Price Linkage and Transmission between Shippers and Retailers in the French Fresh Vegetable Channel

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Abstract:

The existence and the kind of asymmetry that characterize the relationships between shipping-point and retail prices are investigated for two major French fresh vegetables: tomatoes and chicory. Weekly data allow considering these relationships at very detailed levels such as region or supermarket chain. Moreover, the methodology proposes an implicit treatment of asymmetries in price transmission by using recently developed threshold cointegration methods. Our results do not give evidence to the widespread assertion that shipping-point price increases are completely and rapidly passed by middlemen on to consumers while there is a slower and less complete transmission of shipping-point price declines. As already emphasized in the literature, these results may be linked to the perishable nature of the two considered fresh vegetables.

EconLit Subject Descriptors: L66, L81, Q13.

1. Introduction

Pricing through food marketing channels is of considerable interest not only for the economic agents taking part in the channel: producers, shippers, wholesalers and retailers, but also for policymakers. Recent manifestations of French producers complaining that middlemen, and, more precisely, large-scale distribution, pass rapidly any cost increase while they transmit slowly and less completely cost savings, are evidence of this interest. The fresh vegetable channel is one of the more concerned channels. Indeed, fresh vegetables undergo only light processing, and packaging, handling and transportation are the main activities in this channel. Vegetables producers confront thus directly large-scale distribution which is very concentrated in France (five main supermarket chains share 74% of food retailing) and whose market share represents near 60% of the total sales of fresh vegetables in France.

In this paper the price linkages among retail and shipping-point prices will be analyzed to provide empirical evidence about price transmission in the French fresh vegetables channel: Does the reaction of the retail price to a shipping-point price change depend on whether this change is positive or negative, or not? If the answer is positive, price transmission will then be defined as asymmetric. Moreover, if the answer is positive, is the response to a shipping-point price increase quicker and more intense than that of a decrease, as usually emphasized?

Previous empirical studies have dealt with price transmission in the sector of fresh vegetables in other countries than France. See, among others, Ward and Zepp (1981), Ward (1982), Powers (1995), Brooker *et al.* (1997), Aguiar and Santana (1999), and, recently, Worth (2000). These studies raise different conclusions about price transmission in the fresh vegetable channel. For instance, Worth (2000) does not find any evidence of asymmetry in the transmission of shipping-point price changes to retail prices for four of the six fresh vegetables he considered (celery, lettuce, onions and potatoes). In the case of carrots and tomatoes, he finds evidence that retail prices show a greater response to shipping price increases. On the other hand, Ward (1982), examining the markets for various fresh vegetables in different cities, reports some evidence that wholesale price decreases are reflected at the retail stage more so than are wholesale price increases. But almost all these studies share the following two features: (1) they use variants of an econometric technique introduced by Wolffram (1971) and refined by Houck (1977) for estimating nonreversible functions, and (2) they generally use average monthly price to determine how prices throughout a marketing channel adjust to a change in price at one exchange point.

Hereafter, to determine whether an asymmetric relationship is present between changes in shipping-point prices and retail prices, instead of using the Wolffram-Houck's technique, we employ an error-correction model where short-run dynamics of the price series are linked to their long-run equilibrium behavior (Engle and Granger, 1987). Price transmission is seen as the consequence of short-run departures from the long-run relationship between shipping-point and retail prices. This approach postulates thus that the price series are cointegrated, i.e., some linear combination of both forms a stationary process. Notice that it has been shown that the Wolffram-Houck's specification is incompatible with cointegration between the prices being studied (von Cramon-Taubadel, 1998). The stationarity properties of the price series must be checked before using this specification.

In order to address the issue of asymmetries, we use threshold cointegration methods recently developed by Enders and Granger (1998) and Enders and Sicklos (2001). These methods allow analyzing the stationarity of time series under the assumption of asymmetric adjustment. The symmetric adjustment involved in the Engle and Granger (1987)'s test of cointegration appears to be a special case of the threshold models introduced by Enders and Granger (1998). If data support the evidence of an asymmetric adjustment to the long-run equilibrium relationship, then we can apply a threshold autoregressive model within an error correction model to determine whether an asymmetric relationship is present between changes in shipping-point prices and retail prices. Threshold cointegration methods have been recently used by Abdulai and Rieder (1999) to estimate asymmetric price transmission in the Swiss pork market, and by Abdulai (2000) to characterize spatial price transmission and asymmetry in the Ghanaian maize markets.

To determine whether an asymmetric relationship is present between changes in shipping-point prices and retail prices in the French fresh vegetables channel, we are fortunate to have very detailed weekly data, and unlike the other aforementioned studies (except, Brooker *et al.*, 1997), can capture the very short-run asymmetries if present. Indeed, weekly data seem to be more consistent with planning horizons for participants in the fresh vegetables marketing channel, which can be expected to be much less than one month. Changes in pricing and inventory strategies may occur several times each month because of the perishable nature of fresh vegetables and of the relatively volatile nature of supplies entering the marketing channel (Brooker *et al*., 1997). Moreover, the retail price series we use are available at the supermarket level. Various aggregation levels can thus be considered: store, supermarket chain, regional market, and nationwide market, enabling us to investigate regularities in the way shipping-point price changes are transmitted.

Our empirical analysis focuses on two fresh vegetables: tomatoes and chicory. France is the third European producer for tomatoes, which are mainly grown in the southeast and Brittany regions. Tomatoes are considered by the various participants of the French fresh vegetable channel as leading produce in this channel. France is the first European producer of chicory whose main production area is the North-Picardie region.

The paper is organized as follows. Section 2 presents the econometric approach used in the empirical analysis. Section 3 describes the data. Section 4 reports our main empirical results. Lastly, section 6 gathers our conclusions.

2. Methodology

The methodology we apply draws from the Engle and Granger (1987)'s approach of the cointegration between two time-series and from the recent works of Enders and Granger (1998) end Enders and Sicklos (2001) where threshold autoregressive models are introduced in the previous approach. The methodology involves the following three steps.

Step 1: Assessment of the statistical properties of the price series.

Let $P^S{}_t$ and $P^R{}_t$ denote the observed shipper price and retail price at time t, respectively. Engle and Granger's approach of cointegration applies when the two time-series are integrated of order one, i.e., when first differencing the data ensures stationarity. Thus, the first step in the analysis is to pretest each variable to determine its order of integration. Augmented Dickey and Fuller tests (see Enders, 1995) are performed to infer the number of unit roots (if any) in each of the price series.

Step 2: Estimation of the long-run equilibrium relationship between retail and shipper prices.

