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Price Transmission and its Volatility in Rice Marketing Chain in Iran: A Case Study of Kamfirozian Variety

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ABSTRACT

Volatility and imperfect price transmission in food markets always impress the welfare of producers and consumers, especially in the developing countries. Therefore, the purpose of this study was to investigate the price relationship in vertical market levels (i.e. farm gate, wholesale and retail) of rice as a staple food for Iranians, using the Vector Error Correction Model (VECM) and the Generalized AutoRegressive Conditional Heteroskedastic (GARCH). The data used was based on monthly observations of prices in Kamfiroz Rice Market from April 1997 to March 2015. Results showed that the direction of Granger causality and partial price transmission were from farm gate to retail market as well as from wholesale to farm gate level and retail market to wholesale, such that, if wholesale prices increase by 1%, farm gate prices will increase about 0.37%. Also, if retail prices increase by 1%, then wholesale prices will increase by about 0.36%. In addition, if farm gate prices increase by 1%, then retail prices will decrease by about 0.08%. Results also implied that retail and wholesale price volatilities have positive spillover effects on the volatility of farm gate prices (i.e. 0.50 and 0.31, respectively). In addition, retail prices are more sensitive to wholesale prices and more volatile (i.e. 0.56) than the others. Finally, in order to increase the transparency of information and increase the efficiency of price transmission in Kamfiroz Rice Market, it was suggested that marketing cooperatives of this product be increased and supported more.

Keywords: Farm gate prices, Multivariate GARCH model, Retail prices, Vector error correction model, Wholesale prices.

INTRODUCTION

Price Transmission (PT) in the vertical market deals with the mechanism of modifying market's shocks, which are determined by the actions of market agents i.e. farmers, wholesalers, distributors, retailer, and the like. If modification is expensive or is subjected to restrictions, price signals passed from agent to agent may occur partially in speed or size (Vavra and Goodwin, 2005). It means that price increases or decreases in one end of the marketing chain are not transmitted perfectly to the other end. Moreover, imperfect *PT* also affects the market participants' welfare because it changes relative prices. Hence, perception of the relationships among prices in the vertical markets is essential to analyze markets performance. This knowledge collects useful information in connection with, for example, efficient pricing, market integration and structural rigidity of prices. The mechanism of *PT* not only can be considered in adjusting direct upward and downward price shocks but in adjusting volatilities in marketing chain as well because one important feature of agricultural price relationships in the vertical markets is the degree of price volatility. The range within which prices might vary in the future can be shown by price volatility (Weaver and Natcher, 2000).

The greater price volatility, the greater uncertainty about future prices, because the range in which prices lie become wider in the future. Due to that, producers and consumers can be influenced by increased price volatility. More specifically, increased price volatility can reduce

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the accuracy of producers and consumers' predicting of future agricultural commodity prices (Apergis and Rezitis, 2003a). Since welfare reduction for both producers and consumers of agricultural commodities is undeniable, it is vital to be aware of the price volatility degree to insure them to make appropriate marketing strategies (Jensen, 2009).

So far, various studies have been carried out to investigate the price transmission and price volatility of agricultural products in Iran. Among these, we can mention the studies of Pishbahar and Alizadeh (2016), Sherafatmand and Baghestani (2016), Layani *et al.* (2015), Mosavi *et al.* (2014), Yosofi Motaghaed and Moghadesi (2013); Mosavi, S. H. and Esmaeili, A. (2012); Jezghani *et al.* (2011) and Rahmani and Esmaeili (2010). The review of these studies shows that there is a significant price relationship between different levels of the Iranian agricultural markets, and in many cases the price of agricultural products in different levels of markets are affected by volatility and fluctuation transmissions. However, the results of these studies show that in many cases, the information transmission in the Iranian agricultural markets is relatively weak and, therefore, the price transmissions in most of agricultural products markets in Iran is incomplete. In addition, several studies investigated the mechanisms of *PT* in food and agricultural markets throughout the world. Most of the researches have commonly used a time-series structure to recognize more-complicated features of *PT* relationships, for instance, they determined the extent to which price adjustments can be asymmetric. For example, Ward (1982) modeled the impact of wholesale prices on retail and freight on board (FOB) prices of fresh vegetables in the US market.

Ward (1982) found out the existence of asymmetry in the contemporaneous and distributed lag effects of cumulative wholesale prices variations on both *FOB* and retail prices. Goodwin and Holt (1999) investigate the relationship between farm, wholesale and retail beef prices in the US, using a three-regime error correction specification. It is shown that the dynamic relationship between farm, wholesale and retail prices as a whole is different according to the deviation from the long run equilibrium. Apergis and Rezitis (2003a, b) used the VECM and multivariate GARCH model to analyze the relationship among input, output, and retail food prices in Greece. They found imperfect *PT* among the mentioned prices as well that agricultural output prices were more volatile than agricultural input and retail food prices. Apergis and Rezitis (2003c) also examined the volatility spillover effects between producer and consumers prices in Greek and found significant price effects in the markets under consideration. Chavas and Mehta (2004) investigated the wholesale-retail price dynamics in the US butter market and found that the nature of price dynamics in this vertical sector was nonlinear. Von Cramon-Taubadel (1998) analyzed the price transmission between producer and wholesale pork prices in northern Germany. In this study, it was observed that transmission between producer and wholesale pork prices in northern Germany was asymmetric.

Loy and Weaver (1998) surveyed the relationship between inflation and relative price volatility in Russian food markets using GARCH-M model. They showed that distortions in relative prices were induced by the anticipated inflation rate, rather than by unanticipated inflation or a measure of inflation uncertainty. They also found no support for the hypothesis that a positive relationship exists between the relative price structure and the unanticipated rate of inflation. Yang *et al.* (2001) examined the effect of radical agricultural liberalization policy, i.e. the 1996 FAIR Act, on US agricultural commodity price volatility using GARCH-M models. Their results indicated that the agricultural liberalization policy had caused an increase in the price volatility for three major grain commodities (corn, soybeans, and wheat) and little change for oats, but a decrease for cotton. Reziti (2005) analyzed the relationship between macroeconomic variables and relative price variability in Greek agriculture using OLS regression. She indicated that changes in inflation rate and economic activity had a strong positive effect on relative price variability. Hassouneh *et al.* (2012) investigated the impact of avian influenza on vertical price transmission in the Egyptian poultry sector using VECM model. Their results showed that price adjustments to deviations from the market equilibrium parity depend on the magnitude of the avian influenza crisis.

Baquedano *et al.* (2014) surveyed the relationship of market integration and price transmission in consumer markets of developing countries using Error Correction Model (ECM). They found that developing countries' consumer markets were co-integrated with world markets. They also found that the transmission of changes in both world prices and real exchange rates to domestic consumer prices was not high. Ganneval (2016) analyzed the impact of volatility on market linkages for homogenous commodities in French food markets using Threshold Vector Error Correction Models (TVECM). The results show that in a high volatility regime, price deviations from the long term equilibrium are corrected faster and the price equilibration process after a price shock takes less time. Arnade *et al.* (2017) investigated the transmission of international agricultural prices to the domestic Chinese market using an ECM model. They found significant differences in transmission across commodities, with Chinese soybeans, soymeal and chicken prices being the most integrated with world prices and rice being the least integrated. They also found that short run transmission of prices was much lower than long run price transmissions.

