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Price Transmission, Threshold Behavior and Asymmetric Adjustment in Iranian Poultry Market

Research Article

M. Kavoosi Kalashami[1*], P. Khaligh Khiyavi[2] and M.S. Allahyari[2]

[1] Department of Agricultural Economics, Faculty of Agricultural Science, University of Guilan, Rasht, Iran
[2] Department of Agricultural Management, Rasht Branch, Islamic Azad University, Rasht, Iran

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*Correspondence E-mail: mkavoosi@guilan.ac.ir

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ABSTRACT

The Iranian poultry sector has experienced many significant structural changes in recent years. Such changes may have influenced price dynamics and transmission of shocks through marketing channels especially on retail markets. This paper investigate price transmission, threshold behavior and asymmetric adjustment in poultry sector of Ardebil (AR), east Azerbaijan (EA) and west Azerbaijan (WA) provinces using weekly price data for the period covering 1998 through 2012. Our analysis uses a threshold cointegration model that permits asymmetric adjustment to positive and negative price shocks. R software is used for data analyzing. Main findings reveal existence of asymmetry in price transmission for all markets. Based on minimizing of the sum of squared error (SSR) criterion the estimated threshold for EA-AR, WA-AR and EA-WA markets are (0.38, 1.217), (1.61, 0.211), (0.38, 1.95), respectively. As another try the thresholds are estimated using TVECM methodology and the same results are found.

KEY WORDS asymmetric price transmission, poultry markets, spatial price transmission, threshold vector error correction model.

INTRODUCTION

Short production period, small space needed for a poultry breeding house, higher production in unit area and finally the low price of poultry increased governmental support from the investors in this field after the war between Iran and Iraq. The consumption pattern of Iranian families changed from meat to poultry, influenced by this policy. The import of poultry has raised from 552 tons in 2006 to 19000 tons in 2009.

These great imports to support consumers caused expectation of supply in the market, but in the following year (2009), the rate of import suddenly decreased to 9000 tons. Although the demand in market was increased, sudden change in the policy and reduction of import made the domestic production re sponsible to fulfill this demand.

Domestic producers could not increase their production suddenly; therefore, market encountered with a price shock. As this industry is dependent to inputs from foreign markets, any change in inputs world price is resulted in change in cost of poultry product price. Various studies have been done about the transmission of price, threshold behavior, and asymmetric adjustments. Ward (1982) studied the asymmetric price in the retail and wholesale in the vegetables markets using Wolffram (1971) model and found that the vertical transmission of the price was asymmetric and the reduction of price in the wholesale market was transmitted more to the retail market than did the increase in the price. Kinnucan and Forker (1987) studied the price transmission from the farm to the retail for four dairy products including butter, cheese, milk and ice cream in the United States using Houck (1997) approach and found that the

process of price transmission from the farm to the retail was asymmetric.

Bernard and Willet (1996) studied the asymmetric price adjustments for broiler market in the United States and concluded that increased price in the wholesale was transmitted more quickly and complete to the retail than did the decrease in the price.

Using Wolffram (1971) standard model, Cramon-Taubadel (2000) studied the asymmetric price adjustments between the prices of producers and wholesale markets for pork in Germany and concluded that the wholesale prices reacted more rapidly to the positive shocks than to the negative shocks originating at the farm level. Goodwin and Holt (1999) evaluated the price transmission in the beef markets using asymmetric threshold error correction models and found the price transmission in the pork market.

Goodwin and Harper (2000) studied the relationship between farms, wholesale and retail markets in the U.S. pork science 1987 to 1998 using weekly price data and threshold co-integration model. The asymmetry and the price adjustments patterns were determined one-way. Information tended to flow from the farm to the wholesale and retail markets. Goulven (2001) analyzed the pork market in two northern and southern regions of Vietnam. He used Houck approach and error correction in his study and concluded that in the northern region which was a private market, long-term adjustment was not observed between the producer prices and retail prices and the transmission of prices between these levels was asymmetric. However, in the southern region of Vietnam, with a governmental market, although fluctuations in the producer prices did not transmit to the retail market during a week, price adjustment in this market was asymmetric.

Aguiar and Santana (2002) studied the mechanism of price transmission in Brazil for three groups of agricultural products including tomato and onion (perishable products traded in the competitive market), coffee powder and milk powder (storable products traded in the monopolistic market), and rice and beans(storable products traded in the competitive market). Using approach Houck, they came to the conclusion that the price increase in the tomato, milk powder, coffee powder, and beans was asymmetric, but it was symmetric in the cases of the onion and rice.