If the results of step 1 indicate that the two price series $P^S{}_t$ and $P^R{}_t$ are both integrated or order one, the next step involves the estimation of the long-run equilibrium relationship in the form:

$$P^R{}_t = \alpha + \beta P^S{}_t + \mu_t \qquad (1)$$

where β is a parameter to be estimated, and μ_t is a disturbance term which may be serially correlated. OLS can then be used to estimate ρ in the following relationship:

$$\Delta\mu_t = \rho\, \mu_{t-1} + \varepsilon_t \qquad (2)$$

where ε_t is a white noise. The rejection of the null hypothesis of non-cointegration between the two price series P^S_t and P^R_t (i.e., accepting the alternative hypothesis of $-2 < \rho < 0$ in equation (2)), implies that the residuals in equation (1) are stationary with mean zero. Notice that the alternative hypothesis entails a symmetric adjustment process of these residuals around $\mu = 0$, the long run equilibrium relationship. For instance, the change in μ_t equals μ_{t-1} multiplied by ρ irrespective of whether μ_{t-1} is negative or positive.

As the residuals μ_t are not observable, the test is performed on the estimated residuals μ^{est}_t. The test involves the estimation of the following equation:

$$\Delta\mu^{est}_t = \rho\, \mu^{est}_{t-1} + \Sigma_j\ \gamma_j\ \Delta\mu^{est}_{t-j} + \varepsilon_t \qquad (3)$$

where lags are introduced such that the sequence of the ε_t appears to be white noise. The appropriate lag length is determined using Ljung-Box autocorrelation test. If the null hypothesis $\rho = 0$ is rejected in favor of the alternative hypothesis $-2 < \rho < 0$, we can conclude that the residual sequence μ^{est}_t is stationary and that the two price series P^S_t and P^R_t are cointegrated. Engle and Granger (1987) provide test statistics and tables that can be used to test the aforementioned null hypothesis.

When the two price series are cointegrated, the existence of a constant absolute margin can be investigated by testing $\beta = 1$ in the long-run equilibrium relationship. Although the estimator of β can be shown to be superconsistent, the endogeneity of P^S_t prevents the use of the standard t-test. Stock and Watson (1993) propose the introduction of leads and lags on ΔP^S_t in the regression model (1) to get an efficient estimator of β. If the residuals are not autocorrelated, then the t-statistics associated with the estimator of β in the transformed regression model is asymptotically distributed as a standard normal distribution. The test of the hypothesis $\beta = 1$ can then be easily implemented.

Moreover, when the two price series are cointegrated, their short-run dynamics can be represented using an error-correction model of the form:

$$\begin{cases} \Delta P^R_t = \delta\, \mu_{t-1} + \Sigma_j\ \lambda_{1,j}\ \Delta P^R_{t-j} + \Sigma_j\ \lambda_{2,j}\ \Delta P^S_{t-j} + \varepsilon_t \\ \Delta P^S_t = \phi\, \mu_{t-1} + \Sigma_j\ \theta_{1,j}\ \Delta P^R_{t-j} + \Sigma_j\ \theta_{2,j}\ \Delta P^S_{t-j} + \nu_t \end{cases} \qquad (4)$$

This system of two equations can be estimated replacing the error-correction term μ_{t-1} by its estimated value and using OLS equation by equation. The equations are estimated using lag lengths that yield serially uncorrelated errors.

The speed of adjustment parameters δ and ϕ are of particular interest in that they have important implications for the short-run dynamics of the system. First, notice that, if the two price series are cointegrated, at least one of the speed of adjustment parameters should be significantly different from zero. Second, if the parameters ϕ and θ_1 (δ and λ_2, resp.) are equal to zero, then it can be said that P^R_t (P^S_t, resp.) does not Granger cause P^S_t (P^R_t, resp.) (Enders, 1995). Indeed, the error-correction representation clearly indicates that, for example, there are two possible source of causation (in the Granger sense) for P^R_t by P^S_t; one through the μ_{t-1} term, since it is a function of P^R_{t-1} and P^S_{t-1} if $\delta \neq 0$, and the other through the lagged ΔP^S_{t-j} terms if they are present in the equation describing the short-run dynamics of the retail price. But causality is purely a statistical method used to assess the utility of one price series for predicting a second price series. Recently, Kuiper and Meulenberg (1999) showed that, given P^R_t is error-correcting, i.e., $\delta \neq 0$, testing whether or not P^S_t responds to the deviation from the long-run equilibrium relationship allows discriminating between two different models of pricing behaviors within channels. Thus, they showed that the null hypothesis $\phi = 0$ corresponds to a model where retailers allow their suppliers to set their prices only on the basis of the costs they face but not on the basis of consumer demand. But, if this null hypothesis is rejected in favor of the alternative hypothesis according to which P^S_t displays error-correcting behavior, then we can conclude that suppliers are able to behave as vertical price leaders in the sense of Stackelberg price leadership, i.e., they have some pricing–setting power vis-à-vis the retailer. Significance tests on the speed of adjustment parameters δ and ϕ are performed in view to characterize which model seems to be useful for explaining pricing practices within the marketing channels.

Step 3: Short-run adjustments: symmetric or asymmetric?

The implicit assumption behind the various tests involved in the previous step is that the price responses of the retail price are symmetric in the sense that a shock to the shipping-point price (if this price appears to be the channel leading price) would elicit the same response in retail prices, regardless of whether the shock reflected a price increase or decrease. Asymmetry can be introduced in the previous framework considering alternative error correction specifications, in which equation (2) is represented as:

$$\Delta\mu_t = \rho_1\, \mu_{t-1}\, 1(\mu_{t-1} \geq 0) + \rho_2\, \mu_{t-1}\, 1(\mu_{t-1} < 0) + \varepsilon_t \quad (5)$$

or as

$$\Delta\mu_t = \rho_1\, \mu_{t-1}\, 1(\Delta\mu_{t-1} \geq 0) + \rho_2\, \mu_{t-1}\, 1(\Delta\mu_{t-1} < 0) + \varepsilon_t \quad (6)$$

where $1(\mathrm{A}) = 1$, if condition A is satisfied, and 0, elsewhere.

Enders and Granger (1998) introduced these two models, called threshold autoregressive model (TAR) and momentum-threshold autoregressive model (M-TAR) respectively. If the adjustment process described by these two models is convergent, $\mu_t = 0$ can be considered as the long-run equilibrium value of the sequence. In the first model, if μ_{t-1} is above its long-run equilibrium value, the adjustment is $\rho_1\, \mu_{t-1}$, and if μ_{t-1} is below its long-run equilibrium value, the adjustment is $\rho_2\, \mu_{t-1}$. In the second model, the speed of adjustment is now allowed to depend on the sign of the change of μ_{t-1} in the previous period. The TAR model is designed to capture asymmetrically "deep" movements in the series of the deviations from the long-run equilibrium, while the M-TAR model is useful in capturing the possibility of asymmetrically "steep" movements in this series (Enders and Granger, 1998). Notice that since adjustment is symmetric if $\rho_1 = \rho_2$, whatever the considered model, equation (2) is a special case of (5) or (6).