Ahmad *et al.* (2017) analyzed spatial differences in price volatility across regional rice markets in Pakistan using GARCH-M models. They detected the presence of spatial differences in price volatility in rice markets. Also, they found that there was positive association of price volatility across regional rice markets in Pakistan. Ceballos *et al.* (2017) analyzed the impacts of international grain price and volatility transmission on domestic markets in developing countries using GARCH-M approach. They only observed significant interactions from international to domestic markets in few cases. They found that transmission of volatility was statistically significant in just one-quarter of the maize markets tested, more than half of rice markets tested, and all wheat markets tested. Jacques (2018) surveyed asymmetric price transmission in Brazilian rice market using several econometric approaches such as VECM model. His results using VECM models indicated that there was some asymmetry, but it was not possible to infer that it remained in the long-run. Dong *et al.* (2018) investigated price transmission in the Chinese pork and pig markets using ECM models. They identified a symmetric price transmission between pork and pig prices for the period between June 1994 and June 2007, while there was an asymmetric price transmission for the period July 2007 to June 2016.

In most of the mentioned studies, researchers frequently used VECM and GARCH-M models to investigate the price transmission and price volatility in food markets. They also used highly aggregated price indices thus their finding and conclusions should be viewed with cautiousness. Nevertheless, the review of past studies shows that, due to the different characteristics of agricultural products and the regional differences in food markets, the same procedure for price transmission and price volatility spillover is not worth mentioning. Therefore, identifying the characteristics of price transmission and price volatility spillover for different products requires case studies.

This study investigates price and volatility transmission among farm gate, wholesale, and retail levels of the rice market chain in Kamfiroz Region of Iran using monthly data, shown in Figure 1. Rice is the staple component of the national diet and more than 15% of the country's arable lands are under rice cultivation. The average per capita consumption of rice is 33 kg; therefore, with respect to the population, total annual rice consumption is over 2.9 million MT (FAO, 2016). In the same time, total rice production has not increased over 2.3 million MT, therefore, Iran imports the gap between the production and consumption each year, usually from Thailand, India and Vietnam (Central Bank of Iran, 2016). The increasing costs of import associated with low price elasticity of rice demand have justified continuous government intervention in this market (Mosavi, 2012).

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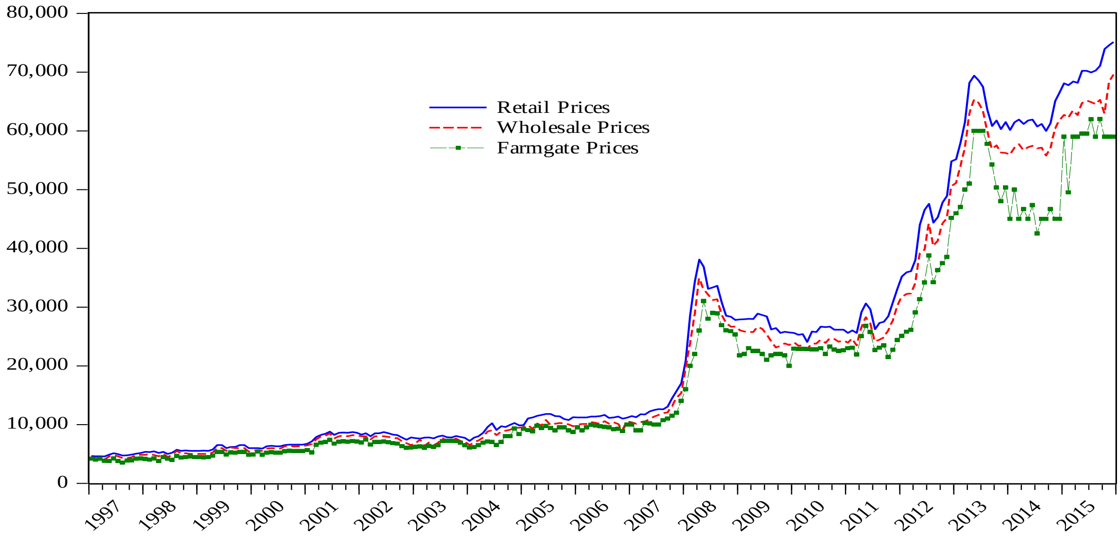

Figure 1. Farm gate, wholesale and retail rice prices from April 1997 to December 2015 (Rials).

The government protection policies cause higher producer prices than equilibrium ones, however, producer prices still show significant fluctuations, which are a result of limited transmission of institutional prices and unexpected changes in weather conditions. The eight-year war between Iran and Iraq, high and fluctuating inflation rates in the non-farm economy, traditional agricultural and marketing chains and expansive monetary policy have resulted in high and volatile agricultural farm gate prices, especially for rice, from the 1979 Revolution until now (Mosavi *et al.*, 2017). On the other hand, wholesale and retail prices have experienced high level of fluctuations in the last two decades due to continuous changes in the import tariffs, increased marketing middleman, imperfect information and traditional transportation infrastructures, so, wholesale and retail prices might be volatile as well. Thus, it is reasonable to believe that the conditional variances associated with rice prices throughout farm to home would not have remained constant during this period. (Shahvari, *et al.* 2019; Mortazavi *et al.* 2019; and Najafi Alamdarlo *et al.* 2018). On the other hand, due to the problem of water shortage, rice production is mainly carried out in north provinces of Iran. Therefore, due to the great distance between the north and other areas of the country, it is important to supply domestic rice needed for the other parts of the country, especially in western provinces. Therefore, price formation in different regions of rice production in the country can vary according to regional characteristics. Kamfiroz Town is one of the most important areas of rice planting in southwestern Iran where rice needed for consumers in many areas of southern provinces such as Fars, Bushehr, and Hormozgan are provided through the planting of Kamfiroz Variety of rice (Esfandyari *et al.*, 2012).

In addition, the production and distribution of rice are the main occupation of many people in this town. Therefore, studying the mechanism of Kamfiroz Rice Supply Chain as one of the most desirable types of rice produced in Iran is a significant contribution to increase the supply and demand performance of this product in important parts of Iran.

The purpose of this paper is threefold

To identify the short and long run dynamics as well as the direction of causality between farm gate, retail and wholesale prices, which imply that farmers, wholesalers, and retailers use information from each other when forming their own price expectations, thus indicating some degree of market integration.

To examine the magnitude of *PT* in the rice marketing chain. Vertical *PT* is typically characterized by the adjustments mechanism through the supply chain to market shocks that are generated at different levels of the marketing process. For example, if a positive shock in the primary commodity market induces an upward shock to the farm price, then, what is the size and timing of any impacts on wholesale and retail prices? Alternatively, one can evaluate the impact on farm level prices following a shock whose first incidence is on retail prices. Moreover, partial *PT* in the vertical markets leads to inefficiency in the government protection policies since production (consumption) price incentives may not transmit from producers (consumers) to consumers (producers).

