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Investigation the Transmission of International Prices of Some Selected Agricultural Products (meat and chicken) to Iranian Domestic Markets The Application of Maximum Entropy Method

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ABSTRACT

This paper analyzes the price transmission effects from international markets to domestic markets for two agricultural products (meat and chicken) in IRAN. For this purpose we estimate the elasticities of substitution between imported and domestically produced goods (Armington Elasticity). Annual data(1992-2009) are analyzed with an econometric framework based on the Maximum Entropy. Result show that there is a substitution relationship between imported and domestic chicken but for meat, its vice versa.

KEYWORDS: Maximum Entropy (ME); Armington Elasticity; IRAN

1. INTRODUCTION

A wide economic literature has studied the relationship between world and domestic prices .From 2007 onwards , food prices surged rapidly and have led to food crisis in 2008 . So during the food crisis the international price of main agricultural commodities increased more than doubled . This food price escalation has raised serious concerns about its adverse impacts on the poor in developing countries. As the international price of food increases, it is expected that the domestic consumer price of basic food items also increase.

Various studies have been conducted in different countries about the world price transmission to domestic markets such as:

Kaspersen *et al* (2010): Investigates price transmission for agricultural commodities between world markets and the Ugandan market in an attempt to determine the impact of world market prices on the Ugandan market. For this purpose a Vector Autoregressive (VAR) Model is used. Result indicates that sorghum price transmission , are not integrated into world markets, and oil prices are a very determining factor for price transmission within the country. But for robusta coffee , prices in Uganda were strongly connected to world prices, and did not depend on the oil price. This indicates that if high demand appears in world markets, such effects could transmit to local markets.

Dawe (2008): Analyzes that have recent increases in international cereal prices been transmitted to domestic economies in seven large Asian countries? This research have several conclusions. First, the data show that the increases in world cereal prices have been accompanied by a real depreciation of the US dollar. Second, domestic commodity specific policies in several of these Asian countries have stabilized domestic prices relative to the change in world prices. This has been especially true for rice and after that for wheat. third, for the specific cases, producer or farmgate prices have changed by approximately the same percentage as consumer prices . In these Asian countries, domestic markets seem to be transmitting price changes between farmers and Consumers rather efficiently.

Kilima(2006): Investigate which world market price changes are transmitted through changes in border prices in to local producer prices for four agricultural product(sugar, cotton, wheat and rice) markets in tanzania. The statistical analysis finds that, in general, tanzanian border and world market prices for these products do not move closely together, Although there is evidence that border prices are influenced by world market price levels but not vice versa.

Brooks *et al* (2005): They study the transmission of world prices to Brazil markets . For this purpose they use Brazilian monthly prices for wheat, maize, rice, dry beans, soybeans, coffee, poultry, pig meat and beef (Logs) from january 1989 to october 2003. Cointegration tests for Brazilian prices support the hypothesis of

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discontinuous price transmission and the presence of different regimes following policy reforms in the Mid-1990s (with differences amongst the different markets). Once threshold effects are taken in to account, prices show a much faster rate of adjustment outside the bound.

Baek and Koo(2005): examines price dynamics in the U.S. and canadian hard red spring and durum wheat markets by using a Vector Error-Correction Model and for this purpose thay use monthly FOB prices for the US and Canadian durum and hard red spring prices, from July 1979 to June 2002. Result show that the hard red wheat exporting industry and Canada have been the price leader in north American wheat markets.

2. MATERIAL AND METHODS

Armington (1969) assumed that, besides being differentiated by kind, goods are also differentiated by their Place of production .So the Armington Elasticity, measures the degree of substitution between domestic and imported goods, is a key behavioral parameter that drives the results of interest to policymakers. So the higher value of this parameter, show the closer degree of substitution. In other words, a high value of this parameter means that imports and domestic supplies are considered by purchasers to be Identical , so in here Armington Elasticity is :

$$\sigma = \frac{\partial \ln \frac{M_{i,t}}{D_{i,t}}}{\partial \ln \frac{p_{Di,t}}{p_{Mi,t}}}$$

where :

Mi→amount of imports for commodity i for each year

Di→ amount of domestic production for commodity i for each year

p_{Di}→ domestic price of commodity i

p_{Mi}→ import price of commodity i

σ→ Armington Elasticity

And study of Warr (2005) show that the higher the Armington Elasticity, Implied the higher the value of the pass-through elasticity, other things being equal. It means that the higher Armington Elasticity show the higher degree of price transmission from world to domestic market.