We estimate a regression equation in the form of (5) or (6) where we use estimated residuals μ^{est}_t from equation (1), i.e.,

$$\Delta\mu^{est}_t = \rho_1\, \mu^{est}_{t-1}\, 1(\mu^{est}_{t-1} \geq 0) + \rho_2\, \mu^{est}_{t-1}\, 1(\mu^{est}_{t-1} < 0) + \Sigma_j\ \gamma_j\ \Delta\mu^{est}_{t-j} + \varepsilon_t \quad (7)$$

or

$$\Delta\mu^{est}_t = \rho_1\, \mu^{est}_{t-1}\, 1(\Delta\mu^{est}_{t-1} \geq 0) + \rho_2\, \mu^{est}_{t-1}\, 1(\Delta\mu^{est}_{t-1} < 0) + \Sigma_j\ \gamma_j\ \Delta\mu^{est}_{t-j} + \varepsilon_t \quad (8)$$

where lags are introduced such that the sequence of the ε_t appears to be white noise. We obtain the sample values of the t-statistics for the null hypothesis $\rho_1 = 0$ and $\rho_2 = 0$ and the F-statistic for the null hypothesis $\rho_1 = \rho_2 = 0$. These values are compared with the appropriate critical values tabulated in Enders and Granger (1998) and Enders and Siklos (1998) to determine whether the null hypothesis of a unit root can be rejected. If the alternative hypothesis is accepted, it is possible to test for asymmetric adjustment since ρ_1 and ρ_2 converge to a multivariate normal distribution (Enders and Granger, 1998). The restriction that adjustment is symmetric, i.e., the null hypothesis $\rho_1 = \rho_2$ can be tested using the usual F-statistic.

Given the existence of a cointegrating vector in the form of (1), the short-run dynamics of the two price series can be represented using an error-correction model of the form:

$$\begin{cases} \Delta P^R_t = \delta_1\, \mu^+_{t-1} + \delta_2\, \mu^-_{t-1} + \Sigma_j\ \lambda_{1,j}\ \Delta P^R_{t-j} + \Sigma_j\, \lambda_{2,j}\ \Delta P^S_{t-j} + \varepsilon_t \\ \Delta P^S_t = \phi_1\, \mu^+_{t-1} + \phi_2\, \mu^-_{t-1} + \Sigma_j\ \theta_{1,j}\ \Delta P^R_{t-j} + \Sigma_j\, \theta_{2,j}\ \Delta P^S_{t-j} + \nu_t \end{cases} \tag{9}$$

where $\mu^+_{t-1} = \mu_{t-1}\, 1(\mu_{t-1} \geq 0)$ ($= \mu_{t-1}\, 1(\Delta\mu_{t-1} \geq 0)$, resp.) and $\mu^-_{t-1} = \mu_{t-1}\, 1(\mu_{t-1} < 0)$ ($= \mu_{t-1}\, 1(\Delta\mu_{t-1} < 0)$, resp.) if the deviations from the long-run equilibrium relationship can be represented by a TAR model (M-TAR model, resp.).

The system (9) can be estimated replacing the error-correction term μ_{t-1} by its estimated value and using OLS equation by equation. The equations are estimated using lag lengths that yield serially uncorrelated errors. Different speeds of short-run adjustment are then estimated depending on the chosen (TAR or M-TAR) model. As above, joint significance tests on these parameters are performed in view to characterize which stage is the channel leading price: shipping or retail.

3. Data Description

The analysis relies on price data collected by the *Service des Nouvelles de Marché*, hereafter *SNM*, of the French Ministry of Agriculture. The mandate of this department is to collect price data at the different stages of the marketing channel (shipping, wholesaling and retailing) for agricultural products belonging to the fruits and vegetables sector, and to provide detailed information on these prices to the different participants in the marketing channels. Indeed, the aim of this mandate was the strengthening of the openness in the functioning of markets where, until recently, the actors were numerous.

Shipping-point price data has been collected everyday through phone calls to the main traders in each production area for at least ten years. They are then averaged for each product. Wholesale price data corresponding to the main wholesale markets (for example, the wholesale market of Rungis, a town near Paris) has been constructed similarly for at least ten years. Products are defined at a very precise level depending on the variety, the grade, the area of production, and the packaging. The collection of price data at the retail stage is a recent activity of *SNM*. A sample of 150 supermarkets whose surfaces exceed 1000 m^2 and which are distributed over the French territory, has been visited on a weekly basis (on Thursday or Friday) since the forty-first week of 1997. This sample is representative of the main big French supermarket chains. The way prices are collected allows constructing a one to one correspondence between a product at the shipping or wholesaling stages and its equivalent at the retail stage. Indeed, for each store, when a product is displayed, we know not only its price but also its variety, grade, and production origin. Moreover, the data include the region where the supermarket is located, and the name of the supermarket chain. The *SNM* splits France into seven regions: Ile de France (*RU*), Basse-Normandie + Centre + Pays de Loire + Poitou-Charentes + Bretagne (*CO*), Picardie + Champagne-Ardenne + Haute-Normandie + Nord (*NO*), Franche-Comté + Lorraine + Alsace (*EE*), Rhône-Alpes + Auvergne + Bourgogne (*RA*), Provence Alpes Côte d'Azur + Languedoc (*SE*), and Aquitaine + Midi-Pyrénées + Limousin (*SO*). The surveyed stores belong to twenty-one supermarket chains.

The analysis focus on two fresh vegetables: tomatoes and chicory, and two channel stages: shipping and retail. The choice of these two fresh vegetables is dictated by econometric considerations. These two fresh vegetables are displayed throughout the whole year. Time-series of prices can then be constructed with enough observations. Notice that the British *Office of Fair Trading* recommends the availability of long time series of data, with at least 50 observations, to implement cointegration analysis (Office of Fair Trading, 1999).

The recent changes in the marketing channel of fresh vegetables motivate the analysis of price transmission between only shipping and retailing. Indeed, two groups have recently emerged in this channel. On one side, the producers have assembled into cooperatives integrating the various operations involved in shipping (i.e., grading, stocking and packaging), and directly have acted on the shipping stage. On the other side, the main store chains have vertically integrated the wholesaling stage through central purchasing offices, which directly buy to shippers. Wholesaling have tended towards marginalization and specialization in supplying very specialized retail trade and catering. Wholesaling now represents only one third of the purchases of fresh vegetables from the big French store chains.

Forty-two shipping-point/retail price relationships are under investigation: twenty-two for tomatoes, and twenty for chicory. The shipping-point price series are the original series provided by *SNM*. For instance, we have the shipping-point price series for a product named "tomatoes, type = round, grade = 57-67 mm, and production origin = southeast region of France, i.e., *SE* region". The retail price series are computed by averaging the store-level price series for each product at different levels: the nationwide market, the regional market, and the supermarket chain level. The store-level price series presenting frequent cuts, averaging allows constructing more complete price series.

The way we averaged store-level price data raises the following comments. First, notice that the lack of any quantity data prevents us from computing weighted averages where each weight is equal to the share of each store in total purchases of the product under consideration. Thus, our study differs from other studies on vertical relationships between retail, wholesale and/or producer/shipper price, which rely on such weighted averages. Second, store-level price data reflect not only the prices that are really paid by consumers, but also the temporal pattern of promotions made by stores. These data present an interest per se by allowing the study of the way supermarkets price the goods they sell (see Pesendorfer, 2000). But the direct comparison of these disaggregated data to the shipping-point price data provided by the *SNM*, will suffer from the lack of a precise information about the contractual arrangements that fix the prices really paid by the supermarket to its suppliers during promotional periods.

