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Price Transmission Mechanism in the Iranian Rice Market

F. Jezghani[1]*; R. Moghaddasi[1];S. Yazdani[2]; A. Mohamadinejad[1]

1:Department of Agricultural Economics, Faculty of Agriculture and Natural Resources,Science and Research Branch, Islamic Azad University, Tehran, Iran
2:Department of Agricultural Economics, University of Tehran, Karaj, Iran

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ABSTRACT

In this article, we estimate the vertical price transmission through the Iranian rice marketing chain by using monthly data from March 2000 to February, 2009 and error correction model (ECM).The causality test results indicate that changes in the producer price clearly led changes in wholesale and retail prices. In Producer-Retail and Wholesale-Retail models, price transmission is asymmetric but in Producer-Wholesale model the estimated model supports symmetric price transmission for rice in Islamic Republic of Iran.

Keywords: Rice market;Asymmetry;Vertical supply chain;Causality.

***Corresponding Author Email:** fjezghani@gmail.com

INTRODUCTION

Market liberalization at the domestic level and at the boarder level has been a dominant feature of market reforms in most developing countries during the last two decades. Islamic Republic of Iran has undertaken market reforms, its main food grain rice by both reducing public intervention for procurement and distribution since 1998. Rice accounts for a high caloric share in the Iranian diet, also high share in the farmers' agricultural income and the employment. Therefore, a pre-requisite for producers and consumers to benefit from this new and changing market environment is the ability of market to function efficiently. But if the markets at the spatial or through the value chain dimensions are constrained by factors such as imperfect market information, lack of credit availability to finance short run inventories, insufficient transportation, lack of management skills, market power and etc. The inferred benefits from reforms will be jeopardized.

Recent years, Rice production in the Iran has witnessed extreme fluctuations in price. The main cause of price fluctuations is related to seasonal and production fluctuations of this product. Production fluctuations were due to bad climatic conditions in the Asia (such as was Thailand, Pakistan and Iran). Government intervention in the rice market is the main other factor that influences on the price of agricultural products. It happens often by determination of the price floor to protect producers and sometimes by providing various inputs to producer for reduction of the consumer prices.

What is vital is that the government has a full understanding of how information is transmitted between the rice producers and retailers and the effects of changes in the marketing margin. Such understanding makes it possible to develop effective long-run policies and short-run adaptive measures. Better the market integration, lesser the intervention required by the government.

The food grain (mainly rice) marketing chains are long in developing countries because of many small scale intermediaries which make the producer prices to be lower and consumer prices to be higher, therefore resulting in the higher price spread. There was a widely-held belief about the domestic markets that possible manipulation in the agricultural markets as well as concerns about the sources of asymmetry. In the domestic markets, a price increase passes very quickly though the supply chain compared to a price decrease. As a result, perception by consumers and the government exists that at least the market is being manipulated and raising food prices unfairly, at the expenses of the poor households who are net buyers and for whom food is a major expenditure share (Alam*et al*., 2010).

In the industrial organization literatures retail prices are often assumed to be determined by the conditions of the wholesale market (Tirole, 1988). In the mark-up model, prices are determined by the upstream of the supply chain to the downstream, although, there are some criticisms on it.

Examining the market functioning at the vertical level in developing countries is importance to evaluate how the private traders and the markets are delivering for the producers and the consumers' welfare. It is also important to identify what kind of policy can be introduced, if needed at all and at what level of the marketing chain to correct the market inefficiency, if any. The vertical price leadership at the wholesale level to the retail in the marketing literature is inferred in one hand but also in the other hand in the development economics literatures, there are suspicious that in the developing country, the retail price might dominate the wholesale prices but none of these are empirically verified and conclusive in any cases.

Therefore, this paper is an attempt to fill up this gap. The paper address the research questions: Is there a relationship between producer and wholesale, wholesale and retail and producer and retail prices in rice supply chain in the regime of new market environment in Iran or is price formation independent each other? Is the producer market dominates the retail one or the vice-versa? Is the wholesale market dominates the retail one or the vice-versa? Is the price relationship linear or non-linear? In other words, whether price relationship in the supply chain is symmetric with respect to price increases and price decrease? The next section describes the data used in the analysis followed by the econometric methodology and results in section 3. The last section concludes.

MATERIALS AND METHODS

The paper uses the monthly average producer, wholesale and retail price of rice for Iran. The prices data used for this study are taken from Central Bank of Iran. The data period covers from March 2000 to February, 2009.Variables are transformed in logarithms.

