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Price Transmission in Agricultural Markets: An Iranian Experience

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Abstract: In this article, we describe the price transmission mechanism for two main Iranian agricultural products; namely: Pistachio and Date using monthly data over the period 1996.01 to 2006.09. Price transmission would be more important if any price change in farm level get path through retail level asymmetrically. The results of this study depict that price transmission according to Houck approach in pistachio market is asymmetric. In other words, price increases are transmitted more completely than its decreases. Error Correction model in the date market shows that farm price increases are more rapid and fully transmitted than price decreases. This reveals asymmetry in price transmission.

Key words: Price Transmission · Pistachio · Date

INTRODUCTION

It's widely acknowledged that the success of market reforms in developing countries depends to a large extent on strength of price signals transmitted between different levels of market. So the linkages among farm, wholesale and retail prices continues to be of a considerable economic interest. The relationship between farm and retail prices provides insights into marketing efficiency as well as consumer and producer welfare. Regarding to price theory, flexible prices are responsible for efficient resource allocation and price transmission integrates markets vertically and spatially. However, the extant literature is replete with examples to indicate that asymmetric price transmissions indeed are very common, meaning that retail (farm) prices would not respond in the same manner for both increases and decreases in farm (retail) prices. The presence of asymmetric price transmission often is considered because it may point to large gaps in economic theory and also asymmetry can have important implications for policy making. Different factors are leading to asymmetric price transmission including: non-competitive market structure, adjusting and menu costs, government policies, efficient information system [1,2].

One characteristic of the literature on asymmetric price transmission and especially estimation techniques is the strong focus on agricultural markets. Unlike other fields of economics, agricultural economics have had more examples of asymmetric price transmission.

Different subsectors of agriculture, particularly horticulture, have crucial role for purpose of providing foodstuffs to an increasingly population. So date and pistachio are kind of unique products which are source of foreign exchange earnings in Iran. Nowadays competition has increased in the international market of these products and as a consequence they have been under the care. During current decade, cultivation of date and pistachio has increased in different regions of our country, while there is not suitable condition for marketing. This has resulted to large fluctuations in price series of theses products. So in this study price transmission in farm to retail has been investigated.

Over the last three decades lots of surveys have been performed on price transmission, also the most empirical efforts to test for a presence of asymmetric price transmission have been based on a variable-splitting technique developed by Wolffram [3] and later adapted by Houck [4] and Ward [2]. Kinnucan and Forker [5] regarding dairy product price transmission in the U.S come to the conclusion that retail prices were more sensitive to increase in farm prices than to their decreases. Aguiar and Santana [6] describe price transmission mechanism for four groups of agricultural products in Brazil to determine if they follow the pattern found in previous studies. Their study showed that neither product storability nor market concentration were required for price increases to be more intensely transmitted than price decreases. Ward [2] on the other hand; found that

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retail prices were more responsive to decrease in farm prices than to increase. This survey was done in retail, wholesale and shipping point price levels of fresh vegetables.

Von Cramon-Taubadel and Fahlbusch [7] demonstrated that an asymmetric error correction model (ECM) based on the work of Granger and Lee [8] could be used to test for asymmetric price transmission. The analysis indicates that transmission between producer and wholesale pork prices in northern Germany is asymmetric. Von Cramon-Taubadel and Loy [9] extended this application of ECM and concluded that the model was more appropriate than the use of conventional Houck approach. Le Goulven [10] employed this specification to investigate institutions and price transmission in the Vietnamese hog market. The analysis addresses that difference in the institutional structure of hog market in the Vietnam may have an impact on its efficiency. Testing for asymmetric price transmission was performed by Capps and Sherwell [11] in farm-retail price levels associated with fluid milk products and empirical results using Houck and ECM approaches, suggest that farm-retail price transmission process for milk is asymmetric. Linkage between producer and retail levels was estimated by Ghahraman Zade and Falsafian [12] employing threshold cointegration method. They found out that price transmission in meet market is asymmetric.

MATERIALS AND METHODS

In this section we present alternative approach in detecting price transmission. Specific econometric models focus on different aspects of the relation between input and output prices. we identify two major classes of econometric models, namely; "Houck approach" and "Error Correction Model (ECM)".

The empirical literature on price transmission goes back to Farrel [13]. This is the first attempt to investigate empirically relation between different price levels in the market. At the end of the 60s and during 70s most of the studies on price transmission concentrate, not surprisingly, on agricultural products. Tweeten and Quance [14] investigate the relationship between the level of output and ratio of input to output prices in the agricultural sector. Then Wolffram [3] improved the former approach and proposed variable splitting technique which explicitly includes first difference of variables in the equation. In the ensuing years, Houck [4] presented a specification that is similar to the Wolffram approach, but operationally clearer. Unlike Wolffram, he did not take the first observation into account, as a consequence of considering differential effects. In this case the level of the first observation will have no independent explanatory power.

