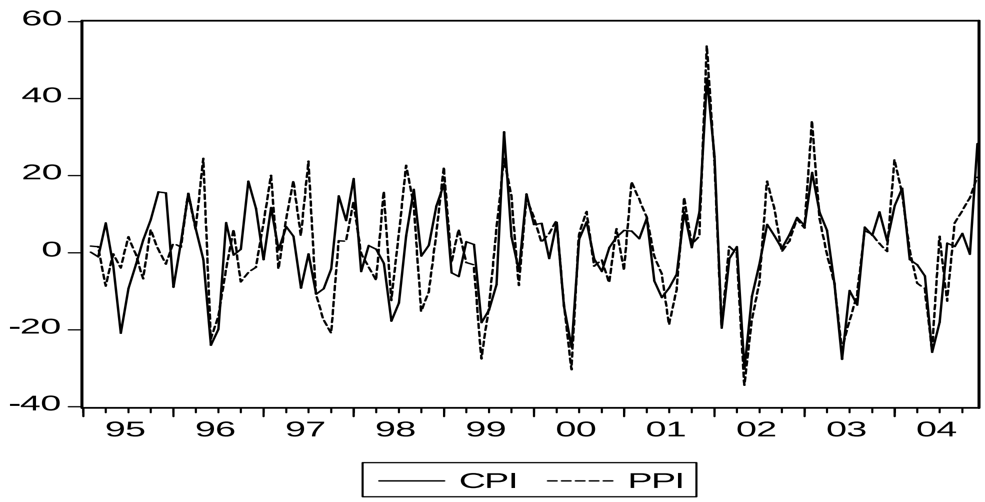

Figure 3. Food prices of producer and consumer (%) :1995-2004

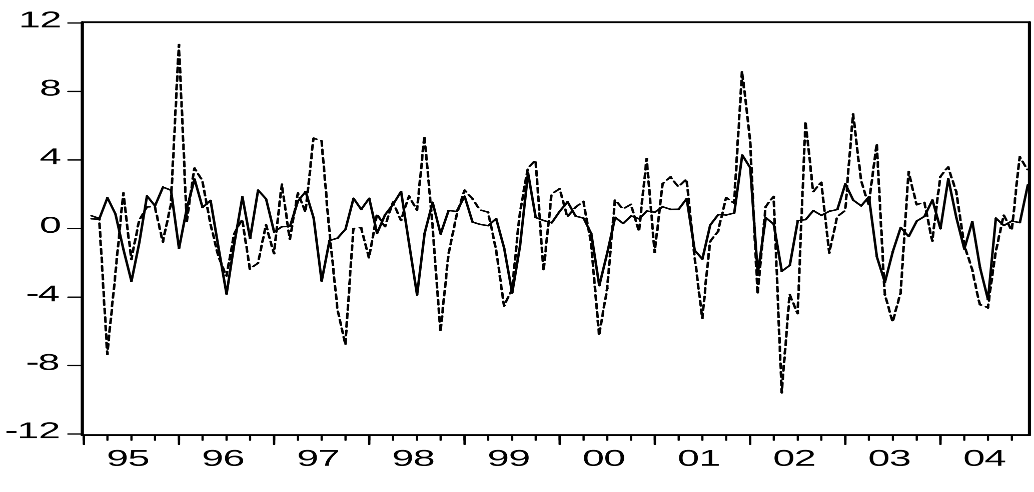

TABLE 1

JOHANSEN TESTS FOR PAIRWISE COINTREGRATION AND RESTRICTIONS ON THE VECM

No. of Lags	Rank	Max. Eigenval.	Trace	Weak exogeneity		Causality results
				Price 1	Price 2	Food prices
				H_0: α_{11}=0	H_0: α_{21}=0	
(2)	r=0	25.79*	27.46*	23.64*	1.89	PP ← PC
				[0.000]	[0.169]	
	r≤1	1.66	1.66			
						Fruit prices
(7)	r=0	22.72*	24.37*	9.44*	3.18	PP ← PC
				[0.002]	[0.074]	
	r≤1	1.65	1.65			
						Vegetable prices
(6)	r=0	32.53*	37.56*	3.92*	2.68	PP → PC
				[0.048]	[0.101]	
	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% for the Trace test. ** significant at the 1% level for the $x^2(1)$ test statistic with critical values, 6.64 with [p-values] and * significant level at the 5% with critical value 3.84.