4. Results

Step 1. The results – not presented here for sake of brevity but available upon request – support the presence of one unit root in each case, indicating nonstationarity in each price series.

Step 2. The estimated long-run equilibrium relationships between shipping-point and retail prices are given in table 1-a and table 1-b. The corresponding cointegration tests, i.e., test of the null hypothesis $\rho = 0$ in equation (3), are given in table 2-a and 2-b. Notice then that this null hypothesis of no cointegration between the retail price and the shipping-point price can be rejected for every product and retail aggregation level. Each pair of shipping-point and retail prices are thus cointegrated and their estimated relationship can be interpreted as a long-run equilibrium relationship.

Formal hypothesis testing in regard to the value of the cointegrating parameters cannot be directly carried out with the cointegration results because verification of nonstationarity of the price series implies that the estimated standard errors are not consistent, although the estimates of the parameters are consistent. However, notice that the coefficients of the shipping-point price are in many cases close to one in numerical value when considering the results for tomatoes (see table 1-a). The Stock and Watson (1993)'s tests – not presented here for sake of brevity but available upon request – clearly indicate that the null hypothesis $\beta = 1$ cannot be rejected in sixteen of the twenty-two estimated long-run equilibrium relationships for tomatoes, indicating that retail price and shipping-point price are linked by a constant absolute margin. For instance, for tomatoes whose type is round, size is 57-67 mm, and production area is southeast part of France, this constant margin approximately equals 5 FF/kg, the average shipping-point price being 6 FF/kg. This constant margin varies from 4.80 FF/kg in the production area to 5.77 FF/kg in the North of France, the farthest region from the production area, reflecting the growing importance of transportation costs from this latter area to consumption areas.

The Stock and Watson (1993)'s test concludes fifteen times (over twenty) in the rejection of the null hypothesis $\beta = 1$ in the chicory case. The marketing margin is now proportional to the shipping-point price, indicating that retailers increase their margins when the demand for chicory is high and reduce them in the other occurrence. Nevertheless, the constant part of the margin prevails over the variable part. Indeed, on average, this latter equals to 0.91 FF/kg while the former is worth 6.44 FF/kg for an average shipping-point price of chicory of 7 FF/kg.

Each pair of shipping-point and retail prices being cointegrated, an error correction model the expression of which is given by equation (4) can represent their short-run dynamics. For sake of brevity, we do not report all the estimated results – they are available upon request. Two findings are noticeable. First, in the majority of cases joint significance tests allow for the acceptation of the null hypothesis that lagged changes in retail prices and the error correction term do not affect shipping-point price, and for the rejection of the null hypothesis that lagged changes in shipping-point prices and the error correction term do not affect retail price for any pair of shipping-point and retail prices. These findings suggest directional causation (in the Granger sense) from shipping-point price to retail price whatever the considered product. Second, the error-correction term μ_{t-1} only significantly enters the equation describing the short-run dynamics of retail prices, for every considered pair of shipping-point and retail prices (see the summarized results in the seventh columns of table 1-a and 1-b). Shipping-point price does not exhibit error-correcting behavior. Its short-run dynamics capture only temporal variations in production and shipping costs without responding to the error-correction term. Thus, following Kuiper and Meulenberg (1999), these results seem to indicate that retailers do not allow the shippers to influence retail prices beyond the cost fluctuations they face.

Step 3. The sixth columns of tables 1-a and 1-b summarize the results of the investigation of potential asymmetry in the short-run price responses. The corresponding tests, i.e., cointegration tests (i.e., tests of the null hypotheses $\rho_1 = 0$, $\rho_2 = 0$, and $\rho_1 = \rho_2 = 0$ in equations (7) or (8)) and symmetry tests (i.e., test of the null hypothesis $\rho_1 = \rho_2$ in equations (7) or (8)) are given in tables 2-a and 2-b. The null hypothesis of no cointegration between the retail price and the shipping-point price is again rejected for every product and retail aggregation level. As emphasized above, each pair of shipping-point and retail prices are cointegrated and their estimated relationship can always be interpreted as a long-run equilibrium relationship.

In the tomato case, half of the short-run adjustment mechanisms are shown to be symmetric (eleven cases over the considered twenty-two cases). When asymmetry prevails, the adjustment always follows an M-TAR model. Indeed, the results given in table 2-a show that asymmetric adjustments between the shipping-point and the retail prices can be characterized using this kind of model, and that a TAR model cannot be disentangled from a symmetric model. As emphasized by Abdulai and Rieder (1999), M-TAR model can capture asymmetric price transmission in cases where retailers must quickly adjust their prices in response to variations in their suppliers' prices. Indeed, tomato production is very sensitive to day after day climatic changes. Frequent and quick changes in shipping-point prices occur and retailers may respond very rapidly to these changes.

Moreover, when asymmetry prevails, the estimated values of the short-run adjustment parameters δ_1 and δ_2 reported in table 3-a indicate that adjustment of retail prices towards the long-run equilibrium relationship between shipping-point and retail prices is generally (ten cases over eleven) faster when changes in deviation is positive (i.e., when shipping-point prices decline to increase the marketing margin) than when they are negative (i.e., when shipping-point prices rise to decrease the marketing margin). Reductions in shipping-point prices appear thus to be passed on the retail prices faster than increases in the shipping-point price. For information only, the average short-run adjustment speeds computed over the ten cases of asymmetry are 0.94 and 0.58, meaning that a shipping-point price drop of 1 FF/kg leads to a retail price decrease of, on average, 0.94 FF/kg during the following week, and that a rise of the same amount of the shipping-point price leads a retail price increase of, on average, only 0.58 FF/kg.

In the chicory case, the short-run adjustment mechanisms are more often symmetric than asymmetric (thirteen cases of symmetry over twenty investigated cases). When short-run asymmetries are highlighted, the chosen model is generally (seven cases over eight asymmetric cases) a TAR model. Enders and Granger (1998) show that this type of models can capture asymmetrically "deep" movements in a series. Such deepness may be related to the fact that chicory production, which is less sensitive to climatic changes and better monitored than tomatoes production, better fits demand changes. Chicory prices are less affected by fluctuations in supply than tomato prices. Indeed, chicory shipping-point prices exhibit less steep changes.

Finally, when asymmetry prevails, the estimated values of the short-run adjustment parameters δ_1 and δ_2 reported in table 3-b indicate, in six cases over seven, that adjustment of retail prices towards the long-run equilibrium relationship between chicory shipping-point and retail prices is generally faster when deviations are negative (i.e., when shipping-point prices rise) than when they are positive (i.e., when shipping-point prices decline). Increases in shipping-point prices seem to be passed on the retail prices faster than declines in the shipping-point price. Here, the average short-run adjustment speeds computed over the six cases are 0.39 when shipping-point prices drop and 0.51 when they rise.