Girapunthoug *et al.* (2003) analyzed the price transmission between producer levels, wholesale, and retail in the US fresh tomato market. They concluded that prices were transmitted from producer to the wholesale and then to the retail.

Moreover, the wholesale prices were adjusted more rapidly in comparison with the farm prices and also retail prices were adjusted more rapidly in comparison with the increase in the wholesale prices. Capps and Sherwell (2005) studied the asymmetry between producer prices and retail for the liquid milk products in seven US states (Atlanta, Boston, Chicago, Dallas, Hartford, Seattle, Louis). They used Houck and error correction methods. Their findings revealed that the asymmetric transmission of the milk price.

Hansen and Seo (2002) developed a maximum likelihood based estimation theory for the multivariate threshold error correction model with the unknown co-integration vector. They also provided statistics and asymptotic theory for testing the existence of a threshold effect in the two-regime ECM. Some studies developed a Sup-Wald test for the linear no co-integration null hypothesis in a TVECM and derived its null asymptotic distribution.

Spite of importance of co-integration threshold in providing policy information and considerable research attention from researches, there are a few studies on price transmission in Iranian markets. Specifically there are few researches in the poultry market.

Iranian poultry sector has experienced many significant structural changes in recent years. Such changes have influenced price dynamics and transmitted shocks to the marketing channels especially in the retail markets. This paper investigates price transmission mechanism in the poultry sector between three markets (AR, EA and WA) using weekly price data science 1998 to 2012.

MATERIALS AND METHODS

Threshold co-integratition and asymmetric price adjustments

Threshold effects occur when larger shocks (i.e., shocks above some threshold) bring about a different response than do smaller shocks. Balke and Fomby (1997), noting the correspondence between error-correction models representing co-integration relationships and autoregressive models of an error-correction term, extended the threshold autoregressive models to a co-integration framework. Balke and Fomby (1997) also showed that standard methods for evaluating unit roots and co-integration work reasonably well when threshold co-integration is present. Therefore, consider a standard co-integration relationship representing an economic equilibrium:

$$V_t = Y_{1t} - ß_1 Y_{2y} - ß_2 Y_{3t} -...- ß_k Y_{kt}$$

Where:

$$V_t = PV_{t-1} + e_t$$

Co-integration of the Y_{1t} variables depends upon the nature of the autoregressive process for V_t as P approaches 1, deviations from the equilibrium become non stationary and thus the variables are not co-integrated. Balke and Fomby

(1997) extend this simple framework to the case where v, follows a threshold auto regression:

$$p = \begin{cases} p^{(1)} & \text{if } |v_{t-1}| \leq c \\ p^{(2)} & \text{if } |v_{t-1}| > c \end{cases}$$

Where:
c: represents the threshold which delineates alternative regimes.

A common case is that of $P^{(1)}= 1$, which implies that the relationship for small deviations from equilibrium is characterized by a random walk (i.e., a lack of co-integration). This simple framework is easily extended to permit multiple thresholds, implying multiple parametric regimes and thus allowing asymmetric adjustment (Balke and Fomby, 1997). In the case of k thresholds, k + 1 different regime are implied, each having a unique set of parameters and implying its own dynamics for the system. Multiple thresholds allow one to model asymmetries in relationships among the variables as different regimes may correspond to positive versus negative shocks. Our analysis considers a case of two thresholds (C_1 and C_2), which implies three regimes. In this case, an equivalent vector error correction representation of the threshold model is given by:

$$\Delta y_t = \begin{cases} \sum_{t=1}^{p} \gamma_i^{(1)} \Delta y_{t-1} + \theta^{(1)} v_{t-1} + \varepsilon_t^{(1)} & \text{if } v_{t-1} < c_1 \\ \sum_{t=1}^{p} \gamma_i^{(2)} \Delta y_{t-1} + \theta^{(2)} v_{t-1} + \varepsilon_t^{(2)} & \text{if } c_1 \leq v_{t-1} \leq c_2 \\ \sum_{t=1}^{p} \gamma_i^{(3)} \Delta y_{t-1} + \theta^{(3)} v_{t-1} + \varepsilon_t^{(3)} & \text{if } v_{t-1} > c_2 \end{cases}$$

Where:
ϵ: is a mean zero residual.

Once the presence of threshold effects is confirmed, some parametric estimation strategy must be considered to estimate the threshold. Two-dimensional grid search is used to estimate the thresholds C_1 and C_2 which define the three regimes.