RESULTS AND DISCUSSION

The methodology employed in this paper follows the following four steps. First, variables of interest are tested for unit roots. For this purpose the augmented Dickey & Fuller (ADF) test, the Philips & Peron (PP) test and Kwiatkowski Philips Schmidt Shin (KPSS) are used. The standard Augmented Dickey and Fuller (1979) unit root test (ADF) with optimal lag length, determined by Schwarz Bayesian criterion (SBC) and sufficient to eliminate serial correlation in the error terms, is used in following form:

$$\Delta X_t = \alpha + (\rho - 1) X_{t-1} + \sum_{i=1}^{n} \varphi \Delta X_{t-1} + \varepsilon_t, \quad (1)$$

Where X_t is the respective time series and Δ is first difference operator and ε_t denotes white noise error term.

Hypothesis is:

H_0: $\rho - 1 = 0$,
H_1: $\rho - 1 < 0$.

Using another unit root test proposed by Philips and Peron (1988) we also test the presence of a unit root in following specification.

$$X_t = \alpha + \beta\{t - \frac{T}{2}\} + \rho X_{t-1} + \nu_t \quad (2)$$

Where X_t is respective time series $\{t - \frac{T}{2}\}$, is the time trend and T is sample size. ν_t is errorterm. This procedure, in fact, uses a non-parametric adjustment to the Dickey–Fuller teststatistics and allows for dependence and heterogeneity in the error tem.

The KPPS (1992) Test is based on the residuals from an ordinary least square regression of y_t on the exogenous variable(s)x_t as follows:

$$y_t = x_t'\delta + u_t \quad (3)$$

The Lagrange Multiplier (LM) statistic is defined as:

$$LM = \sum_t S(t)^2 / (T^2 f_0) \quad (4)$$

where T is the sample size, S(t) is a cumulative residual function:

$$S(t) = \sum_{r=1}^{t} \hat{u}_r \quad (5)$$

Here $\hat{u}_r$ is the estimated residual from (3). f_0 is an estimator of the residual spectrum at frequency zero. This statistic has to be compared with KPSS (1992) critical values.

The augmented Dickey-Fuller, Philip Perron unit root test and KPSS on each of the variables are reported in the Table 1. The results of all the tests indicate that all price series are non-stationary at their level but stationary at their first difference. Note that the ADF,PP and KPSS tests were done only with drift and drift plus trend models. In time series econometrics, it is said that prices are integrated of order one denoted by presenting $p_t \sim I(1)$ and prices of integrated of order zero denoted by $\Delta p_t \sim I(0)$. Here the order of the integration is one. Therefore, the results allow to proceed for co integration tests for the testing the long run equilibrium relationship.

Table 1: Results of unit root tests

Variables	Level			First-differences		
	ADF	PP	KPSS	ADF	PP	KPSS
LRFP	-1.41	-1.54	0.25	-7.32***	-6.48***	0.05***
LRWP	-1.99	-1.36	0.23	-7.76***	-7.23***	0.06***
LRRP	-2.69	-2.40	0.19	-5.71***	-5.69***	0.05***

***indicates that unit root in the first differences are rejected at 1 percent.
Source: Authors findings

Second, using Johansen and Juselius' (1990) multivariate co integration procedure long–run relationships among the variables in a dynamic framework is examined. If there is a long run relationship between these variables then the movement among these variables will be bounded together. In other words, these variables will be co integrated. To test for co integration, we apply Johansen and Juselius (1990) likelihood ratio tests using Vector Autoregressive(VAR) model in following specification:

$$\Delta Z_t = \mu + \Pi Z_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \varepsilon_t \quad (6)$$

Where Z_t includes all *n* variables of the model and ε_t, is vector of random error with zero

mean and constant variance. The rank of Π matrix contains long run information about the variables. If rank (Π) = 0, (1) all elements in Z_t are non-stationary; and (2) there are no co integrating vectors among the variables. If rank (Π) = 1, there is single co integrating vector and

for 1 <rank(Π) <n, there are multiple co integrating vectors. The co integrating vectors are found using the following two test statistics:

λ_{trace} (r) = -T $\sum_{i=r+1}^{n}$ ln $(1-\lambda_i)$(7)

λ_{max} (r, r+1) = -T ln $(1-\lambda_{r+1})$(8)

where; λ_i is the estimated values of the characteristic roots (eigen values) obtained from the estimated Π matrix and Tis the number of usable observations. The trace statistic tests the null hypothesis that the number of distinct co integrating vectors is less than or equal to r against a general alternative. Another statistic called maximal eigen value tests the null that the number of co integrating vectors is ragainst the alternative of r +1 co integrating vectors.