5. Concluding Remarks.

In this paper, we investigate the existence and the kind of asymmetry that characterize the relationships between shipping-point and retail prices for two major French fresh vegetable productions: tomatoes and chicory. The weekly data we use allow us to consider these relationships at very detailed levels such as region or supermarket chain. Moreover, our methodology incorporates recent developments in cointegration analysis dealing with the issue of asymmetry in the relationship between two time-series.

Our major findings do not give evidence to the widespread assertion that middlemen with speculative aims systematically use price changes occurring in the first stages of a marketing channel. Indeed, we find only in seven relationships over the forty-one shipping-point and retail price relationships we investigate (mainly for chicory), that shipping-point price increases are completely and rapidly passed on to consumers while there is a slower and less complete transmission of shipping-point price declines. In eleven cases (mainly for tomatoes), the converse result holds. But in the majority of cases (twenty-three cases), price transmission appears to be symmetric.

To sum up, price transmission is generally symmetric for the two considered fresh vegetables. When price transmission is asymmetric, shipping-point price declines are generally transmitted more completely and rapidly than shipping-point price increases. As emphasized by Ward (1982) and, more recently, by Aguiar and Santana (1999), the perishable nature of the considered products may be the main cause of this type of price asymmetry. Indeed, tomatoes and chicory are both perishable fresh vegetables and retailers may be reluctant to increase their prices for fear of an inability to move the perishable item they are not used to store. But we are left with an open question: Why does this form of asymmetry appear more frequently for tomatoes than chicory?

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Table 1.a – Summary of the main results: Tomatoes

Shipping Price Series	Aggregation Level	Retail Price Series	Long-Run Equilibrium Relationship	H_0: $\beta = 1$	Symmetry	H_0: $\delta = 0$ H_0: $\phi = 0$
Tomatoes Type: Cluster Production Area: South-East	National	National	$P^D_t - 1,13P^E_t = 5,59$ (23,8) (15,1)	Accepted	No: M-TAR	Rejected Accepted
	Regional	SE	$P^D_t - 1,04P^E_t = 5,71$ (17,1) (11,9)	Accepted	Yes	Rejected Accepted
		SO	$P^D_t - 1,11P^E_t = 6,12$ (15,4) (11,1)	Accepted	No: M-TAR	Rejected Accepted
	Store Chain	E1	$P^D_t - 1,41P^E_t = 3,52$ (19,4) (6,3)	Rejected	No: M-TAR	Rejected Accepted
		E2	$P^D_t - 1,24P^E_t = 4,58$ (10,6) (5,7)	Rejected	Yes	Rejected Accepted
		E3	$P^D_t - 1,21P^E_t = 4,27$ (13,2) (6,2)	Rejected	No: M-TAR	Rejected Accepted
Tomatoes Type: Cluster Production Area: Brittany	National	National	$P^D_t - 1,20P^E_t = 5,28$ (18,5) (9,2)	Rejected	Yes	Rejected Accepted
	Regional	CO	$P^D_t - 1,30P^E_t = 4,43$ (22,5) (8,8)	Rejected	Yes	Rejected Accepted
		RU	$P^D_t - 1,09P^E_t = 6,22$ (11,3) (7,4)	Accepted	Yes	Rejected Accepted
		NO	$P^D_t - 1,09P^E_t = 6,51$ (11,1) (7,6)	Accepted	Yes	Rejected Accepted
	Store Chain	E1	$P^D_t - 1,26P^E_t = 4,48$ (17,1) (7,1)	Rejected	No: M-TAR	Rejected Accepted
		E2	$P^D_t - 1,10P^E_t = 6,56$ (11,7) (8,5)	Accepted	No: M-TAR	Rejected Accepted
		E3	$P^D_t - 1,28P^E_t = 4,33$ (12,8) (5,5)	Rejected	Yes	Rejected Accepted
Tomatoes Type: Round Size: 57-67 mm Production area : South-East	National	National	$P^D_t - 1,04P^E_t = 4,93$ (15,9) (16,4)	Accepted	No: M-TAR	Rejected Accepted
	Regional	SE	$P^D_t - 0,95P^E_t = 4,80$ (13,9) (15,6)	Accepted	No: M-TAR	Rejected Accepted
		SW	$P^D_t - 1,01P^E_t = 4,95$ (11,0) (9,6)	Accepted	No: M-TAR	Rejected Accepted
		RU	$P^D_t - 1,01P^E_t = 5,04$ (10,9) (10,1)	Accepted	Yes	Rejected Accepted
		NO	$P^D_t - 0,93P^E_t = 5,77$ (8,8) (10,3)	Accepted	Yes	Rejected Rejected
		RA	$P^D_t - 0,94P^E_t = 5,63$ (8,6) (9,6)	Accepted	No: M-TAR	Rejected Rejected
	Store Chain	E1	$P^D_t - 1,14P^E_t = 4,22$ (15,4) (11,5)	Accepted	Yes	Rejected Accepted
		E2	$P^D_t - 0,97P^E_t = 5,14$ (10,6) (12,4)	Accepted	Yes	Rejected Accepted
		E19	$P^D_t - 0,98P^E_t = 5,36$ (8,9) (10,4)	Accepted	No: M-TAR	Rejected Accepted

Notes:

- The t-student are between parentheses.
- The null hypotheses H_0: $\delta = 0$ and H_0: $\phi = 0$ become H_0: $\delta_1 = 0$ and $\delta_2 = 0$, and H_0: $\phi_1 = 0$ and $\phi_2 = 0$ when asymmetry prevails.