To investigate volatility spillover effects among farm gate, wholesale and retail prices in the rice marketing chain in order to examine the relative uncertainty of these prices as well as the degree by which price uncertainty in one market affects price uncertainty in the others (Varga, 2007). The results that we find are relevant because not only they can affect the capability of farmers and consumers to forecast prices but also can help decision makers to establish proper marketing strategies, particularly in the case where the volatility of consumers price (proxied by retail prices) is found to be sensitive to changes in the volatility of farm-gate and wholesale prices and vice versa.

MATERIALS AND METHODS

In this study, we apply the Vector Error Correction Model and Multivariate GARCH model to analyze *PT* and volatility spillover in the rice marketing chain in Kamfiroz Region of Iran. Kamfiroz, due to its relevant conditions, is a main rice producing region in the south west of Iran. Therefore, coping with the imperfect marketing chain not only ensures smallholder's income but also contributes to obtain food security for the poor consumers. Many authors have used these methods to explore various commodity price relationship issues (Apergis and Rezitis, 2003; Roche and Mc Quinn, 2003; Karanja *et al.*, 2003; Hassan and Malik, 2007; Haigh and Holt, 2000).

Vector Error Correction Model (VECM)

Engle and Granger (1987) pointed out that if co-integration is detected, an error correction term should be included in the model. Following the two-step procedure suggested by Engle and Granger (1987), first, we should test the hypothesis that the price series concerned are non-stationary using the Augmented Dickey-Fuller (ADF) test. The Akaike information criterion (AIC) is used to determine the appropriate lag-length truncation. Testing for a unit root is important because there cannot be a long-run relationship among variables integrated of different order. The second step consists of using Johansen and Juselius (1990) multivariate co-integration procedure to analyze long-run linkage among prices. This stage determines the accurate specification of the following VECM:

$$\Delta X_t = \mu + \sum_{i=1}^{k} \gamma_i \Delta X_{t-i} + \varphi \vartheta_{t-1} + \varepsilon_t \quad (1)$$

Where, $\boldsymbol{\Delta}$ is the difference operator, $\mathbf{X}$ is a 3×1 vector of prices, $\boldsymbol{\mu}$ is a 3×1 constant vector, $\boldsymbol{\gamma}$ is a 3×3 coefficients matrix, $\boldsymbol{\upsilon_{t-1}}$ is the lagged value of the error correction term obtained from the second step and $\boldsymbol{\varepsilon}$ is a 3×1 error term vector. This model is capable of performing Granger causality tests and calculating *PT* effects as a second step.

Multivariate GARCH Model (MVGARCH)

As Figure 1 shows, farm gate, wholesale and retail prices like many other economic time series exhibit periods of usually large volatility, followed by periods of relative tranquility. Engle (1982) showed it is possible to model simultaneously the mean and the variance of a series. Bollerslev (1986) introduced GARCH model by extending Engle's original work. He developed a technique that allows the conditional variance to be an ARMA process. Finally, GARCH models have become very popular in

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that they enable to estimate the variance of a series at a particular point in time. One interesting development is the application of GARCH models in a multivariate setting. There is little conceptual difficulty in formulating a multivariate model such that the conditional volatilities are interdependent. For our purpose, we considered the following three-variety GARCH model:

$$\Delta X_t = \lambda + \Gamma \Delta X_{t-1} + \varphi EC_{t-1} + e_t \qquad (2)$$
$$h_t = b_0 + b_1 e_{t-1}^2 + b_2 h_{t-1}$$

Where, $\mathbf{\Delta X_t}$ is a 3×1 vector of farm gate, wholesale, and retail rice prices in the first differences, λ is a 3×1 constant vector, Γ is a 3×3 coefficients matrix, $\boldsymbol{EC_{t-1}}$ is the lagged value of the error correction term and $\boldsymbol{e_t}$ is a stochastic disturbance vector of the mean process for farm gate, wholesale, and retail rice prices, respectively. Finally, $\boldsymbol{h_t}$ is a vector of conditional variances of the considered prices. The coefficients in vector $\boldsymbol{b_1}$ capture spillover effects from farm gate, wholesale, and retail rice prices. By contrast, the elements of $\boldsymbol{b_2}$ capture volatility spillover effects from prices. The sum of the coefficients in each equation is a measure of persistence. If each sum is less than one, the GARCH model is valid, i.e. if one sum equals one, the volatility is infinite. Assuming conditional normality, the model is jointly estimated by Maximum likelihood techniques.

RESULTS AND DISCUSSION

The data used in this analysis is based on 228 monthly observations of average farm gate prices (P) (proxy by producer prices), average Wholesale prices (W), and average Retail prices (R), from April 1997 to March 2015, obtained from Central Agricultural Organization of Fars Province. The real prices are derived from the price deflator index (1997= 100). Furthermore, as Hamilton (1994) stated, the logarithmic transformation of data mitigates fluctuations of individual series, increasing the likelihood of stationarity after first differencing. Therefore, all of the estimations are performed by variables in natural logarithms form. We checked the data for presence of seasonal effects through the filter based methods of seasonal adjustment known as X11 procedure and by regressing the prices on quarterly and monthly dummy variables. None of the seasonal effects was statistically significant. Descriptive Statistics for the prices are listed in Table 1. The results of Table 1 show that, in the desired period, average monthly wholesale price of rice versus farm price was 13% higher. Also, average monthly retail price of this product was about 8% higher than its wholesale price. Eventually, average monthly retail price of Kamfiroz Rice was about 23% higher than farm gate price. It seems that because of market power for the wholesalers and because of variety of rice products in the Iranian rice market, the margin of profit for the wholesalers is more than other parts of rice market.

Next, in order to properly specify the VECM, prices are tested for unit roots. Unit root null hypothesis was tested through the Augmented Dickey–Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test statistics. Table 2 shows the test results of all prices in levels and first differences. According to the statistical evidence, all of the variables are non-stationary in levels. The *ADF* test fails to reject the null hypothesis of a unit root for all variables at the 5% significance level. The *KPSS* test with lags equal 1 for the three series harmonizes as well. Regarding the first differences of the variables, all seem stationary. Therefore, we proceed with

Table 1. Descriptive statistics of prices at different levels of Kamfiroz Rice Market.

	Farm gate prices (Rials)	Retail prices (Rials)	Wholesale prices (Rials)
Mean	18931	23343	21476
Median	9500	11409	10222
Maximum	62000	75111	69600
Minimum	3512	4562	4069
Observations	228	228	228

Table 2. Results of unit root test.[a]

Variables	P	W	R
ADF statistic:			
Levels	-3.02 (1)	-2.57 (1)	-2.09 (1)
P-value	0.12	0.29	0.54
First differences	-6.88 (0)	-10.52 (0)	-8.62 (0)
P-value	0.00	0.00	0.00
KPSS statistic:			
Levels	0.23	0.24	0.25
First differences	0.03	0.03	0.03

[a] All econometric analyses were conducted using EViews9. Figures in the parentheses are the number of lags included in the regressions. The lag lengths are chosen by adding lags until serial correlation *LM* test (Breusch-Godfrey) fails to reject no serial correlation at the 5% significance level. Critical values of the ADF test at the 1% and 5% levels are -3.92 and -3.42, respectively. Also, critical values for the *KPSS* test at the 1 and 5% levels are 0.21 and 0.14, respectively.