2.1) Maximum Entropy (ME)

The origin of Entropy dates back to 19th century. In 1948, the Entropy concept as a measure of uncertainty was developed by shannon. After in 1957, Jaynes formulated Shannon's Entropy as a method for estimation and inference and so called Maximum Entropy (ME) principle. More recently, Golan *et al* (1996) developed the Generalized Maximum Entropy (GME) estimator and started a new discussion in econometrics.

Suppose that in this study the econometric model (or Base Model) specified as:

$$\ln\left(\frac{M_{i,t}}{D_{i,t}}\right) = \beta_1 + \beta_2 \ln\left(\frac{p_{Di,t}}{p_{mi,t}}\right) + e_t$$

So if we show $\ln\left(\frac{M_{i,t}}{Di_{,t}}\right)$ with y and $\ln\left(\frac{p_{Di,t}}{p_{mi,t}}\right)$ with x then we have:

$$y_t = \beta_1 + \beta_2 x_t + e_t$$

Where t (=1, 2 ,…,T) is the number of data points, β_1 the constant term, β_2 the Armington Elasticity, and e the noise associated to each equation.

In order to specify the (Generalized) ME problem, consider the parametric space supports $z_k=(z_{k1},\ldots, z_{kM})$, k=1,2 , M=5 with corresponding probabilities $\rho_K = (\rho_{K1}, \ldots, \rho_{KM})$, for the vector of parameters $\beta = (\beta_1, \beta_2)$ and the support $v_t=(v_1,\ldots, v_j)$, J=3, with corresponding weights $w_t=(w_{1t},\ldots, w_{jt})$..Then we can state the ME problem as:

$$\max_{p,w} H(p,w) = -\sum_{k=1}^{K}\sum_{m=1}^{M} \rho'_{km} \times \ln(p_{km}) - \sum_{t=1}^{T}\sum_{j=1}^{J} w'_{tj} \ln(w_{tj})$$

Subject to the constraints:

$$\sum_{k=1}^{K}\sum_{m=1}^{M} \rho'_{km} \cdot z_{km} \cdot x_{tk} + \sum_{j=1}^{J} w'_{tj} \cdot v_{tj} = y_t \qquad \text{for } t = 1,2,\dots,T$$

$$\sum_{m=1}^{M} \rho_{km} = 1 \qquad \text{for } t = 1,2,\dots,k$$

$$\sum_{j=1}^{J} w_{tj} = 1 \qquad \text{for } t = 1,2,\dots,T$$

After estimation of probabilities with Non-Linear Programing (NLP) , we can estimate the β coeficint as:

$$\hat{\beta}_k = \sum_{m=1}^{M} \rho'_{km} \cdot z_{km} \qquad \text{for } k = 1,2,\dots,k$$

$$\hat{u}_t = \sum_{j=1}^{J} w'_{tj} \cdot v_{tj} \qquad \text{for } t = 1,2,\dots,T$$

3. RESULTS

In this study we estimate Armington Elasticity for two agricultural products, this products are(Meat and Chicken)

for this purpose three models are used :

1) Base Model
2) Partial Adjustment Model
3) Error Correction Model

According to Golan *et al* and as a general rule we select the estimate from support with Normalized Entropy $s(\hat{\rho})$ nearest to 0.999.

$$s(\hat{\rho}) = \frac{-\sum_{k=1}^{K}\sum_{m=1}^{M} \rho'_{km} \times ln(p_{km})}{k \log(M)}$$

first we estimate the Base Model (BM) to obtain Armington Elasticities. according to the above specifications.

Table 1) Armington Elasticity For Meat in Base Model

Parameter Supports	A.E	Entropy Estimated	Normalized Entropy
$[-10 \quad -5 \quad 0 \quad 5 \quad 10]$	-0.55	21.867	0.995
$[-20 \quad -10 \quad 0 \quad 10 \quad 20]$	-0.55	21.877	0.998
$[-40 \quad -20 \quad 0 \quad 20 \quad 40]$	**-0.56**	**21.88**	**0.999**

Source: Authors' *Computation*

As it can be seen in table 1 the elasticity is negative , that it means there is no Substitution Relationship between the Import product and domestic products . So increasing in domestic price doesn't result increasing in import amount. It shows that something that is important for consumer is the quality of products. So result show that as consumer point of view the domestic fresh meats is better than frozen imported meats.

Table 2) Armington Elasticity For Chicken in Base Model

Parameter Supports	A.E	Entropy Estimated	Normalized Entropy
$[-10 \quad -5 \quad 0 \quad 5 \quad 10]$	0.08	21.43	0.996
$[-20 \quad -10 \quad 0 \quad 10 \quad 20]$	0.25	21.51	0.997
$[-40 \quad -20 \quad 0 \quad 20 \quad 40]$	0.32	21.53	0.998
$[-60 \quad -40 \quad 0 \quad 40 \quad 60]$	**0.32**	**21.53**	**0.999**

Source: Authors' *Computation*

In table 2; It can be seen that the elasticity chicken are small and the results also indicate that substitution possibilities between this Product from different sources are indeed limited. So domestic and import chicken are imperfect substitutes. So because of this reason the pass through effect is also became small.