His static asymmetric model can be written as:

$$Y_t^* = Y_t - Y_0 = \alpha_0 t + \beta_0^+ \sum_{t=1}^{T} \Delta x_t^+ + \beta_0^- \sum_{t=1}^{T} \Delta x_t^- + \varepsilon_t \qquad (1)$$

Where Y and X are dependent and independent variables respectively, t = 1, 2, 3…

$$\Delta x_t{}^+ = xt - x_{t-1} \qquad IF x_t \rangle x_{t-1}$$
$$\Delta x_t{}^+ = 0 \qquad IF x_t \langle x_{t-1}$$
$$\Delta x_t{}^- = x_t - x_{t-1} \qquad IF x_t \langle x_{t-1}$$
$$\Delta x_t{}^- = 0 \qquad IF x_t \rangle x_{t-1}$$

β^+_0, β^-_0, α_0 are coefficients and T denotes the current time period.

Ward [19] extended Houck's specification by including lags of exogenous variables.

$$Y^* = \alpha_0 t + \sum_{i=0}^{k} \beta_i^+ \Delta X_{t-i}^+ + \sum_{i=0}^{l} \beta_i^- \Delta X_{t-i}^- + \varepsilon_t \qquad (2)$$

The number of lags (k, l) in equation (2) can be different, because there is no a priori reason to expect equal lag length for rising and falling phases of the explanatory variables. As such a formal test of the symmetry hypothesis is:

$$H_0 : \sum_{i=1}^{k} \beta_i^+ = \sum_{i=1}^{l} \beta_i^- \qquad (3)$$

In the literature dealing with price transmission for the most part has not paid proper attention to the time-series properties of the data. The Error Correction Method (ECM) is motivated by the fact that all variants of the aforementioned Houck approach are not consistent with cointegration between farm and retail price series. When equation (2) is estimated without regard to the time series nature of the data used, spurious correlation can arise if farm and retail prices are non-stationary.

If X and Y are cointegrated, then by the Engle-Granger [15] representation theorem, one may develop an alternative specification for the price transmission process, which in standard notation, takes the form:

$$\Delta Y_t = Y_t - Y_{t-1} = \varphi_1 + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-i} + \sum_{i=0}^{l} \beta_i \Delta x_{t-i} + \varphi_2 ECT_{t-1} + \varepsilon_t \quad (4)$$

Where $ECT_{t-1} = U_{t-1} = Y_{t-1} - \alpha_0 - \alpha_1 X_{t-1}$ (residuals from the cointegration relation between X and Y).

Granger and Lee [8] proposed a modification to equation (4) which the lagged cointegration equation residuals " U_{t-1}" are split into positive and negative components:

$$\Delta Y_t = \varphi_1 + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-i} + \sum_{i=0}^{l} \beta_i \Delta x_{t-i} + \varphi_2^+ ECT_{t-1}^+ + \varphi_2^- ECT_{t-1}^- + \varepsilon_t \quad (5)$$

Since $ECT_{t-1} = ECT_{t-1}^+ + ECT_{t-1}^-$

In equation (5), the null hypothesis of symmetry therefore becomes:

$$\varphi_2^+ = \varphi_2^- \quad (6)$$

Now in the following we're going to represent the process of our survey and also the tests which call for a price transmission analysis.

The standard classical methods of estimation, are based on the assumption that the means and variances of the variables are well defined constants and independent of time. However, applications of the unit root tests have shown that these assumptions are not satisfied by a large number of macroeconomic time series. Variables, whose means and variances change over time, are known as non-stationary or unit root variables. So at first step, Dickey-Fuller test(or ADF) is applied to determine whether the variables included in the regression equation are stationary or not.

Afterward in a case of stationary variables, we test for causality to determine which time series is dependent variable. The Granger [16] approach to the question of whether X causes Y is to see how much of the current value of Y, can be explained by past values of Y and then to see whether adding lagged values of X can improve the explanation. Y is said to be Granger-caused by X, if X helps in the prediction of Y. Finally, Wald test will be used for testing asymmetric price transmission.