Table 3. Results of the cointegration test.

Null hypothesis	Alternative hypothesis	Critical value 95%	
λ_{Trace} *rank test*		λ_{Trace} *rank value*	
$r = 0$	$r \geq 1$	71.94	35.19
$r \leq 1$	$r \geq 2$	26.85	20.26
$r \leq 2$	$r \geq 3$	5.27	9.14
λ_{Max} *rank test*		λ_{Max} *rank value*	
$r = 0$	$r = 1$	45.09	22.29
$r \leq 1$	$r = 2$	21.58	15.89
$r \leq 2$	$r = 3$	5.27	9.16

the assumption that all variables are difference stationary.

This result leaves open the possibility of co-integration among the variables. Co-integration tests (Johansen and Juselius, 1990) reveal evidence in favor of co-integration among prices. Table 3 reports the results of co-integration tests. Both the maximum eigenvalue test statistic λ_{Max} and the trace test statistic λ_{Trace} indicate the existence of at least one long-run relationship among the farm gate, wholesale, and retail rice prices.

Normalizing with respect to the coefficient of *P*, the co-integration vector takes the following form:

$$P_t = \underbrace{-2.44R_t}_{(0.43)} + \underbrace{1.44W_t}_{(0.43)} \qquad (3)$$

The estimated Equation (3) describes a long-run equilibrium among the three prices under study, after allowing all adjustments to take place. Thus, all three prices under study were moving together in the long run. Accordingly, with one percent increase in wholesale prices of Kamfiroz Rice in the long run, farm gate prices would increase by 1.44 percent. Also, with one percent increase in retail prices in the long run, farm gate prices would decrease by 2.44 percent.

In the next step, a Vector Auto Regression model (VAR) is postulated to obtain a relationship between prices. Given likelihood ratio tests, one lag seems adequate to capture the dynamics in the data. Then, the associated error correction vector autoregressive mechanism, which describes the short-run dynamics, was estimated. Table 4 indicates the results of VECM. The elements of the adjustment vector (i.e.φ) ensure the stability of the model. The significant negative signs of φ_1 and φ_3 indicate that in order to establishing stability in the model, farm gate and wholesale prices would have to decrease even though the sign of retail prices is non-significant. The adjustment coefficients represent the proportion by which the long-run disequilibrium in the dependent variables is corrected in each short-term period. The estimated adjustment coefficients indicate

Table 4. Results of Vector Error Correction model.

	ΔP_t	ΔR_t	ΔW_t
φ	-0.18*** [-5.32]	-0.009 [-0.32]	-0.12*** [-3.96]
ΔP_{t-1}	-0.40*** [-5.38]	-0.11* [-1.97]	-0.02 [-0.43]
ΔR_{t-1}	0.008 [0.05]	0.34** [2.67]	0.44** [3.18]
ΔW_{t-1}	0.52** [3.88]	0.08 [0.81]	-0.21* [-1.89]
μ	0.01** [2.47]	0.008** [2.61]	0.009** [2.77]
R-squared	0.29	0.13	0.21
F-statistic	22.25	8.38	14.78
Akaike *AIC*	-2.76	-3.24	-3.06
Schwarz *SC*	-2.69	-3.17	-2.99

* denote significance at the 10% level, ** denote significance at the 5% level, *** denote significance at the 1% level.

that about 18% and 12 percent of long-run disequilibrium in farm gate and wholesale prices is corrected within one month time period. It is shown that the farm gate price of rice adjusts faster toward the long-run equilibrium level than both wholesale and retail prices. On the other hand, the smaller adjustment coefficient of retail price indicates that the short-run adjustment to the long-run for retail price is much slower than the other two variables. Therefore, it seems that compared to the other two variables, the retail price variable is a function of more variables. This is due to the fact that the retail price of rice as the final price of this product is affected by various factors, especially from the demand side. In this regard, the existence of multiple substitutes for retail rice (i.e. domestic and imported rice brands in the retail market) is one of most important factors that makes retail price of Kamfiroz Variety to have little flexibility to get back to long-run relationship after receiving shocks. *R*-squared for farm gate, retail, and wholesale price equations show that price changes at market levels only account for less than 30% of farm gate, retail, and wholesale price changes. Therefore, it is natural that other than the price transmissions, other factors affect the formation of prices in Kamfiroz Rice Market. However, the purpose of this study is to focus on price transmission in Kamfiroz Rice Market from one stage to another and to examine their interrelationship and the investigation of other factors affecting rice prices has not been the goal of this study. Similar values of R^2 have been reported in surveys conducted by Anash (2012), Ojiako *et al.* (2013), Lemma and Singh (2015), Darbandi and Saghaian (2016), and Makbul and Ratnaningtyas (2017) where the price transmissions were considered at different stages of goods markets.

Block exogeneity tests are performed to determine the direction of causality among rice prices in the three different marketing stages. Table 5 gives the results of Granger causality tests. The significance of the causality direction also is examined by Wald tests. According to causality tests, wholesale and retail prices are Granger cause of farm gate prices where farm gate prices are Granger cause of retail prices and retail prices are Granger cause of wholesale prices. These results have important implications because they show that farmers in Kamfiroz

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Table 5. Results of Granger causality test in rice marketing stages.

Null hypothesis	Wald statistic
Farm gate prices	
Retail prices do not Granger cause farm gate price	81.09***
Wholesale prices do not Granger cause farm gate price	57.17***
Retail prices	
Farm gate prices do not Granger cause retail prices	9.33**
Wholesale prices do not Granger cause retail prices	1.02
Wholesale prices	
Farm gate prices do not Granger cause wholesale prices	2.15
Retail prices do not Granger cause wholesale prices	41.5**

* denote significance at the 10% level, ** denote significance at the 1% level.

Table 6. *PT* among three stages of rice marketing chain.

Null hypothesis	Estimated impact	Wald statistic
Farm gate prices		
PT from retail to farm gate prices	0.005	0.002
PT from wholesale to farm gate prices	0.37	15.05***
Retail prices		
PT from farm gate to retail prices	-0.08	3.88**
PT from wholesale to retail prices	0.05	0.66
Wholesale prices		
PT from farm gate to wholesale prices	-0.01	0.18
PT from retail to wholesale prices	0.36	10.11***

Region use information from wholesalers in order to produce rice, however, retail prices do not have any significant effect on farmer's prices and income. On the other hand, the retail prices are very sensitive to farm gate prices such that retailers use information of production side to determine their prices. It is in line with "cost-push" theory for price formation in the retail rice market (Zaleski, 1992).

Granger causality results also imply asymmetric *PT* because the information of the final stage of rice marketing chain is not transmitted to the farm level. Estimates of short-run dynamic *PT* are calculated based on the study by Johansen and Juselius (1994) and reported in Table 6.