The trace test (λ_{trace}) and maximum eigenvalue (λ_{max}) results from equation (7) and (8) arepresented in Table 2. Many studies showed that the rejection of the null hypothesis of no integration by using only trace test is sufficient to identify the co integration rank (Dawson & Dey, 2002; Mohanty *et al.,* 1996; Taylor *et al.,* 1996). From the test results in Table 2, it is seen that in the vertical level of rice supply chain contain one co integrating vector. That means this co integrating rank gives the number of stationary linear combinations of the price series. So it is consistent with the identification of one linear combination of prices (as it is a bi-variate case) that exhibits stability over the time. The leg length was determined using AIC and SIC criteria. The SIC selected a 3-lag.The results of co integration test confirm that the variables share a common trend and both the maximum eigen value test and the trace test statistics imply that there are at most one co integrating vectors ($r \leq 1$).

Table 2: Johansen–Juseliuscointegration test

	λ_{trace} test				λ_{max} test			
	Null	Alternative	λ_{trace}	Prob.**	Null	Alternative	λ_{max}	Prob.**
LRRP/LRWP	r=0*	r≥1	38.80	0.00	r=0*	r=1	38.32	0.00
	r≤1	r≥2	0.49	0.48	r≤1	r=2	0.49	0.48
LRRP/LRPP	r=0*	r≥1	42.10	0.00	r=0*	r=1	41.46	0.00
	r≤1	r≥2	0.64	0.42	r≤1	r=2	0.64	0.42
LRWP/LRPP	r=0*	r≥ 1	19.33	0.01	r=0*	r=1	18.54	0.01
	r≤1	r≥2	0.79	0.37	r≤1	r=2	0.79	0.37

Trace and Max-eigen value tests indicate 1 co integration equation at 0.05 levels.
*Denotes rejection of the hypothesis at the 0.05 level
** MacKinnon-Haug-Michelis (1999) p-value source: Authors findings

Third, were view causality between producer and wholesale market, wholesale and retail market and producer and retail market, that ultimately it shows the market effect of the three different levels. In other words, through causality test can determine which market effects on price and its changes in other markets. For pair-wise causal relationship, it can be written in the following two equations:

$Pw_t=\alpha_{10}+\sum_{i=1}^{k}\alpha_i Pw_{t-j}+\sum_{j=1}^{k}\beta_{1j}Pr_{t-j}+U_{1t}i,j=1,2,\ldots,n$ (9)

$Pr_t=\alpha_{20}+\sum_{j=1}^{k}\lambda_i Pr_{t-j}+\sum_{j=1}^{k}\delta_{2j}Pw_{t-j}+U_{2t}i,j=1,2,\ldots,m$ (10)

If disruption components are Non-correlation, there are 4 modes in the following separation: 1 - If ($\sum\beta_j \neq 0$) and ($\sum\delta_j = 0$), then unilateral causality wills from the Pr to Pw, therefore, the retail market creates by price changes in the wholesale market.

2 - If ($\sum\beta_j = 0$) and ($\sum\delta_j \neq 0$), then unilateral causality will from the Pw to Pr, therefore, wholesale market creates by price changes in the retail market.

3 - If the total coefficients of Pw and Pr in regression were statistically significant and non-zero, then they have two-way causality and both markets influence each other.

4 - If the total coefficients of Pw and Pr in regression were not statistically significant, then and both markets are independent.

The pair-wise causal relationship between producer and wholesale market and between

producer and retail market is the same as equation 9 and 10.

The results indicate that changes in the producer price clearly led changes in wholesale and retail prices.

Table 3:Causality test for rice market

Null Hypothesis	F-statistic	Prob.	lag
DLPP does not Granger Cause DLWP	4.78	0.01	2
DLWP does not Granger Cause DLPP	0.03	0.98	
DLWP does not Granger Cause DLRP	8.84	0.01	2
DLRP does not Granger Cause DLWP	0.03	0.96	
DLPP does not Granger Cause DLRP	9.91	0.00	2
DLRP does not Granger Cause DLPP	0.05	0.95	

Source: Authors findings

Finally we Tests asymmetric price transmission. Based on Houck (1977) many authors have developed a test for asymmetric price transmission based on the segmentation of price variables into increasing and decreasing phases (Boyd & Brorsen, 1988; Kinnucan & Forker, 1987; Bailey & Brorsen, 1989;Zhang, Fletcher & Carley, 1995; Mohanty, Peterson& Kruse, 1995; Willet, Hansmire & Bernard, 1997; Peltzman , 2000; Aguiar & Santana 2002).

