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Estimating Iranian Wheat Market (A Comparative Study between ARDL and SUR)

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Abstract

In this study with estimating the econometric pattern of wheat, the affecting element in supply, product, import and consumption can be recognized. Auto regressive distributed lag (ARDL) and seemingly unrelated regressions (SUR) have been used for getting the following results: Price elasticity of demand for wheat is 2/29 and the cross price elasticity of demand between wheat and barley is 1/49. Production function showed that with increasing the area under harvested with 1 percent, the amount of production will increase 0/68 percent. Fertilizer has direct effect in the amount of production in next year. Results of consumption model show that consumption income element in demand model is a small number with positive sign but it is not meaningful. The results of demand elasticity of bread showed that this factor is 0/156. It means that the demand for bread is not very responsive to changes in price. Although results showed increasing the consumption per capita of rice with 1 percent will decrease the consumption per capita of wheat with 0/23 percent. Import model shows that increasing the amount of gross domestic production with 1 percent will increase the amount of demand with 1/1 percent. In this estimation, the coefficient of the price ratios is positive and is opposite the ordinary cases. It is because of the responsibility of government in importing wheat and this activity doesn't relate to domestic price and is related to domestic needs.

Keywords: Auto Regressive Distributed Lag, Cobb Douglas Production Function, Khan Import Function, Nerlove Supply Function, Seemingly Unrelated Regressions, Wheat Market.

Introduction

Among the various economic sectors of a developing country, agricultural sector as the catering agent of the society is of remarkable importance (Akbari & ranjkesh, 2003). Wheat has an outstanding cultivated area among the agricultural products and plays an important role in the people's nutrition. Thus estimating the market of this essential good is important from the view point of econometrics.

Nutrition is a key element to any strategy to reduce the global burden of disease. Wheat, the dominant food crop of Iran, is grown in all the major farming systems prevailing in the country, in most of which crops and livestock are closely related. Self-sufficiency in wheat has been one of the major goals of Iranian agricultural policies since the Revolution of 1979 (piraie, 1994). As a result, the market analyzing of this product can help this sector of production. The objective of this paper is to formulate and estimate an econometric model for the supply, demand, import and product for wheat in Iran.

Literature Review

In this research regarding to its goal that is estimating the econometric model of wheat in Iran, so knowing the studies related to supply, demand, import and production of goods can be useful and can help us for reducing the problems in catching the goal. Taheri et al (2009) in their study, investigated the effects of government protective policies on wheat supply, aria under cultivated and yield in Iran. They used time series data (1973-2006) for calculating nominal rate of protection and then with using ARDL model and Nerlove Model, the effect of protective policies has been estimated. The results show that nominal rate of protection during that time series had negative sign and this means that not only there isn't any protection for this product but also from producing of this product, by the way some taxes has been get. In short run, the real price of wheat doesn't have significant effect on wheat supply increase and in long run real price of wheat, changing technology and aria under cultivation have positive effect on wheat supply. Although results show that nominal rate of protection doesn't have any effect on aria under cultivation and just aria under cultivation in previous year has significant effect on it. Faryadras (2007) in a study estimated the most ideal supply system and agricultural input demand for wheat in Iran. The results show that all elasticities of demand for wheat inputs have negative sign and less than 1 and elasticities of expenditure have positive sign. Noori (2006) in a study investigated the market distortions and its effects on rice supply, demand and import in Iran. For measuring the distortions, he applied the adjusted protection rat (APR). The APR measures the total policy, which combines "direct" effect of sectoral price and trade policies and the "indirect" effect of economy-wide policies, which affect the exchange rate. The results show that distortions have positive effects on domestic supply of rice, because the distortions create greater difference between domestic price and border price that is attractive for producers. The estimated demand function indicated that the distortions have negative effects on per capita consumption of rice, although subsidized rice distribution reduces the impact of the distortions on per capita consumption of rice. The distortions also have negative effects on the import of rice.

Materials and Methods

The model consists of four basic components which explain supply, consumer, producer and import functions. The empirical model consists of four behavioral equations- a domestic supply equation, a production equation, a domestic demand for wheat and an import equation. The empirical model is specified as follows:

$$S_t = a_{10} + a_{11}A_t + a_{12}PFW_{t-1} + a_{13}PFB_{t-1} + a_{14}S_{t-1} + a_{15}SU_t + a_{16}Rain_t + a_{17}T_t + e_{1t} \quad (1)$$

$$Y_t = b_{10} + b_{11}A_t + b_{12}SHIfer_{t-1} + b_{13}Rain_t + b_{14}Seed_t + b_{15}Lab_t + e_{2t} \quad (2)$$

$$Q_t = c_{10} + c_{11}ConI_t + c_{13}Pnan_t + c_{15}QperR_t + c_{17}Q_{t-1} + e_{3t} \quad (3)$$

$$M_t = d_{10} + d_{11}\left(\frac{P_m}{P_d}\right)_t + d_{12}GDP_t + d_{13}Dummy + e_{4t} \quad (4)$$