Results indicate that only *PT* from wholesale to farm gate stage, from retail rice market to wholesale, and from farm gate to retail rice market are significant. These results are in line with vector error correction model reported in Table 4. It means that if wholesale prices increase (decrease) by 1%, farm gate prices will increase (decrease) about 0.37% implying imperfect performance and price rigidity in the market. Also, results show that if retail prices increase (decrease) by 1%, the wholesale prices will increase (decrease) by about 0.36%. These results support the study of Jezghani *et al*. (2011) regarding the value of price transmission in the Iranian rice market. According to their study and the procedure of Johansen and Juselius (1994), the values of price transmission from wholesale market to farm gate market and from retail market to wholesale market in the Iranian rice market is obtained as 0.48 and 0.17, respectively.

Moreover, the rates of change of retail prices partially adjust to the rate of change in farm gate prices. If farm gate prices increase (decrease) by 1%, the retail prices will decrease (increase) by about 0.08%. The partial PT between farmers and retailers may be due to three reasons. First, different kinds of rice in the retail level that are closely substituted with each other such that the change in farm gate price of rice in Kamfiroz does not transmit to the retail rice market. Second, the main retail market for the rice of Kamfiroz is established in Shiraz, which is far from the Kamfiroz Region, so the distance between the stages of rice marketing chain could result in reverse price transmission. Third, it seems that the pricing rule in the Kamfirozian Rice Market don't conform mark-up model, because in this situation we have $R=(1+M)P$ and then, if M is constant, a 1% rise in farm gate price will indeed result in a 1% rise in retail price. In the presence of other marketing cost (M_1) and the additive pricing rule such as $R=M_1+P$, the changes in the farm gate level cannot transmit to the retail level completely. Of course, it is valuable to note that the underlying assumption of all these conclusions is symmetric *PT* because the behavior of market agents in the presence of upwards and downwards shocks may differ, so the effect of 1% increase or decrease of one price has an equal impact of other prices. In addition, in Figure 2, result estimation of impulse response functions is reported. As can be seen, with a shock entry to prices at any stage of the Kamfiroz Rice Market, price changes in the other two stages would be constant in certain levels after few months. In this regard, Retail price (LR) changes are higher than the other two stages of Kamfiroz Rice Market in the early months. Therefore, the sensitivity of retail prices to price shocks appears to be much higher than Wholesale price (LW) and Farm gate price (LF) and the interests of rice consumers are further affected.

The estimated results of the three-variate

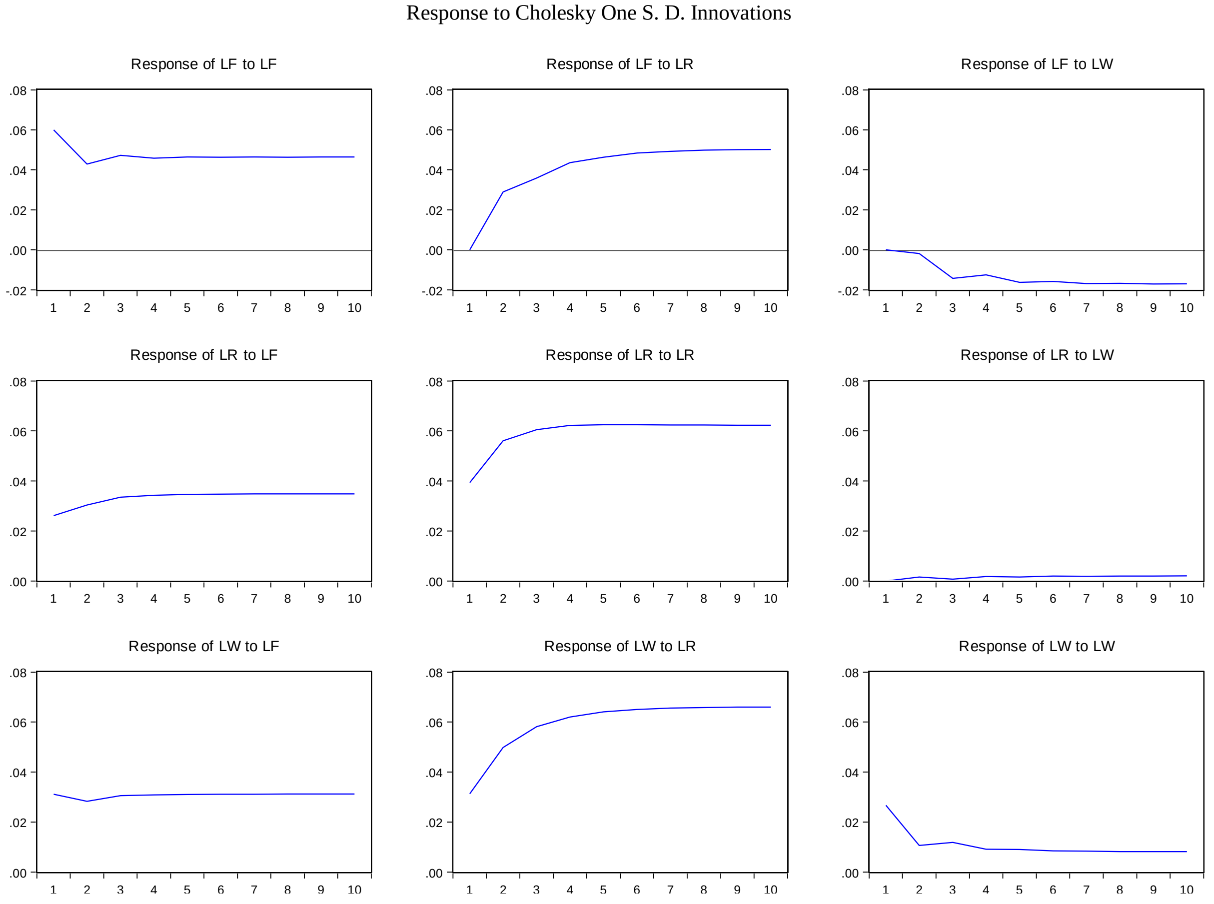

Figure 2. Result estimation of Impulse Response Functions. The vertical axes are expressed in units of the price variables (i.e. LF, LW and LR). The lines show the point estimate for the amount each price is expected to change following a unit impulse after the number of periods on the horizontal axes.

Table 7. ML estimation of three-variate GARCH(1,1) model.

		Mean Equations					
Variables		ΔP Equation		ΔR Equation		ΔW Equation	
φ		-0.57***	(-2.88)	-0.14	(-0.21)	-0.29	(-1.42)
Γ	Γ_P	-0.46***	(-5.25)	-0.06	(-1.006)	-0.008	(-0.13)
	Γ_R	0.47***	(4.06)	0.05	(0.48)	0.40***	(11.58)
	Γ_W	0.74***	(4.16)	0.13	(0.72)	-0.01	(-0.08)
λ		0.001	(0.31)	0.008**	(2.31)	0.03	(0.84)
R-squared		0.47		0.27		0.48	
DW stat		2.51		1.95		2.28	
		Variance equations					
Variables		h_P Equation		h_R Equation		h_W Equation	
	b_0	0.002**	(2.15)	0.0006***	(4.34)	0.001***	(4.11)
b_1	b_{1P}	0.19*	(1.93)	0.15***	(2.63)	0.20***	(3.76)
	b_{1R}	0.15***	(2.63)	0.23***	(3.92)	0.19***	(3.88)
	b_{1W}	0.20***	(3.76)	0.19***	(3.88)	0.23***	(3.57)
b_2	b_{2P}	0.32	(1.26)	0.50***	(3.09)	0.31**	(2.19)
	b_{2R}	0.50***	(3.09)	0.53***	(6.61)	0.56***	(3.18)
	b_{2W}	0.31**	(2.19)	0.56***	(3.18)	0.47***	(5.36)

* Denote significance at the 10% level, ** Denote significance at the 5% level, *** Denote significance at the 1% level.