With few exceptions, all the previous researches, at least in the agricultural economics literature have not considered the inherent time series properties of the data i. e., non-stationarity and the long run equilibrium relationship. The asymmetric error correction model approach was motivated first by the fact that all the aforementioned approach in the Houck specification was not consistent with the co integration between the retail and the farm price series (Von Cramon-Taubadel (1998) and von Cramon-Taubadel and Loy (1996)). They first recognized the inconsistencies by investigating asymmetric price behavior of producer and consumer prices of the pork market in Germany. They concluded the classical Houck approach is fundamentally incorrect with co integration between two price series. Two recent articles by Meyer and Von Cramon-Taubadel (2004) provided a comprehensive discussion of the possible causes and types of the asymmetric price transmission along with a brief review of the empirical works done during last couple of decades. The authors concluded that the existing literature is far from being conclusive and it has largely been method driven with little attention devoted to the theoretical underpinnings and the plausible interpretation of the results. Therefore much interesting theoretical and empirical works remains to be done.

To test the asymmetric transmission in the prices we used an error correction model (ECM). In this stage, based on our results of co integration and causality we proceed for focusing the asymmetric error correction representation, in the form of an asymmetric error correction model.

From our earlier results, we use wholesale price of rice as exogenous for estimating the static OLS, so that

$$RP_t = \alpha_0 + \alpha_1 WP_t + \varepsilon_t t=1, \ldots, T \quad (11)$$

$$\Delta RP_t = const + \sum_{n=0}^{k} \alpha_n \Delta PW_{t-n} + \sum_{n=1}^{l} \beta_n \Delta PR_{t-n} + \lambda ECT_{t-1} + \nu_t \quad (12)$$

In where the RP is the retail price, WP is the wholesale pricesandε is the usual error term.

According to the Granger two-step approach, the long-term relationship between retail and wholesale prices in equation (11) is estimated first. The lagged residuals from (11) are then used as the error correction term (ECT) to estimate (12). λ measures adjustments to deviations from the long-run equilibrium, while short-run dynamics are measured by the$\alpha_k$and $\beta_l$coefficients. To allow for asymmetric price adjustment we also estimate the ECM in (13) in which the ECT is segmented into positive (ECT^+) and negative (ECT^-) deviations from the long-run equilibrium (von Cramon-Taubadel, 1998). Asymmetry is concluded if λ^+differs significantly from λ^-(F-test).

$$\Delta RP_t = const + \sum_{n=0}^{k} \alpha_n \Delta PW_{t-n} + \sum_{n=1}^{l} \beta_n \Delta PR_{t-n} + \lambda^{+} ECT_{t-1}^{+} + \lambda^{-} ECT_{t-1}^{-} + \nu_t \quad (13)$$

From the equation (13), the existence of asymmetry, will be tested by the implementation of the

Wald χ^2-test for the hypothesis that$\lambda^{+} = \lambda^{-}$. If the hypothesis is rejected then the asymmetric error correction model is superior.

Also according to our earlier results, we use producer price of rice as exogenous for estimating the static OLS. To allow for asymmetric price adjustment we also estimate the ECM in (14 and 15) in which the ECT is segmented into positive (ECT^{+}) and negative (ECT^{-}) deviations from the long-run equilibrium. Asymmetry is concluded if φ^{+} differs significantly from φ^{-} (14)and ρ^{+}differs significantly from ρ^{-}(15).

$$\Delta PP_t = const + \sum_{n=0}^{k} \sigma_n \Delta PP_{t-n} + \sum_{n=1}^{l} \delta_n \Delta PW_{t-n} + \varphi^{+} ECT_{t-1}^{+} + \varphi^{-} ECT_{t-1}^{-} + \nu_t \quad (14)$$

$$\Delta PP_t = const + \sum_{n=0}^{k} \theta_n \Delta PP_{t-n} + \sum_{n=1}^{l} \gamma_n \Delta PR_{t-n} + \rho^{+} ECT_{t-1}^{+} + \rho^{-} ECT_{t-1}^{-} + \nu_t \quad (15)$$

Table (4) shows the results of the three models. Estimated coefficients in the Table 4, suggest that positive error correction term (ECT_{t-1}^{+}) is significant, whereas the negative error correction term (ECT_{t-1}^{-})is notstatistically significant.

In Wholesale-Retail and Producer- Wholesale modelsECT_{t-1}^{+} induces significantly greater change inretail prices than ECT_{t-1}^{-}, meaning that wholesale and producer price increases are transmitted completely to retail and wholesale prices than it's decreases which occur in the wholesale and producer levels but in Producer-Retail model ECT_{t-1}^{-} induces greater change inretail prices than ECT_{t-1}^{+}.