Two alternative grid search techniques have been proposed. Obstfeld and Taylor (1997) use a grid search to find the threshold which maximizes a likelihood function. Balke and Fomby (1997) use a grid search which minimizes a sum of squared error criterion. The latter method is used in this paper. Estimation of the threshold with given co-integrating values is done for 1 and 2 threshold. Threshold autoregressive (TAR) model can be written in a usual regression form as:

$Y_t= I_1(\mu_L+P_{1,1}Y_{t-1}+...+P_{L,P}Y_{t-P}M) + I_M(\mu_M+P_{M,1}Y_{t-1}+\ldots+P_{M,P}MY_{t-P}M) + I_H(\mu_H+P_{H,1}Y_{t-1}+\ldots+P_{H,P}MY_{t-P}M)$

Where:
I_a: dummy functions that take either 0 or 1 depending on if $Y_{t-1} \epsilon$ a.
a: L, M or H.

$$I_a = \begin{cases} 1 & \text{if } y_{t-1} \in a \\ 0 & \text{otherwise} \end{cases}$$

Hence, to obtain an estimator minimizing the sum of squares or maximizing the log-likelihood, an analytical form can't be derived, nor can usual optimization algorithms be used, as the objective function is highly erratic. A solution is obtained through concentration of the objective function. As the slope estimators given a threshold are OLS, one can reduce the problem by concentrating out the minimization problem through ß(θ) and the corresponding sum of residual squares SSR(θ) The objective function becomes:

$\hat{\theta} = \arg\min SSR(\vartheta)$

Minimization of 5 is done through a grid search: the values of the variable are sorted, a certain percentage of the first and last values is excluded to ensure a minimal number of observations in each regime, the SSR is estimated for each selected value and the one that minimize the SSR is taken as the estimator. This method has received different names in the literature such as concentrated LS, conditional LS.

Threshold vector error correction

Estimation of the threshold and co-integrating parameters could be done in the long-run relationship and those estimates plugged into the TVECM, as the Engle-Granger (1987) advocates for the linear case.

Balk and Foby (1997) mention that the super-convergence of the OLS estimator in the LR still holds when the residuals follow a SETAR process under the condition. Rather, Hansen and Seo (2002) study estimators directly based on the TVECM. Hansen and Seo (1997) derive a maximum-likelihood (ML) estimator and use a two-dimensional grid search for simultaneous estimation of $\hat{\theta}$ and $\hat{\gamma}$. This two-dimensionality can't be avoided as the parameters can't be exprγessed as functions each of the other one: for each co-integrating value the ECT will be different. For θ, the grid is restricted to the existing values of the ECT, with exclusion of the upper and lower ranges. For the co-integrating value, HS suggest to conduct the search based on a confidence interval obtained in the linear

model. When the two values are given , the slope and speed adjustment parameters can be concentrated out and the estimator is simply OLS (though HS depict it as MLE, it is only MLE as starting values for the algorithm are based on the linear MLE estimate).

This method can be done in a simple bivariate model without intercept in the co-integrated relationship, but becomes intractable with more than two co-integrating relationships.

This is called co-integration with threshold effect framework, where an external variable rather than the ECT is taken as transition variable, estimation is highly simplified as the interdependency between the ECT term and the threshold variable is ruled out. Estimation of multivariate VECM with many co-integrating relationships is then feasible, the grid search being conduced only over the threshold parameter space (Krishnakumar, 2009).

RESULTS AND DISCUSSION

Variables used in this study included data of the poultry price in three provinces including Ardebil, east Azerbaijan and west Azerbaijan science 1998 to 2012. In each year near the holy month of Ramadan (fasting month of Moslems), due to the summer price fluctuations and increased demand, there is a need for import.

East Azerbaijan province has the fifth rank among the producers of poultry (3.2%) and is considered one of the production poles in Iran (Statistics of Jihad-e-Agriculture Organization of East Azarbaijan, 2012).

Statistics of production of animal products of Ardebil province during 1986-2006 show that the rate of poultry production has increased from 7471 tons to 19139 tons. This is a great success. Poultry production was 21978 tons in 2012 (Statistics of Jihad-e-Agriculture Organization of Ardebil, 2012).

First, stationary of the price series are tested by augmented dickey-fuller (ADF), phillips-perron (PP), Elliot-Rothenberg-Stock point optimal (ERS), Kwiatkowski *et al*. (1992) and NG-Perron test and testing for the co-integration relationships are done using Johansen's.