GARCH model are reported in Table 7. The base form of GARCH model is GARCH (1,1). Therefore, Breusch-Godfrey and ARCH tests were performed to make sure that the GARCH (1,1) can fully explain the heteroskedasticity. Selection procedures indicated that a three-variate GARCH (1,1) model for relative rice prices exhibited the best fit. Higher lags were also tried, but the extra coefficients were statistically insignificant. The upper part of Table 7 reports the estimates of the error correction (EC) part, and the lower part reports the estimates of the conditional variances. Numbers in parentheses are *t*-statistics. In the mean equations, only the error correcting coefficients (φ) of farm gate prices is statistically significant, implying that there is non-significant feedback among other levels of the rice marketing chain. Thus, only the farmers use information from each other when forming their own price expectations. In the variance equations, some important results are observed.

The results show that in the $\boldsymbol{h_P}$ equations, the volatility coefficient is equal to 0.32, but statistically non-significant, which implies that the own volatility of farm gate prices does not lead to volatility in farm gate prices in the next periods. Despite this, the volatility coefficients are positive and significant for $\boldsymbol{h_R}$ and $\boldsymbol{h_W}$ equations. The greater volatility spillover of wholesale prices (i.e. 0.50) relative to the retail prices (i.e. 0.31) in the $\boldsymbol{h_P}$ equations indicate that farm gate prices are more sensitive to wholesale prices in the meaning of volatility transfer. Also, the magnitude of these coefficients is high, which indicates strong volatility spillovers from the wholesale and retail markets to the farm gate market. On the other hand, retail and wholesale prices are strongly influenced by farm gate volatility too, as shown in Table 7. Retail and wholesale prices are also affected by own volatility as well as by the volatility of each other prices, as all of them are positive and statistically different from zero. In the meaning of volatility, the behavior of wholesale and retail prices is similar. Here, it should be noted again that in addition to price variables, other factors also affect the changes and fluctuations in rice prices. Therefore, R-squared statistics show only the share of price variables in explaining the fluctuation of prices from one level to another in Kamfiroz Rice Market. Other studies have been conducted with similar values of R^2, including the study of Cheteni (2016); AL-Najjar (2016), and Cermak *et al.* (2017).

The volatility of wholesale and retail prices themselves have a positive and significant effect on future volatility of their prices. The magnitude of volatility spillover coefficients from the other two market levels to wholesale and retail stage is relatively strong. Totally, the findings imply that the retail level of the rice marketing chain in the Kamfiroz Region is more volatile than the others, so, it might be associated with high degree of price uncertainty for consumers. The persistence measure in each equation, which is the sum of the coefficients in the variance model, validates the three-variate GARCH model. As the variance equation of retail prices is stationary, its persistence measure is greater than for the other equations, which shows retail price volatility shocks take more time to decay.

CONCLUSIONS

This study investigated the price linkage in the rice marketing chain of Kamfiroz District of Iran (i.e. farm gate, wholesale, and retail markets) through Vector Error Correction and three-variate GARCH models. From the VECM with symmetric *PT* follow three main results. First, farm gate prices of rice are adjusted faster toward their long-run equilibrium level than both wholesale and retail prices. Second, Granger causality tests along with VECM model indicated that wholesale prices are Granger cause of farm gate prices, while farm gate prices are Granger cause of retail prices and retail prices are Granger cause of wholesale prices. Therefore, the results confirm “cost pull” theory and imply unilateral *PT* because the information of the final stage of rice marketing chain is not transmitted to the farm level. Third, farm gate prices are partially adjusted to wholesale prices as well as retail prices to farm gate prices and wholesale prices to retail prices. It is very important because in case of partial *PT*, the government policies that are generally carried out at the farm gate level do not transmit to final consumers, leading to inefficiency in the market. Therefore, one of basic and pivotal assistance that the government should make for the transparency of information transmission and improving the performance of price transmission cycle in this market is to set up and support rice marketing cooperatives in Kamfiroz Town. The existence of marketing cooperatives, in addition to increasing the transparency of information on the rice market, will increase the efficiency and prosperity of rice supply and demand. Also, the government can increase the efficiency of the formation of prices in the rice market through continuous price surveys and the availability of price data banks.

In the meaning of price volatility, the empirical analysis of the three-variate GARCH model showed only the presence of feedback among the farm gate levels of the rice marketing chain, indicating that farmers only use information from each other when forming their own price expectations. In addition, the statistical results showed the presence of significant volatility spillover effects across the three vertical markets, which in turn indicate the existence of price uncertainty for the farmers and especially consumers. The spillover volatility in the farm gate prices commonly is due to no contraction in the rice markets and the biological nature of rice production, which in turn leads to a less price elastic farm-level demand relative to wholesale and retail demands. Nevertheless, the results of this study indicate that the volatility of the retail market is greater than the other two markets. It might be because of two main reasons. First, the government carries out most of the protection policies at the farm gate level, which in turn leads to more tranquility at the farm gate level than at other levels. Second, world prices, which are not considered in this study, can cause volatility at the retail level of rice market. Since Iran needs to import over 0.5 million MT of rice each year, it entails government to perform two kind of policies in order to secure the poor consumers and to promote the farmers incentives. To achieve these goals, government has manipulated the import tariffs extensively, so, the direct effect of these policies is to fluctuate internal prices and, of course, the retail prices. In this regard, statistical evidence suggests that rice imports are significant in all seasons in the country, and especially in the harvest season of domestic rice. Therefore, targeting rice import tariffs according to the domestic market conditions so that the tariffs for the harvesting season be set as high as possible, and in other seasons be set according to market requirements, can make a significant help in adjusting rice supply and demand prices. Finally, it is valuable to note that exploration of asymmetric *PT* on agricultural markets can improve better insights for researchers and policy makers, therefore, it is useful to incorporate asymmetric *PT* in future studies.