Table 1.b – Summary of the main results: Chicory

Shipping Price Series	**Aggregation Level**	**Retail Price Series**	**Long-Run Equilibrium Relationship**	**H_0: $\beta = 1$**	**Symmetry**	**H_0: $\delta = 0$ H_0: $\phi = 0$**
Chicory Production Area: North	National	National	$P^D_t - 1.13\, P^E_t = 6.44$ (15.76) (12.43)	Accepted	Yes	Rejected Accepted
	Regional	NO	$P^D_t - 1.16\, P^E_t = 5.91$ (15.44) (10.81)	Rejected	Yes	Rejected Accepted
		RU	$P^D_t - 0.98\, P^E_t = 7.75$ (13.56) (14.66)	Accepted	Yes	Rejected Accepted
		CO	$P^D_t - 1.16\, P^E_t = 5.75$ (15.40) (10.89)	Rejected	No: TAR	Rejected Accepted
		SO	$P^D_t - 1.18\, P^E_t = 6.41$ (17.29) (12.59)	Rejected	Yes	Rejected Accepted
		EE	$P^D_t - 1.27\, P^E_t = 5.70$ (16.10) (9.84)	Rejected	Yes	Rejected Accepted
		SE	$P^D_t - 1.17\, P^E_t = 6.18$ (17.29) (12.59)	Rejected	No: TAR	Rejected Accepted
	Store Chain	E2	$P^D_t - 1.46\, P^E_t = 4.01$ (18.36) (6.53)	Rejected	Yes	Rejected Accepted
		E3	$P^D_t - 0.77\, P^E_t = 9.65$ (13.09) (22.03)	Rejected	Yes	Rejected Accepted
		E6	$P^D_t - 1.32\, P^E_t = 5.36$ (15.49) (8.60)	Rejected	No: TAR	Rejected Accepted
		E7	$P^D_t - 1.18\, P^E_t = 6.28$ (17.55) (11.77)	Rejected	Yes	Rejected Accepted
		E10	$P^D_t - 1.34\, P^E_t = 4.28$ (14.95) (6.31)	Rejected	Yes	Rejected Accepted
		E13	$P^D_t - 1.07\, P^E_t = 7.36$ (13.87) (12.85)	Accepted	No: M-TAR:	Rejected Accepted
		E14	$P^D_t - 1.26\, P^E_t = 5.37$ (12.01) (7.39)	Rejected	Yes	Rejected Accepted
		E18	$P^D_t - 0.77\, P^E_t = 8.45$ (11.29) (16.04)	Rejected	No: TAR	Rejected Accepted
		E19	$P^D_t - 1.13\, P^E_t = 5.81$ (15.02) (10.74)	Rejected	No: TAR	Rejected Accepted
	Store	M1640	$P^D_t - 1.15\, P^E_t = 8.11$ (11.17) (9.16)	Accepted	Yes	Rejected Accepted
		M1649	$P^D_t - 1.46\, P^E_t = 2.85$ (17.5) (4.50)	Rejected	Yes	Rejected Accepted
		M1753	$P^D_t - 1.04\, P^E_t = 7.90$ (10.75) (10.39)	Accepted	Yes	Rejected Accepted
		M1763	$P^D_t - 1.50\, P^E_t = 3.93$ (9.12) (3.31)	Rejected	No: TAR	Rejected Accepted

Notes:

- The t-student are between parentheses.
- The null hypotheses $\delta = 0$ and $\phi = 0$ become $\delta_1 = 0$ and $\delta_2 = 0$, and $\phi_1 = 0$ and $\phi_2 = 0$ when asymmetry prevails.

Table 2.a. – Cointegration and threshold cointegration tests: Tomatoes

Product	Aggregation Level	Retail Price Series	Symmetry: Engle-Granger	Asymmetry: TAR	Asymmetry: M-TAR
Tomatoes Type: Cluster, Production area: South-East	National	France	ρ = -0.902 (-5.35)	• ρ_1 = -0.904 (-4.73) ρ_2 = -0.789 (-3.67) • Φ_μ = 17.35 • Signif ($\rho_1 = \rho_2$) = 0.54	• ρ_1 = -1.090 (-5.06) ρ_2 = -0.586 (-3.00) • Φ_μ = 17.35 • Signif ($\rho_1 = \rho_2$) = 0.00
	Regional	SO	ρ = -0.890 (-6.69)	• ρ_1 = -0.911 (-4.76) ρ_2 = -0.869 (-4.61) • Φ_μ = 22.01 • Signif ($\rho_1 = \rho_2$) = 0.60	• ρ_1 = -0.940 (-5.26) ρ_2 = -0.679 (-3.73) • Φ_μ = 20.69 • Signif ($\rho_1 = \rho_2$) = 0.00
	Store Chain	E1	ρ = -0.780 (-6.26)	• ρ_1 = -0.868 (-7.05) ρ_2 = -0.671 (-2.90) • Φ_μ = 29.07 • Signif ($\rho_1 = \rho_2$) = 0.28	• ρ_1 = -0.834 (-4.24) ρ_2 = -0.628 (-3.83) • Φ_μ = 28.31 • Signif ($\rho_1 = \rho_2$) = 0.045
		E3	ρ = -0.516 (-4.38)	• ρ_1 = -0.516 (-2.93) ρ_2 = -0.516 (-2.89) • Φ_μ = 35.21 • Signif ($\rho_1 = \rho_2$) = 0.98	• ρ_1 = -0.609 (-3.49) ρ_2 = -0.511 (-3.17) • Φ_μ = 37.23 • Signif ($\rho_1 = \rho_2$) = 0.00
Tomatoes Type: Cluster, Production area: Brittany	Store Chain	E1	ρ = -0.850 (-4.38)	• ρ_1 = -0.899 (-4.73) ρ_2 = -0.807 (-4.93) • Φ_μ = 23.42 • Signif ($\rho_1 = \rho_2$) = 0.72	• ρ_1 = -0.930 (-4.45) ρ_2 = -0.802 (-4.84) • Φ_μ = 21.68 • Signif ($\rho_1 = \rho_2$) = 0.042
		E2	ρ = -0.784 (-5.85)	• ρ_1 = -0.795 (-3.88) ρ_2 = -0.717 (-6.36) • Φ_μ = 27.81 • Signif ($\rho_1 = \rho_2$) = 0.46	• ρ_1 = -0.864 (-4.73) ρ_2 = -0.601 (-5.42) • Φ_μ = 25.93 • Signif ($\rho_1 = \rho_2$) = 0.041
Tomatoes Type: Round Size: 57-67 mm Production area: South-East	National	France	ρ = -0.706 (-6.32)	• ρ_1 = -0.909 (-5.86) ρ_2 = -0.568 (-3.98) • Φ_μ = 25.11 • Signif ($\rho_1 = \rho_2$) = 0.118	• ρ_1 = -1.040 (-6.11) ρ_2 = -0.700 (-4.82) • Φ_μ = 30.41 • Signif ($\rho_1 = \rho_2$) = 0.008
	Regional	SE	ρ = -0.903 (-7.21)	• ρ_1 = -0.887 (-5.29) ρ_2 = -0.925 (-4.81) • Φ_μ = 25.63 • Signif ($\rho_1 = \rho_2$) = 0.82	• ρ_1 = -0.873 (-5.57) ρ_2 = -0.717 (-3.53) • Φ_μ = 21.77 • Signif ($\rho_1 = \rho_2$) = 0.00
		SO	ρ = -0.724 (-6.26)	• ρ_1 = -0.787 (-4.70) ρ_2 = -0.665 (-4.09) • Φ_μ = 19.48 • Signif ($\rho_1 = \rho_2$) = 0.60	• ρ_1 = -0.613 (-4.23) ρ_2 = -1.219 (-6.00) • Φ_μ = 29.98 • Signif ($\rho_1 = \rho_2$) = 0.00
		RA	ρ = -0.875 (-6.23)	• ρ_1 = -0.827 (-4.21) ρ_2 = -0.928 (-4.54) • Φ_μ = 19.19 • Signif ($\rho_1 = \rho_2$) = 0.72	• ρ_1 = -0.887 (-4.44) ρ_2 = -0.870 (-4.04) • Φ_μ =18.03 • Signif ($\rho_1 = \rho_2$) = 0.03
	Store Chain	E19	ρ = -0.917 (-7.18)	• ρ_1 = -1.168 (-5.79) ρ_2 = -0.974 (-4.38) • Φ_μ = 21.86 • Signif ($\rho_1 = \rho_2$) = 0.46	• ρ_1 = -1.229 (-7.58) ρ_2 = -0.868 (-3.27) • Φ_μ = 22.01 • Signif ($\rho_1 = \rho_2$) = 0.049

Notes: [a]Coefficients and t-statistics for the null hypothesis $\rho = 0$.
[b]Coefficients and t-statistics for the null hypotheses $\rho_1 = 0$ and $\rho_2 = 0$ when the chosen representation of the deviation is μ_t is a TAR model. Φ_μ is the sample value of the statistic for the null hypothesis $\rho_1 = \rho_2 = 0$. Signif($\rho_1 = \rho_2$) gives the empirical significance level for the null hypothesis $\rho_1 = \rho_2$.