In the case of unit root variables and if these variables satisfy certain conditions, cointegrating regressions are estimated. It's convenient to view cointegration as a technique to estimate the equilibrium or long-run relationship among unit root variables. So the main hypothesis to be tested is that changes in X are all transferred to the Y. In statistical terms, this means that X and Y time series drift together, although individually these variables are non-stationary in the sense that they tend upwards or downwards overtime. This common drifting of variable makes linear relationships between these variables exist over long periods of time, thereby giving us insight into long-run equilibrium relationships of these variables. In other words, if these linear relationships do hold over long periods of time, X and Y are cointegrated. In order to test whether variables are cointegrated or not, Johansen's method [17] will be used. Then if variables weren't cointegrated, Hock approach will be employed, if not (the results confirm cointegration between variables), ECM method is suggested. Note that Granger causality must be tested before using this approach and similar to Houck approach, Wald test is the last step in ECM method for price transmission analysis.

DATA AND RESULTS

The data used in this study are based on monthly observations of farm and retail prices for pistachio and date in Iran. The data cover the period from 1996.01-2006.09. Farm and retail prices are represented by Pf and Pr respectively.

In examining the stationarity of these variables, we used Augmented Dickey-Fuller (ADF) test as shown in Table 1.

In order to find proper structure of equations in a terms of how many extra lagged terms to include in equations for eliminating possible autocorrelation in the disturbance, the usual Akaike´s [18] Information Criterion (AIC) and Schwarz [19] Criterion (SC) is suggested. The minimum values of AIC and SC indicate the best structure of the equations. Furthermore, the maximum value of adjusted R^2 conduct us to the appropriate lag lengths.

Using ADF test [20], we fail to reject the null hypothesis of non-stationary for each time series in both products. Pf and Pr may, therefore be cointegrated.

Table 1: Augmented Dickey-Fuller Test Results

				Critical Values of the Test		
	Variables	t-statistic	Lags	%1	%5	%10
Pistachio	PF	-0.83	1	-4.03	-3.44	-3.15
	PR	-2.90	3	-4.03	-3.44	-3.15
Date	PF	-2.50	2	-4.03	-3.44	-3.15
	PR	-2.94	2	-4.03	-3.44	-3.15

Table 2: Results of Cointegration Between P_f and P_r

			Critical Values		
	Eigenvalue	Likelihood Ratio	%1	%5	Hypothesized No. of CE(s)
Pistachio	0.09	14.05	23.46	17.18	r = 0
	0.009	1.16	6.40	3.74	r ≥ 1
Date	0.07	14.52	23.46	17.18	r = 0
	0.04	5.50	6.40	3.74	r ≥ 1*

Table 3: Results of Granger causality test between ΔP_f and Δp_r

	Null Hypothesis	F-Statistic	Probability	Lags
Pistachio	ΔPR does not Granger cause ΔPF	4.70	0.004	3
	ΔPF does not Granger cause ΔPR	0.60	0.63	
Date	ΔPR does not Granger cause ΔPF	0.32	0.72	2
	ΔPF does not Granger cause ΔPR	4.75	0.01	

The Johansen procedure is then used to test for cointegration between Pf and Pr. The results in Table 2 suggest that farm and retail price series are not cointegrated in the pistachio market, but there is a long-run relationship between Pf and Pr in the date market.

So, to analyze price transmission in the pistachio marketing chain, Houck approach is employed and in the date market, we use Error Correction Model.

Before proceeding to the regression analysis, however, test of causality is carried out to determine which price series is dependent variable. Note that the series to be included in the test of Granger causality have to be stationary. The results of the test indicate that ΔPr causes ΔPf in pistachio market after 3 lags and in the date market ΔPr is dependent variable. These findings are demonstrated in Table3.

Price Transmission in the Pistachio Marketing Chain: In the previous section we found that price series are not cointegrated. Knowing that Pr and Pf are independent and dependent variables respectively, therefore we are allowed to employ equation1. So the following regression is estimated using the least square method:

$$PF_t - PF_0 = \alpha_0 + \sum_{i=0}^{3} \beta_i^{+} \Delta PR_{t-i}^{+} + \beta_0^{-} \Delta PR_t^{-}$$

As it's obvious, with Houck approach, number of lags associated with increasing retail price variables typically is 3, whereas this number for price falling variables is just zero, implying that farm prices react 3 months after a price increase occur at the retail level. The results are reported in Table 4.

Focusing on Table 4, find out that high magnitude of adjusted R^2 is attributable to the fact that approximately all farm price fluctuations are explained by retail price changes.

Since ÓΔPr+ coefficient is statistically insignificant and also hasn't significant effect on a whole regression model, So this variable has been eliminated from the estimated model.