REFERENCES

1. Ahmad, B. Gjolberg, O. and Mehdi, M. 2017. Spatial Differences in Rice Price Volatility: A Case Study of Pakistan 1994-2011. *Pak. Dev. Rev*., **56(3):** 265-289.
2. Al-Najjar, D. 2016. Modelling and Estimation of Volatility Using ARCH/GARCH Models in Jordan's Stock Market. *Asian J. Fin. Acct.*, **8(1):** 152-167.
3. Anash, I. G. K. 2012. Analyzing the Relationship between World Market Prices and Local Prices of Food in African Markets: The Case of Wheat in Ethiopia. A Thesis Submitted in Partial Fulfilment of the Requirement for the Award of MSc. Degree in Management, Economics and Consumer Studies. Wageningen University and Research Centre, Wageningen.
4. Apergis, N. and Rezitis, A. 2003a. A. Mean Spillover Effects in Agricultural Prices: The Case of Greece. *Agribusiness*, **19:** 4-425-437.
5. Apergis, N. and Rezitis, A. 2003b. Agricultural Price Volatility Spillover Effects: The Case of Greece. *Eur. Rev. Agric. Econ.*, **30(3):** 389–406.
6. Apergis, N. and Rezitis, A. 2003c. Food Price Volatility and Macroeconomic Factor Volatility: "Heat Waves" or Meteor Showers? *Econ. Letr*. **8:** 155- 160.
7. Arnade, C., Cooke, B. and Gale, F. 2017. Agricultural Price Transmission: China Relationships with World Commodity markets. *J. Commodity Mark*., 7: 28-40.
8. Baquedano, F. G. and Liefert, W. L. 2014. Market Integration and Price Transmission in Consumer Markets of Developing Countries. *Food Policy*, **44:** 103-114.
9. Bettendorf, L. and Verboven, F. 2000. Incomplete Transmission of Coffee Bean Prices: Evidence from The Netherlands. *Eur. Rev. Agric. Econ*., **27:** 1–16.
10. Bollerslev, T. 1986. Generalized Autoregressive Conditional Heteroskedasticity. *J. Economet*., **31:** 307–27.
11. Ceballos, F. Hernandez, M. A. Minot, N. and Robles, M. 2017. Grain Price and Volatility Transmission from International to Domestic Markets in Developing Countries. *World Dev*., **94:** 305-320.
12. Central Bank of Iran. 2016. *Economic Tme Series Database*. www.cbi.ir
13. Cermak, M. Malec, K. and Maitah, M. 2017. Price Volatility Modelling–Wheat: GARCH Model Application. *Agris On-line Papers in Economics and Informatics*, **4:** 15-24.
14. Chavas, J. P. and Mehta, A. 2004. Price Dynamics in a Vertical Sector: The Case of Butter. *Am. J. Agric. Econ..*, **86:** 1078–1093.
15. Cheteni, P. 2016. *Stock Market Volatility Using GARCH Models: Evidence from South Africa and China Stock Markets*. MPRA Paper No. 77355, Munich Personal RePEc Archive (MARPA). Online at https://mpra.ub.uni-muenchen.de/77355/
16. Darbandi, E. and Saghaian, S. 2016. The Great Recession and Vertical Price Transmission in the US Beef Market. *Selected Paper Prepared for Presentation for the 2016 Agricultural & Applied Economics Association,* July 31-August 2, Boston, MA.
17. Dong, X. Brown, C. Waldron, S. and Zhang, J. 2018. Asymmetric Price Transmission in the Chinese Pork and Pig Market. *British Food J*., **120(1):** 120-132.
18. Engle, R. 1982. Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*. **55:** 251-76.
19. Engle, R. and Granger, C. 1987. Cointegration and Error-Correction: Representation, Estimation and Testing. *Econometrica*. **55:** 251-76.
20. Esfandyari, M. Yaghoubi, M. Shabaninejad, V. and Karbassi, A. 2012. Efficiency Evaluation of Rice Farmers at South Kamfirouz Region of Marvdasht County: Application of Data Envelopment Analysis Model. *J. of Village and Development,* **15(1):** 65-84. (in Persian).
21. FAO. 2016. *Biannual Report on Global Food Markets (Food Outlook).* June 2016.
22. Ganneval, S. 2016. Spatial Price Transmission on Agricultural Commodity Markets under Different Volatility Regimes. *Econ. Model.,* **52:** 173-185.

[DOR: 20.1001.1.16807073.2019.21.7.4.5]

23. Goodwin, B. K. and Holt, M. T. 1999. Price Transmission and Asymmetric Adjustment in the US Beef Sector. *Am. J. Agric. Econ.,* **81:** 630–637.
24. Haigh, M. and Holt, M. 2000. Hedging Multiple Price Uncertainty in International Grain Trade. *Am. J. Agric. Econ.,* **84(2):** 881-896.
25. Hamilton, J. D. 1994: Time Series Analysis. Princeton NJ: Princeton University Press.
26. Hassan, S. A. and Malik, F. 2007. Multivariate GARCH Modeling of Sector Volatility Transmission. *Q. Rev. Econ. Fin*., **47:** 470-480.
27. Hassouneh, I. Radwan, A. Serra, T. and Gil, J. 2012. Food Scare Crises and Developing Countries: The Impact of Avian Influenza on Vertical Price Transmission in the Egyptian Poultry Sector. *Food Policy*, **37(3):** 264-274.
28. Jacques, H. D. 2018. A Methodological and Applied Analysis on Asymmetric Price Transmission Models: Brazilian Rice Market Issues. Thesis Submitted to the Graduate Program in Economic Sciences, as Part of the Requirements for Obtaining the Doctor of Economics, State University of Maringá.
29. Jensen, R. 2009. Information, Efficiency and Welfare in Agricultural Markets. Presented at the 27th International Association of Agricultural Economists Conference, August 16-22, 2009, Beijing, China.
30. Jezghani, F. Moghaddasi, R. Yazdani, S. and Mohamadinejad, A. 2011. Price Transmission Mechanism in the Iranian Rice Market. *Int. J. Agric. Sci. Res.,* **2(4):** 31-38.
31. Johansen, S. and Juselius, K. 1990. Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money. *Oxford Bull. Econ. Stat*., **52:** 169–210.
32. Johansen, S. and Juselius, K. 1994. Identification of the Long-Run and Short-Run Structure: An Application to the IS-LM Model. *J. Economet*., **63:** 7-36.
33. Karanja, A., Kuyvenhoven, A. and Moll, H. 2003. Economic Reform and Evaluation of Producer Prices in Kenya: An ARCH-M Approach. *Afr. Dev. Bank,* **15**: 271-296.
34. Layani, GH. Ghorbanian, A. Bakhshoudeh, M. (2015). World price transmission of cereals to domestic markets of these products. *Journal of Agricultural Economics and Development*. **29(4):** 334-344. (In Persian).
35. Lemma, H. R. and Singh, R. 2015. Testing for Price Co-Integration between Producers and Retailers: Evidence from Ethiopian Milk Market. *iBusiness*, **7:** 1-9.
36. Loy, J and Weaver, R. D. 1998. Inflation and Relative Price Volatility in Russian Food Markets. *Eur. Rev. Agric. Econ.,* **25(1):** 373–394.
37. Makbul, Y. and Ratnaningtyas, S. 2017. Analysis of the Integration of Rice and Paddy Prices in Indonesia Using a Vector Error Correction Model. *Int. J. Appl. Bus. Econ. Res.,* **15(10):** 209-225.
38. Mortazavi, S. A., Najafi Alamdarlo, H., Zaghi Bijarbas, M. 2019. Estimating the Eco-environmental Value of Damages Caused by Groundwater Over Drafting. *Inter. J. Environ. Sci. Tech.*, **16(7)**: 3861-3868.
39. Mosavi, S. H. 2016. Energy Price Reform and Food Markets: The Case of Bread Supply Chain in Iran. *Agric. Econ.* **47(2)**: 169-179.
40. Mosavi, S. H., Esmaeili, A. 2012. Self-Sufficiency Versus Free Trade: The Case of Rice in Iran. *J. Int. Food Agribus. Market*. **24(1)**: 76-90.
41. Mosavi, S. H., Esmaeili, A. K., Azhdari, S. 2014. Evaluating Economic Effects of Exchange Rate Depreciation on the Rice Market in Iran. *J. Agr. Sci. Tech.* **16**:705-717.
42. Mosavi, S. H. Alipour, A. and Shahvari, N. 2017. Liberalizing Energy Price and Abatement Cost of Emissions: Evidence from Iranian Agro-Environment. *J. Agr. Sci. Tech.*, **19(3):** 511-523.
43. Najafi Alamdarlo, H., Pourmozafar, H., Vakilpoor, M. H. 2018. Improving Demand Technology and Internalizing External Effects in Groundwater Market Framework, Case Study: Qazvin Plain in Iran. *Agric. Water Manag.*, **213**: 164-173
44. Ojiako, I. A. Ezedinma, C. Okechukwu, R. U. and Asumugha, G. N. 2013. Spatial Integration and Price Transmission in Selected Cassava Products' Markets in Nigeria: A Case of Gari. *World Appl. Sci. J*., **22(9):** 1373-1383.
45. Pishbahar, E. and Alizadeh, P. 2016. Vertical Price Transmission in the Market of Potato and Onion (Case Study: Kurdistan Province. *Iranian Journal of Agricultural Economics and Development Research,* **47(3):** 533-543. (in Persian).
46. Rahmani, R. and Esmaeili, A. 2010. An Analysis of Price Transmission in Chicken