[c]Coefficients and t-statistics for the null hypotheses $\rho_1 = 0$ and $\rho_2 = 0$ when the chosen representation of the deviation is μ_t is a M-TAR model. Φ^*_μ is the sample value of the statistic for the null hypothesis $\rho_1 = \rho_2 = 0$. Signif($\rho_1 = \rho_2$) gives the empirical significance level for the null hypothesis $\rho_1 = \rho_2$.

Table 2.b. – Cointegration and threshold cointegration tests: Chicory

Product	Aggregation Level	Retail Price Series	Symmetry: Engle-Granger[a]	Asymmetry: TAR[b]	Asymmetry: M-TAR[c]
Chicory: Production area: North	National	France	$\rho = -0.427$ (-4.49)	• $\rho_1 = -0.350$ (-3.03) $\rho_2 = -0.592$ (-4.18) • $\Phi_\mu = 12.22$ • Signif. ($\rho_1 = \rho_2$)= 0.135	• $\rho_1 = -0.397$ (-3.53) $\rho_2 = -0.460$ (-3.01) • $\Phi^*_\mu = 11.54$ • Signif. ($\rho_1 = \rho_2$)= 0.670
	Regional	NO	$\rho = -0.484$ (-4.56)	• $\rho_1 = -0.427$ (-2.89) $\rho_2 = -0.618$ (-4.19) • $\Phi_\mu = 11.01$ • Signif.($\rho_1 = \rho_2$) = 0.264	• $\rho_1 = -0.466$ (-3.01) $\rho_2 = -0.533$ (-3.45) • $\Phi^*_\mu = 8.81$ • Signif. ($\rho_1 = \rho_2$)= 0.167
		RU	$\rho = -0.353$ (-4.01)	• $\rho_1 = -0.344$ (-2.932) $\rho_2 = -0.719$ (-3.38) • $\Phi_\mu = 12.03$ • Signif. ($\rho_1 = \rho_2$)= 0.61	• $\rho_1 = -0.187$ (-1.846) $\rho_2 = -0.435$ (-3.997) • $\Phi^*_\mu = 15.5$ • Signif. ($\rho_1 = \rho_2$)= 0.113
		CO	$\rho = -0.494$ (-3.97)	• $\rho_1 = -\ 0.344$ (-4.231) $\rho_2 = -\ 0.719$ (-3.38) • $\Phi_\mu = 12.03$ • Signif. ($\rho_1 = \rho_2$)= 0.035	• $\rho_1 = -0.390$ (-1.949) $\rho_2 = -0.604$ (-4.565) • $\Phi^*_\mu = 10.62$ • Signif. ($\rho_1 = \rho_2$)= 0.039
		SO	$\rho = -0.436$ (-4.09)	• $\rho_1 = -0.319$ (-2.673) $\rho_2 = -0.583$ (-4.055) • $\Phi_\mu = 9.979$ • Signif. ($\rho_1 = \rho_2$)= 0.119	• $\rho_1 = -0.318$ (-2.67) $\rho_2 = -0.543$ (-4.46) • $\Phi^*_\mu = 12.83$ • Signif. ($\rho_1 = \rho_2$)= 0.188
		EE	$\rho = -0.436$ (-3.49)	• $\rho_1 = -0.343$ (-2.67) $\rho_2 = -0.637$ (-3.86) • $\Phi_\mu = 8.57$ • Signif. ($\rho_1 = \rho_2$)= 0.125	• $\rho_1 = -0.383$ (-3.78) $\rho_2 = -0.472$ (-2.59) • $\Phi^*_\mu = 8.491$ • Signif. ($\rho_1 = \rho_2$)= 0.604
		SE	$\rho = -0.507$ (-5.13)	• $\rho_1 = -0.743$ (-5.04) $\rho_2 = -0.601$ (-4.00) • $\Phi_\mu = 19.86$ • Signif. ($\rho_1 = \rho_2$)= 0.045	• $\rho_1 = -0.296$ (-1.80) $\rho_2 = -0.625$ (-4.90) • $\Phi^*_\mu = 12.29$ • Signif. ($\rho_1 = \rho_2$)= 0.064
	Store Chain	E2	$\rho = -0.499$ (-4.47)	• $\rho_1 = -0.409$ (-3.16) $\rho_2 = -0.632$ (-4.28) • $\Phi_\mu = 12.09$ • Signif. ($\rho_1 = \rho_2$)= 0.201	• $\rho_1 = -0.387$ (-2.56) $\rho_2 = -0.608$ (-4.97) • $\Phi^*_\mu = 13.96$ • Signif. ($\rho_1 = \rho_2$)= 0.203
		E3	$\rho = -0.375$ (-3.85)	• $\rho_1 = -0.312$ (-2.55) $\rho_2 = -0.485$ (-3.21) • $\Phi_\mu = 7.30$ • Signif. ($\rho_1 = \rho_2$)= 0.299	• $\rho_1 = -0.201$ (-1.81) $\rho_2 = -0.369$ (-3.76) • $\Phi^*_\mu = 7.95$ • Signif. ($\rho_1 = \rho_2$)= 0.082
		E6	$\rho = -0.720$ (-5.04)	• $\rho_1 = -0.516$ (-2.99) $\rho_2 = -1.05$ (-6.55) • $\Phi_\mu = 21.48$ • Signif. ($\rho_1 = \rho_2$)= 0.007	• $\rho_1 = -0.326$ (-1.79) $\rho_2 = -0.881$ (-5.04) • $\Phi^*_\mu = 12.81$ • Signif. ($\rho_1 = \rho_2$)= 0.065
		E7	$\rho = -0.410$ (-3.69)	• $\rho_1 = -0.368$ (-2.37) $\rho_2 = -0.467$ (-3.49) • $\Phi_\mu = 7.42$ • Signif. ($\rho_1 = \rho_2$)= 0.578	• $\rho_1 = -0.301$ (-2.29) $\rho_2 = -0.529$ (-3.20) • $\Phi^*_\mu = 6.73$ • Signif. ($\rho_1 = \rho_2$)= 0.192

Table 2.b. (continued)