A two-dimensional grid search is then conducted to define two thresholds. In particular, the purpose of this research is finding the first threshold between 5 percent and 95 percent of the largest (in absolute value) negative residual. Moreover, the second threshold between 5 percent and 95 percent of the largest positive residual is searched using the same method.

The error-correction model was then estimated conditional on the threshold parameters. Findings of these tests rejected the stationary hypothesis and the unit root hypothesis is confirmed completely.

The tests confirmed the existence of a unit root in the price series under consideration and the entire price series are integrated in order one I(1).

Examining stationary all the)variables stationarystudied time seriesare integrated in order one I(1) and had the (precondition needed for cointegration test, the Johansson co-integration test was done.

Findings show that there is a long-run relationship between the poultry markets in the provinces of Ardebil, east Azerbaijan and west Azerbaijan. The poultry price fluctuations in each province are transmitted to the prices in the other studied province. Estimation is discussed first in the long-run relationship for the threshold and slope parameters, with first one and then two thresholds. To achieve this goal, R software was used.

Percentage of critical values is excluded and research is done between minimum observations in or around determined space.

First, the first threshold is examined by two regimes. If the first threshold is admitted, the presence of the second threshold with three regimes is examined. In verifying relationships, maximum auto regression for all regimes is considered 1 and vector of possible threshold delay (the delay) is considered 1 and trimming parameter indicating the minimal percentage of observations in each regime (trim) is considered 0.15.

As pointed out by Enders (2004), a strong threshold effect will result in a sharp U shaped grid search. Once the threshold has been estimated, it can be plugged into the SETAR function. One can thus obtain the slope estimates and their asymptotic P-values (Enders, 2004). To study Ardebil and east Azerbaijan markets, search is done by 150 possible threshold values in regimes with enough amounts of observation (15 per cent).

The ratio of points in low and high regimes was respectively 21.97 per cent and 78.03 per cent of observation. To study Ardebil and west Azerbaijan markets, search is done by 156 possible threshold values in regimes with enough amounts of observation (15 per cent).

East Azerbaijan and west Azerbaijan markets, search is done by 134 possible threshold values in regimes with enough amounts of observation (15 per cent). Admitting the first threshold, two- threshold search is done using SETAR model. The ratio of points in low and high regimes was respectively 15 per cent and 18 per cent of observation. To study Two thresholds based on minimum sum of squared error criterion are determined 0.38 and 1.217 for AR- EA markets, 0.21 and 1.161 for AR-WA markets and 0.338 and 1.195 for EA-WA markets.

Table 2 shows findings of estimated thresholds of SETAR model in regimes between markets under investigation.

Table 1 Unit root tests results

Test series		AR	EA	WA
Levels	ADF	-1.832	-1.002	-0.823
	PP	-1.915	-1.265	-0.724
	KPSS	2.742***	2.749***	1.21***
	ERS	17.309	21.912	21.018
	NG-Perron	-0.592	1.199	-0.236
First differences	ADF	-5.986***	-5.484***	-4.256
	PP	-5.443***	-5.112***	-4.008***
	KPSS	0.084	0.097	0.065
	ERS	1.210***	2.286***	2.498***
	NG-Perron	-75.319***	-49.988***	-15.458

*** (P<0.01).

ADF: augmented dickey-fuller; PP: phillips-perron; ERS: elliot-rothenberg-stock point optimal; AR: Ardebil; EA: east-Azerbaijan and WA: west-Azerbaijan.

Table 2 Estimated thresholds of SETAR model in regimes between markets under investigation

Market	Regime I	Regime II	Regime III
AR-EA	$(-\infty < V_{t-1} \leq 0.38)$	$(0.38 < V_{t-1} \leq 1.217)$	$(1.217 < V_{t-1} < \infty)$
AR-WA	$(-\infty < V_{t-1} \leq 0.21)$	$(0.211 < V_{t-1} \leq 1.161)$	$(1.161 < V_{t-1} < \infty)$
EA-WA	$(-\infty < V_{t-1} \leq 0.33)$	$(0.338 < V_{t-1} \leq 1.195)$	$(1.195 < V_{t-1} < \infty)$

AR: Ardebil; EA: east-Azerbaijan and WA: west-Azerbaijan.

TVECM function is used to calculate TVECM in R software.The function of TVECM allows estimating a bivariate TVECM with two or three regimes with the OLS like estimator.