In the next step we estimate the Partial Adjustment Model with the following specification for each products:

$$ln\left(\frac{M_{i,t}}{D_{i,t}}\right) = \beta_1 + \beta_2 ln\left(\frac{p_{Di,t}}{p_{mi,t}}\right) + \beta_3 ln\left(\frac{M_{i,t-1}}{D_{i,t-1}}\right) + e_t$$

Where:

$\beta_2 \rightarrow$ the short run Armington Elasticity

$\frac{\beta_2}{1-\beta_3} \rightarrow$ the long run Armington Elasticity(Hernández 1998, Kapuscinsky *et al* 2004)

Table 3) Armington Elasticity for Meat Estimated in Partial Adjustment Model

Parameter Supports	A.E		Entropy Estimated	Normalized Entropy
	SAE[1]	LAE[2]		
[−10 −5 0 5 10]	-0.62	-1.22	24.293	0.998
[−20 −10 0 10 20]	**-0.62**	**-1.24**	**24.299**	**0.999**

Source: Authors' *Computation*

Result show that (table 3) the elasticities are negative both in short and long run. that it means there is no Substitution Relationship between the Import product and domestic products . So as it can be seen result in the first and second models are the same.

Table 4) Armington Elasticity for Chicken Estimated in Partial Adjustment Model

Parameter Supports	A.E		Entropy Estimated	Normalized Entropy
	SAE	LAE		
[−10 −5 0 5 10]	0.2	2.66	24.56	0.997
[−20 −10 0 10 20]	**0.26**	**3.25**	**24.57**	**0.999**

Source: Authors' Computation

Result show that(table 4) the elasticities are positive both in short and long run. that it means there is substitution relationship between the Import and domestic chicken .Also the long run elasticity is more than short run , it shows that in long run domestic prices are effected from world price more than short run.So as it can be seen result in the first and second models are the same.

In third step we estimate the Error Correction model (ECM) with the following specification for each products.

$$\Delta ln\left(\frac{M_{i,t}}{D_{i,t}}\right) = \beta_1 + \beta_2 \Delta ln\left(\frac{p_{Di,t}}{p_{mi,t}}\right) + \beta_3 ln\left(\frac{M_{i,t-1}}{D_{i,t-1}}\right) + \beta_4 ln\left(\frac{p_{Di,t-1}}{p_{mi,t-1}}\right) + e_t$$

Where:

$\beta_2 \rightarrow$ the Short Run Armington Elasticity

$-\frac{\beta_4}{\beta_3} \rightarrow$ the Long Run Armington Elasticity (Gallaway et al. 2003, Kapuscinsky *et al* 2004)

According to the above Specifications, Result Show in below tables:

Table 5) Armington Elasticity for Meat Estimated in Error Correction Model

Parameter Supports	A.E		Entropy Estimated	Normalized Entropy
	SAE	LAE		
[−10 −5 0 5 10]	-0.41	-0.43	24.301	0.998
[−20 −10 0 10 20]	**-0.42**	**-0.46**	**24.309**	**0.999**

Source: Authors' Computation

As the result show the Parameter Supports are [−20 −10 0 10 20] and like the two last model the long and short run elasticities are negative

Table 6) Armington Elasticity for Chicken Estimated in Error Correction Model

Parameter Supports	A.E		Entropy Estimated	Normalized Entropy
	SAE	LAE		
[−10 −5 0 5 10]	0.34	0.11	24.21	0.992
[−20 −10 0 10 20]	0.5	0.179	24.251	0.997
[−40 −20 0 20 40]	**0.6**	**0.25**	**24.263**	**0.999**

Source: Authors' Computation

[1] - Short Run Armington Elasticity
[2] - Long Run Armington Elasticity

As it can be seen in table 6 the Parameter Supports are $[-40 \quad -20 \quad 0 \quad 20 \quad 40]$; and like the two last model the long and short run elasticities for chicken are positive and the long run elasticity is more than short run elasticity.

4.CONCLUSION

The objective of this paper was to estimate Armington Elasticities for two Agricultural Products(meat and chicken) with application of maximum entropy method in Iran. For this purpose three models is used (Base Model ,Partial Adjustment Model and Error Correction Model),the Result Show that the Armington Elasticities for meat are negative in each three models but for chicken all elasticities is positive . So world prices of chicken effect the Iranian domestic prices of this product specially in long run.

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