Significance of the coefficient differs for rising and falling in retail prices implying that although price increases which are occurring in the retail level of the pistachio marketing chain have significant impact on price increases on the farm level, coefficients of cumulative decreases in retail prices aren't significant and as a consequence, price falling fluctuations in the retail

Table 4: Empirical results of Houck Approach

Variables	Estimated Coefficients	t-statistic
Intercept	-1562.42	-0.63
$\Sigma\Delta PR^-$	0.10	0.53
$\Sigma\Delta PR^+(-1)$	0.18	1.19
$\Sigma\Delta PR^+(-2)$	-0.46	-1.98**
$\Sigma\Delta PR^+(-3)$	0.63	4.04***
R^{-2}	0.96	-
SC	16.30	-
AIC	16.14	-
φD.W	1.94	-

Note: **significant at 5% ***significant at 1%

Table 5: Price transmission elasticities

Price increases		Price decreases	
Short-run	Long-run	Short-run	Long-run
0.57	1.11	0.32	0.32

Table 6: Empirical Results of Error Correction Method

Variables	Estimated Coefficients	t-statistic
Intercept	109.59	2.78**
$ECT^-(-1)$	-0.05	-0.97
$ECT^+(-1)$	-0.25	-4.71***
$\Sigma\Delta PR(-1)$	0.67	9.60***
$\Sigma\Delta PR(-2)$	-0.65	-9.77***
$\Sigma\Delta PF$	-0.02	-0.19
$\Sigma\Delta PF(-1)$	0.18	1.24
$\Sigma\Delta PF(-2)$	0.03	0.24
$\Sigma\Delta PF(-3)$	-0.73	-4.88***
$\Sigma\Delta PF(-4)$	0.49	3.76***
R^{-2}	0.49	-
AIC	13.52	-
SC	13.74	-
D.W	1.7	-

Note: **significant at 5% ***significant at 1%

level haven't any impact on price fluctuations in the farm level of marketing chain.

Price transmission elasticities evaluated at mean data points, are exhibited in Table 5.

According to the calculated elasticities, it's evident that %1 increase in retail prices in a short period leads 0.57% increase in farm prices, also the long-run rising price elasticities are substantially greater than corresponding short–run elasticities, whereas, 1 % decrease in retail prices of pistachio in short-run causes just 0.32% contraction in farm prices. This finding implies that farm prices react more completely when the retail prices are stretched than when they are squeezed. In other words, price transmission is positive.

Finally, F test of null hypothesis indicate that sums of positive and negative price change coefficients are not equal. So price transmission in the pistachio marketing chain is asymmetric.

Price Transmission in the Date Marketing Chain: As mentioned in the methodology, Houck approach is not in accordance with cointegration between variables and leads to spurious regression. Therefore error correction model has been applied in order to test price transmission in the date marketing chain. In the previous section, ADF test confirm Pr as a dependent variable. So estimated regression is written as:

$$\Delta PR_t = \varphi_1 + \sum_{i=1}^{2}\alpha_i \Delta PR_{t-i} + \sum_{i=0}^{4}\beta_i \Delta PF_{t-i} + \varphi_2^+ ECT_{t-1}^+ + \varphi_2^- ECT_{t-1}^- + \varepsilon_t$$

Where 2 and 4 lags are considered in retail and farm levels, respectively.

Estimated coefficients in the Table 6, suggest that positive error correction term (ECT_{t-1}^+) is significant at 1% level, whereas the negative error correction term (ECT_{t-1}^-) is not statistically significant at any levels and also ECT_{t-1}^+ induces significantly greater change in retail prices than ECT_{t-1}^-, meaning that farm price increases are transmitted completely to retail prices than it's decreases which occur in the farm level. Error correction coefficients indicate that retail prices adjust in order to reach the equilibrium, indeed, retail prices adjust so as to eliminate about 25% of a unit positive change in the deviation from the equilibrium relationships created by changes in farm prices.

Long-run elasticities in date market are derived from normalized equation in cointegration test. In this case the price transmission elasticity under farm price shocks is 0.68 (0.45 * 1.52 = 0.68)

This long-run elasticity implies that %1 change in farm prices, results %0.68 alteration in retail prices in the long period.

However, according to the Wald test, we reject the null hypothesis of symmetry (φ2+ = φ2-) using an F-test statistic (8.61).

CONCLUSIONS

In this paper price transmission in two Iran's major horticultural products including Pistachio and Date is studied. The main findings reveal asymmetry in transmission of a change in farm prices to retail prices. In other words the effects of any increase in farm prices on retail prices is different comparing to any price decrease. Also these effects will be different as time horizon expands. So we can expect that sensitivity of retail prices to farm price changes be different in short and long run. Since Pistachio is almost a luxury product for majority of Iranian households, government should monitor its market more carefully in order to prevent any shocks to prices at the point of production.

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