Product	Aggregation Level	Retail Price Series	Symmetry: Engle-Granger[a]	Asymmetry: TAR[b]	Asymmetry: M-TAR[c]
Chicory: Production area: North	Store chain	E10	ρ = -0.609 (-5.64)	• ρ_1 = -0.556 (-3.97) ρ_2 = -0.673 (-3.77) • Φ_μ = 11.86 • Signif. ($\rho_1 = \rho_2$)= 0.501	• ρ_1 = -0.400 (-2.58) ρ_2 = -0.580(-3.81) • Φ^*_μ = 9.61 • Signif. ($\rho_1 = \rho_2$)= 0.304
		E13	ρ = -0.589 (-4.52)	• ρ_1 = -0.42 (-3.11) ρ_2 = -0.785 (-6.87) • Φ_μ = 24.57 • Signif. ($\rho_1 = \rho_2$)= 0.055	• ρ_1 = -0.399 (-2.921) ρ_2 = -0.826 (-6.57) • Φ^*_μ = 22.21 • Signif. ($\rho_1 = \rho_2$)= 0.028
		E14	ρ = -0.408 (-3.76)	• ρ_1 = -0.319 (3.05) ρ_2 = -0.601 (-4.00) • Φ_μ = 10.77 • Signif. ($\rho_1 = \rho_2$)= 0.116	• ρ_1 = -0.367 (-3.47) ρ_2 = -0.480 (-3.37) • Φ^*_μ = 10.88 • Signif. ($\rho_1 = \rho_2$)= 0.529
		E18	ρ = -0.490 (-4.36)	• ρ_1 = -0.388 (-2.83) ρ_2 = -0.723 (-4.26) • Φ_μ = 12.43 • Signif. ($\rho_1 = \rho_2$)= 0.06	• ρ_1 = -0.38 (-2.22) ρ_2 = -0.698 (-4.87) • Φ^*_μ = 13.70 • Signif. ($\rho_1 = \rho_2$)= 0.048
	Store	E19	ρ = -0.553 (-3.97)	• ρ_1 = -0.420 (-2.39) ρ_2 = -0.810 (-4.41) • Φ_μ = 10.69 • Signif. ($\rho_1 = \rho_2$)= 0.055	• ρ_1 = -0.508 (-2.89) ρ_2 = -0.619 (-3.29) • Φ^*_μ = 9.22 • Signif. ($\rho_1 = \rho_2$)= 0.573
		M1640	ρ = -0.468 (-3.87)	• ρ_1 = -0.232 (-1.50) ρ_2 = -0.637 (-5.61) • Φ_μ = 15.89 • Signif. ($\rho_1 = \rho_2$)= 0.072	• ρ_1 = -0.272 (-1.01) ρ_2 = -0.778 (-5.82) • Φ^*_μ = 16.98 • Signif. ($\rho_1 = \rho_2$)= 0.085
		M1649	ρ = -0.889 (-4.75)	• ρ_1 = -0.816 (-2.76) ρ_2 = -0.970 (-4.48) • Φ_μ = 10.94 • Signif. ($\rho_1 = \rho_2$)= 0.540	• ρ_1 = -0.888 (-3.25) ρ_2 = -0.892 (-4.32) • Φ^*_μ = = 11.54 • Signif. ($\rho_1 = \rho_2$)= 0.906
		M1753	ρ = -0.423 (-3.62)	• ρ_1 = -0.327 (-1.45) ρ_2 = -0.606 (-3.70) • Φ_μ = 13.61 • Signif. ($\rho_1 = \rho_2$)= 0.179	• ρ_1 = -0.345 (-1.63) ρ_2 = -0.641 (-2.93) • Φ^*_μ = 4.88 Signif. ($\rho_1 = \rho_2$)=
		M1764	ρ = -0.488 (-4.44)	• ρ_1 = -0.350 (-2.73) ρ_2 = -0.677 (-4.789) • Φ_μ = 13.61 • Signif. ($\rho_1 = \rho_2$)= 0.062	• ρ_1 = -0.450(-3.58) ρ_2 = -0.534 (-4.02) • Φ^*_μ = 12.80 Signif. ($\rho_1 = \rho_2$)= 0.595

Notes: [a]Coefficients and t-statistics for the null hypothesis $\rho = 0$.
[b]Coefficients and t-statistics for the null hypotheses $\rho_1 = 0$ and $\rho_2 = 0$ when the chosen representation of the deviation is μ_t is a TAR model. Φ_μ is the sample value of the statistic for the null hypothesis $\rho_1 = \rho_2 = 0$. Signif($\rho_1 = \rho_2$) gives the empirical significance level for the null hypothesis $\rho_1 = \rho_2$.
[c]Coefficients and t-statistics for the null hypotheses $\rho_1 = 0$ and $\rho_2 = 0$ when the chosen representation of the deviation is μ_t is a M-TAR model. Φ^*_μ is the sample value of the statistic for the null hypothesis $\rho_1 = \rho_2 = 0$. Signif($\rho_1 = \rho_2$) gives the empirical significance level for the null hypothesis $\rho_1 = \rho_2$.

Table 3.a. – Short-run speeds of adjustment in asymmetric cases: Tomatoes

Product	Endogenous Variable: ΔP^R_t	Asymmetric Model	δ_1	δ_2
Tomatoes Type: Cluster Production Area: South-East	National	M-TAR	-0,490 (-2,03)	-0,800 (-2,96)
	Region: SO	M-TAR	-1,037 (-4,16)	-0,736 (-2.66)
	Store Chain: E1	M-TAR	-0,655 (-3,62)	-0,459 (-2,68)
	Store Chain: E3	M-TAR	-0,903 (-3,53)	-0,712 (-4,39)
Tomatoes Type: Cluster Production Area: Brittany	Store Chain: E1	M-TAR	-0,664 (-3,43)	-0,566 (-3,01)
	Store Chain: E2	M-TAR	-0,836 (-4,08)	-0,646 (-2,94)
Tomatoes Type: Round Size: 57-67 mm Production area: South-East	National	M-TAR	-0,732 (-2,91)	-0,449 (-2,74)
	Region: RA	M-TAR	-0,880 (-3,91)	-0,488 (-1.98)
	Region: SO	M-TAR	-1,325 (-3,12)	-0,541 (-2,39)
	Region: SE	M-TAR	-0,996 (-3,90)	-0,374 (-2,12)
	Store Chain: E19	M-TAR	-1,381 (-3,31)	-0,823 (-4,47)

Note: The t-student are between parentheses.

Table 3.b. – Short-run speeds of adjustment in asymmetric cases: Chicory

Product	**Endogenous Variable: ΔP^R_t**	**Asymmetric Model**	δ_1	δ_2
Chicory Production Area: North	Region: CO	TAR	-0.380 (-4.82)	-0.434 (-6.35)
	Region: SE	TAR	-0.334 (-4.14)	-0.416 (-3.78)
	Store Chain: E6	TAR	-0.461 (-4.96)	-0.643 (-6.28)
	Store Chain: E13	M-TAR	-0.368 (-3.67)	-0.525 (-5.69)
	Store Chain: E18	TAR	-0.413 (-3.08)	-0.542 (-4.91)
	Store Chain: E19	TAR	-0.351 (-2.05)	-0.484 (-2.69)
	Store: M1763	TAR	-0.532 (-3.78)	-0.401 (-2.97)

Note: The t-student are between parentheses.