Table 2

Asymmetric Price Adjustment Equations for Food

Monthly Greece Data: 1994-2004

	Asymmetric ECM-EG Equation OLS		Asymmetric GETS Equation NLLS	
Regressor	Coeff.	t-ratio	Coeff.	t-ratio
Intercept	-	-	0.172	2.46
ΔPC_t^+	0.656	3.24	0.720	4.68
ΔPP_{t-1}^+	0.443	3.87	0.247	2.66
ΔPC_t^-	0.615	2.82	0.900	5.19
ΔPP_{t-1}^-	0.235	2.28	0.159	2.01
π^+	-0.314	-3.90	-	-
π^-	-0.368	-4.19	-	-
θ^+	-	-	-0.560	-9.06
θ^-	-	-	-0.740	-10.27
φ_1	-	-	0.950	41.98
	R^2=0.42		R^2=0.66	
	Adjusted R^2=0.39		Adjusted R^2=0.64	

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: $\pi^+ = \pi^-$ $\chi^2(1)$=0.208 (0.649)

Hypothesis 2: $\theta^+ = \theta^-$ $\chi^2(1)$=6.830 (0.009)

Table 3

Asymmetric Price Adjustment Equations for Fruits

Monthly Greece Data: 1994-2004

	Asymmetric ECM-EG Equation OLS		Asymmetric GETS Equation NLLS	
Regressor	Coeff.	t-ratio	Coeff.	t-ratio
Intercept	-	-	0.281	2.15
ΔPP_{t-1}^{+}	0.307	2.97	0.179	2.11
ΔPP_{t-3}^{+}	-0.358	-3.10	-0.294	-3.23
ΔPC_{t}^{+}	0.575	5.34	0.703	8.31
ΔPC_{t-3}^{+}	0.292	2.13	0.287	2.65
ΔPC_{t}^{-}	0.480	3.06	0.753	5.65
ΔPP_{t-8}^{-}	-0.208	-2.07	-0.169	-2.10
ΔPP_{t-11}^{-}	-0.351	-2.98	-0.298	-3.20
π^{+}	-0.189	-1.86	-	-
π^{-}	-0.449	-5.48	-	-
θ^{+}	-	-	-0.406	-5.21
θ^{-}	-	-	-0.651	-9.38
φ_1	-	-	0.913	19.29
`	R^2=0.46 Adjusted R^2=0.42		R^2=0.67 Adjusted R^2=0.64	

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: $\pi^{+} = \pi^{-}$ $\chi^2(1)$=3.960 (0.047)

Hypothesis 2: $\theta^{+} = \theta^{-}$ $\chi^2(1)$=6.714 (0.009)

Table 4

Asymmetric Price Adjustment Equations for Vegetables

Monthly Greece Data: 1994-2004

	Asymmetric ECM-EG Equation OLS		Asymmetric GETS Equation NLLS	
Regressor	Coeff.	t-ratio	Coeff.	t-ratio
Intercept	-	-	0.594	5.33
ΔPC_{t-5}^{+}	-	-	-0.130	-2.436
ΔPC_{t-6}^{+}	-0.338	-3.50	-	-
ΔPP_{t}^{+}	0.733	12.53	0.737	15.69
ΔPP_{t-6}^{+}	0.195	2.30	-	-
ΔPC_{t-1}^{-}	0.529	4.25	0.340	4.89
ΔPP_{t}^{-}	0.535	7.14	0.572	9.46
ΔPP_{t-1}^{-}	-0.194	-1.82	-	-
ΔPP_{t-2}^{-}	-0.146	-2.27	-0.153	-2.97
π^{+}	-0.200	-2.31	-	-
π^{-}	-0.336	-4.29	-	-
θ^{+}	-	-	-0.459	-8.89
θ^{-}	-	-	-0.545	-9.26
φ_1	-	-	0.74	17.74
	R^2=0.75		R^2=0.84	
	Adjusted R^2=0.73		Adjusted R^2=0.83	

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: $\pi^{+} = \pi^{-}$ $\chi^2(1)$=1.365 (0.243)

Hypothesis 2: $\theta^{+} = \theta^{-}$ $\chi^2(1)$=24.093 (0.000)

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