In Wholesale-Retail model, retail prices adjust so as to eliminate about %78 of a unit positive change in the deviation from the equilibrium relationships created by changes in wholesale prices. In this model ECT_{t-1}^{-}hasn'tthe expected sign.

In Producer-Retail model error correction coefficients indicate that retail prices adjust in order to reach the equilibrium, indeed, retail prices adjust so as to eliminate about %55 of a unit positive change in the deviation from the equilibrium relationships created by changes in producer prices. In this model ECT_{t-1}^{-}hasn'tthe expected sign.

In Producer-Wholesale model wholesale prices adjust so as to eliminate about %56 of a unit positive change in the deviation from the equilibrium relationships created by changes in producer prices. In this model ECT_{t-1}^{-}hasthe expected sign.

In Producer-Retail and Wholesale-Retail models, according to the Wald test, we reject the null hypothesis of symmetry ($\varphi^{+} = \varphi^{-}$ and$\lambda^{+} = \lambda^{-}$) using an F-test statistic. But in Producer-Wholesale model the estimated model support on symmetric price transmission for rice in Iran.

Table 4: Estimated Coefficients for ECM

RWP/RRP			RPP/RRP			RPP/RWP		
Parameter	coefficient	Prob.	Parameter	coefficient	Prob.	Parameter	coefficient	Prob.
ECT_{t-1}^{+}	-0.78	0.00	ECT_{t-1}^{+}	-0.55	0.01	ECT_{t-1}^{+}	-0.56	0.03
ECT_{t-1}^{-}	0.03	0.88	ECT_{t-1}^{-}	1.33	0.06	ECT_{t-1}^{-}	-0.28	0.52
C	0.00	0.38	C	0.01	0.47	C	0.00	0.85
DLRWP	0.15	0.00	DLRPP	-0.22	0.01	DLRPP	0.74	0.00
DLRWP(-1)	-0.44	0.00	DLRPP(-1)	-0.21	0.16	DLRPP(-1)	-0.05	0.43
DLRWP(-2)	0.13	0.05	DLRPP(-2)	-0.14	0.03			
DLRRP(-1)	0.49	0.00	DLRRP(-1)	-0.68	0.01	DLRWP(-1)	0.15	0.01
DLRRP(-2)	-0.29	0.02	DLRRP(-2)	0.08	0.78			
R^2	0.63		R^2	0.58		R^2	0.61	
Adj. R^2	0.60		Adj. R^2	0.55		Adj. R^2	0.60	
F	22.46	0.00	F	17.88	0.00	F	35.06	0.00
DW	1.93		DW	2.15		DW	2.04	
F-statistic for EC(+)=EC(-)	9.49	0.00	F-statistic for EC(+)=EC(-)	4.78	0.03	F-statistic for EC(+)=EC(-)	0.51	0.48

Source: Authors findings

CONCLUSION

The paper focuses on time series estimation to test the price transmission and the asymmetry in the vertical level of the rice supply chain in Islamic Republic of Iran. The objective of this paper is to estimate the link between different levels of supply chain for commodity rice which is subject to the different level of controversy in the policy level.

The result shows unidirectional causality from the producer level to the retail level. Producer price led both wholesale and retail prices. This indicates that price transmissions in the Islamic Republic of Iran rice market flow from producer to wholesale to retail levels.

The main findings reveal asymmetry in transmission of a change in producer prices to retail prices and wholesale prices to retail prices. In other words the effects of any increase in producer prices on retail prices and increase in wholesale prices on retail prices is different comparing to any price decrease. The price transfer from producer to wholesale is symmetry.

Finally, knowing price linkages among market levels will aid in the evaluation of the potential impacts of agricultural policy on producers and consumers. For example, supporting programs to help reduce the cost of production may not benefit consumers if retail prices do not decrease because of decreasing producer prices. The results obtained from price-transmission and price-asymmetry tests give an indication of efficiency in the market. In this study, the existence of asymmetric behavior between producer-retail and wholesale-retail price relationships carries important policy implications. They imply that there is significant evidence indicating market distortions in these relationships. In addition, the causality test suggests prices are set at the producer level and passed on to wholesale and retail levels. These results suggest that producer scan use market strategies such as direct procurement to avoid problems with price transmission in the vertical market system, thereby offsetting some of the problems associated with market power.

These results are significant for understanding the pricing behavior between market segments in the produce industry. Therefore, the policy maker should be very cautious to formulate any decision on the existing private traders dominated markets efficiency which supposed to be much welfare enhancing for the poor consumers who mostly depends on the markets for rice.

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