Meat Market, Fars Province. *Iranian Journal of Agricultural Economics and Development Research*, **41(2):** 275-286. (in Persian).

47. Reziti, I. 2005. The Relationship between Macroeconomic Variables and Relative Price Variability in Greek Agriculture. *Int. Adv. Econ. Res*., **11:** 111-119.
48. Rezitis, A. 2003. Mean and Volatility Spillover Effects in Greek Producer–Consumer Meat Prices. *Appl. Econ. Letr*., **10:** 381–384.
49. Roche, M. and McQuinn, K. 2003. Grain Price Volatility in Small Open Economy. *Eur. Rev. Agric. Econ.,* **30(1):** 77–98.
50. Shahvari, N., Khalilian, S., Mosavi, S. H., Mortazavi, S. A., 2019. Assessing Climate Change Impacts on Water Resources and Crop Yield: A Case Study of Varamin Plain Basin, Iran. *Environ. Monitor. Assess*. **191(3)**:134.
51. Sherafatmand, H. and Baghestani, A. 2016. Identification of Price Transmission Mechanism in Iran's Date Market (Application of Bivariate GARCH Model). *J. Agric. Econ. Develop.* **30(1):** 70-79. (in Persian).
52. Varga, T. 2007. Vertical Price Transmission between Market Operators in Hungarian Agricultural Product Chains. *Stud. Agric. Econ*., **106:** 41-70.
53. Vavra, P. and Goodwin, B. K. 2005. *Analysis of Price Transmission along the Food Chain.* Working Papers, OECD Food Agriculture and Fisheries No. 3.
54. Von Cramon-Taubadel, S. 1998. Estimating Asymmetric Price Transmission with the Error Correction Representation: An Application to the German Pork Market. *Eur. Rev. Agric. Econ*., **25:** 1–18.
55. Ward, R. W. 1982. Asymmetry in Retail, Wholesale and Shipping Point Prices for Fresh Vegetables. *Am. J. Agric. Econ.*, **64:** 205–212.
56. Weaver, R. D. and Natcher, W. 2000. Has Market Reform Exposed Farmers to Greater Price Volatility? In: "*Farm Economics*". Cooperative Extension Service, US Department of Agriculture, College Station, Pennsylvania State University, PA.
57. Yang, I., Haigh, M and Leatham, D. 2001. Agricultural Liberalization Policy and Commodity Price Volatility: A GARCH Application. *Appl. Econ. Letr*., **8:** 593- 598.
58. Yosofi Motaghaed, H. and Moghadesi, R. 2013. World Price Transmission to Domestic Agricultural Markets: Case of Wheat, Barley and Rice. *J. Agric. Econ. Res*., **5(17):** 81-99. (In Persian).
59. Zaleski, P. A. 1992. Industry Concentration and the Transmission of Cost-Push Inflation: Evidence from the 1974 OPEC Oil Crisis. *J. Econ. Bus.,* **44(2):** 135-141.

نوسان و انتقال قیمت در زنجیره بازار برنج ایرانی: شواهدی از بازار رقم کامفیروزی

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چکیده

نوسان و انتقال ناقص قیمت در بازارهای مواد غذایی به ویژه در کشورهای در حال توسعه همواره بر رفاه تولید کنندگان و مصرف کنندگان تأثیر می‌گذارد. بنابراین، هدف از این مطالعه، بررسی رابطه قیمت در بازارهای عمودی (بازار سر مزرعه، بازار خرده‌فروشی و بازار عمده‌فروشی) برنج به عنوان غذای اصلی مردم ایران با استفاده از مدل تصحیح خطای برداری (VECM) و مدل واریانس ناهمسانی شرطی خودتوضیح (GARCH) است. داده‌های مورد استفاده بر اساس مشاهدات ماهیانه قیمت‌ها در بازار برنج کامفیروزی از فروردین‌ماه ۱۳۷۶ تا اسفند ۱۳۹۴ بوده است. نتایج نشان داد که جهت علیت گرنجر و انتقال جزئی قیمت‌ها از بازار سر مزرعه به بازار خرده‌فروشی و همچنین از سطح بازار

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عمده‌فروشی به بازار سر مزرعه و بازار خرده‌فروشی به بازار عمده‌فروشی است. به طوری که اگر قیمت‌های عمده فروشی یک درصد افزایش یابد، قیمت سر مزرعه در حدود ۰/۳۷ درصد افزایش خواهد یافت. همچنین، اگر قیمت خرده فروشی به میزان یک درصد افزایش یابد، قیمت عمده فروشی در حدود ۰/۳۶ درصد افزایش خواهد یافت. علاوه بر این، اگر قیمت سر مزرعه یک درصد افزایش یابد، قیمت خرده فروشی در حدود ۰/۰۸کاهش خواهد یافت. نتایج همچنین نشان داد که نوسانات خرده فروشی و عمده فروشی تاثیرات مثبتی بر نوسان قیمت سر مزرعه از خود نشان می‌دهند (به ترتیب ۰/۵۰ و ۰/۳۱). علاوه‌براین، نوسان قیمت خرده فروشی بیش از همه به نوسان قیمت عمده فروشی حساس است و حساسیت نوسان قیمت در سطح خرده‌فروشی از از سایر سطوح بازار بیشتر است (در حدود ۰/۵۶). در نهایت، به منظور افزایش شفافیت اطلاعات و افزایش کارایی انتقال قیمت در بازار برنج کامفیروزی، پیشنهاد شد که تعاونی های بازاریابی این محصول افزایش یابد و بیش از پیش حمایت شود.

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