It should be emphasized here that there is no difference, except in the starting value, between the OLS and MLE estimator, as conditional on the threshold and the co-integrating value, the MLE estimator is simply LS. Note that a plot of the search is given automatically as this has proved in practice to be a useful tool, experience showing that the confidence interval of co-integration values is very low and only a local minimum which is easily identifiable in the figure is obtained. Findings obtained from the figure for the markets under investigation show that threshold parameter and the best co-integration values for EA-AR markets are respectively 0.38 and 0.85, for WA-AR markets are respectively 0.211 and 0.87, for EA-WA markets are respectively 0.338 and 0.86.

CONCLUSION

Price transmission, threshold behavior, and asymmetric adjustments in the poultry market of Ardebil, East Azerbaijan and west Azerbaijan provinces were studied using threshold co-integration. Threshold co-integration model that permits asymmetric adjustment to the positive and negative price shocks, R software are used for data analyzing and we found there is important asymmetries such as reveal asymmetric transmission existence and threshold behavior in poultry markets between AR-ER, AR-WA and EA-WA. Minimizing the sum of squared error criterion method used to specify threshold's between markets and these values are: EA and AR (0.38, 1.217), WA and AR (1.61, 0.211), EA and WA (0.38, 1.95). And the TVECM-methodology is applied to calculate optimal values of the threshold parameters and convergence for provinces and-their values are: EA and AR (0.38, 0.85), WA and AR (0.87, 0.211), EA and WA (0.338, .86). Investment in poultry industry has good productivity, but due to the great and-unexpected fluctuations in the price of its products, production in this sector are always accompanies with a high risk. Therefore, considering relative stationary price and prediction of the price of poultry and its products can have an important role in regulating policy making to control the instability of prices and decreasing the market risk. Due to the great price fluctuations of poultry in Iran in recent years, the problem should be investigated both in production and distribution sectors.

In the supply sector of the meat needed for the market, because animal affairs support corporation of the Ministry of Jihad-e-Agriculture has the responsibility to order and supply the meat needed for the market, it also should accept the responsibility of regulating the market when the market encounters with sudden shocks of demand like during Gorban festival, Shabanie festival, and especially during the holy month of Ramadan.

It should prevent the noticeable increase in the prices through providing the necessary supply. Moreover, the government should do predictions using statistical economic evaluation and store enough to face these shocks. In the consumption sectors, society should have a better view of frozen chicken and have interest to buy it. In other words, if people provide part of their needs or their extra daily needs through frozen chicken, they will have an important role in the stabilization of the poultry price and preventing increase it price.

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انتقال قیمت، رفتار آستانه‌ای و تعدیل نامتقارن در بازار مرغ ایران

م. کاوسی کلاشمی*، پ. خلیق خیاوی و م.ص. اللهیاری

چکیده

بخش مرغ ایران تغییرات ساختاری معنی دار بسیاری را طی سال‌های اخیر شاهد بوده است. چنین تغییراتی ممکن است پویایی‌های قیمت و انتقال شوک‌ها در کانال‌های بازاریابی را به خصوص در بازارهای خرده فروشی تحت تأثیر قرار دهد. این پژوهش انتقال قیمت، رفتار آستانه‌ای و تعدیل نامتقارن قیمت در بخش مرغ استان‌های اردبیل (AR)، آذربایجان شرقی (EA) و آذربایجان غربی (WA) با استفاده از داده‌های هفتگی قیمت طی سال‌های ۱۹۹۸ تا ۲۰۱۲ مورد بررسی قرار داده است. تحلیل ما از یک الگوی همگرایی آستانه‌ای بهره برده که امکان تعدیل نامتقارن نسبت به شوک‌های مثبت و منفی قیمت را فراهم می‌آورد. نرم‌افزار R به منظور تجزیه و تحلیل داده‌ها مورد استفاده قرار گرفته است. یافته‌های اصلی بیانگر وجود عدم تقارن در انتقال قیمت برای تمام بازارها است. براساس کمینه‌سازی شاخص مجموع مربعات خطا (SSR) آستانه‌های برآوردی برای بازارهای EA-AR، WA-AR و EA-WA به ترتیب برابر با (۱/۲۱۷، ۰/۳۸)، (۰/۲۱۱، ۱/۶۱)، (۱/۹۵، ۰/۳۸) می‌باشد. در تلاشی دیگر آستانه‌ها با استفاده از روش‌شناسی TVECM برآورد شد و نتایج مشابه‌ای حاصل شد.

کلمات کلیدی انتقال نامتقارن قیمت، بازارهای مرغ، انتقال قیمت مکانی، الگوی تصحیح خطای برداری آستانه‌ای.