Where

S_t: wheat supply in period t

Y_t: wheat production in period t

Q_t: wheat consumption in period t

M_t: wheat import in period t

Lagged endogenous variable

S_{t-1}: supply in period t-1

Q_{t-1}: wheat consumption in period t-1

Exogenous variables

A_t: area under harvested in period t

$Rain_t$: the amount of rain in period t

T: Time trend (changes in consumer's taste and preference) in period t

SU_t: the amount of governmental supply of wheat in period t
T: technology
$Seed_t$: seeds that used in wheat production in period t
Lab_t: labor that used in wheat production in period t
$ConI_t$: consumer income in period t
$Pnan_t$: retail price of bread in period t
$QperR_t$: consumption per capita of rice in period t
(Pm/Pd)t: the ratio of import price to domestic price
GDP_t: Iran GDP in period t
Dummy: dummy variable that is a function of the price support improvement in 2004 and the variety of seeds that used since 2003.
Lagged exogenous variables
PFW_{t-1}: the farm price of wheat in period t-1
PFB_{t-1}: the farm price of barely in period t-1
$SHIfer_{t-1}$: fertilizer that used in wheat production in period t-1
A_{t-1}: area under harvested
PPW_{t-1}: wheat producer price in period t-1 [1]
All variables are entered in logarithmic form.

The supply equation in (1) is the Nerlovian (Nerlove, 1983) type of model where the quantity of wheat supplied is regarded as a function of lagged quantity (S_{t-1}), lagged price of wheat (PPW_{t-1}) and lagged of the area under harvested of wheat (A_{t-1}). Area under harvested and the producer price are assumed to be exogenous in the supply equation. Thus the supply equation has two lagged exogenous variable and one lagged endogenous variable. Equation 2 is the production equation for wheat. In this equation we use some available factor inputs that can affect this element. All this factor inputs are expected to have positive sign unless the use of these factors on wheat production has been happened in third sector of production. All these factor inputs assumed to be exogenous in the production function equation. Equation 3 is the consumption equation for wheat that is specified as a function of its retail price (Pwr), the price of substitute goods (barley) (Pjo) and per capita income (conI). In this equation, all the independent variables assumed to be exogenous too. The relation between the retail price of wheat and its consumption expected to be negative in the situation that wheat is a normal good and positive when it is a Giffen good. The sign of barley price expected to be positive and the relation between per capita income and consumption is positive if it is normal good and negative when it is Inferior good. The import demand equation in (4) is the Khan (1975) type of model where the quantity of wheat imported is regarded as a function of import domestic price ratio ((Pm/Pd)), gross domestic production (GDP) and production of wheat (Y). Gross domestic product and import domestic price ratio are assumed to be exogenous in the import demand equation and production of wheat (Y) is assumed to be endogenous. The sign of import domestic price ratio and the quantity of production are expected to be negative and the sign of gross domestic product is expected to be positive if it is normal good and negative when it is Inferior good.

We need to determine the order of cointegration of each variable in applying the cointegration technique However, different tests yield different results, depending on the power of the unit root tests .In view of this problem, Pesaran and Shin (1995) and Perasan et al. (2001) introduce a new method of testing for cointegration. The approach known as the autoregressive distributed lag (ARDL) approach. This method has the advantage of avoiding the classification of

1 We use wheat producer price with one lag because of using nerlove partial adjustment model.

variables into I(1) or I(0) and unlike standard cointegration tests, there is no need for unit root pre-testing(Sharifi-Renani, 2007). However, the ARDL approach is very suitable to modeling the wheat market, because some variables such as wheat supply, area under harvested, the farm price of wheat, wheat production, labor that used in wheat production, consumer income, GDP are I(1) and other variables are I(0)[2].

ARDL Approach

This approach to cointegration was developed by Pesaran et al, (2001). The ARDL approach involves estimating the conditional error correction version of the ARDL model for variable under estimation. The Augmented ARDL (p, q_1, q_2,… q_k) is given by the following equation (Pesaran and Pesaran, 1997; Pesaran and Shin, 2001):

$$\alpha(L,p)y_t = \alpha_0 + \sum_{i=1}^{k} \beta_i(L,q)x_{it} + \acute{\lambda} w_t + \varepsilon_t \qquad \forall_t = 1,2,\dots,n \quad *$$

Where

$$\alpha(L,p) = 1 - \alpha_1 L - \alpha_2 L^2 - \dots - \alpha_p L^p$$

$$\beta_i(L,q_i) = \beta_{i0} + \beta_{i1}L + \beta_{i2}L^2 + \dots + \beta_{iq_i}L^{q_i} \qquad \forall_i = 1,2,\dots,k$$

y_t is an independent variable,α is the constant term, L is the lag operator such that $Ly_t = y_{t-1}$, w_t is s×1 vector of deterministic variables such as intercept term, time trends, or exogenous variables with fixed lags. The log-run equation with respect to intercept and time trend can be written as follows:

$$y = \alpha_0 + \alpha_t + \sum_{i=1}^{k} \beta_i x_i + \gamma w_t + \eta_t \qquad \text{Where: } \alpha = {\alpha_0}/{\alpha(L,p)}$$

The long- term elasticities are estimated by:

$$\phi_i = \frac{\widehat{\beta_i}(l.\hat{q})}{\alpha(l,\hat{p})} = \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} + \dots + \hat{\beta}_{i\hat{q}}}{1 - \hat{\alpha}_1 - \hat{\alpha}_2 - \dots - \hat{\alpha}_p} \quad \forall_i = 1,2,\dots,k$$

Where $\hat{p}$ and $\hat{q}_i, i = 1,2,\dots,k$ are the selected (estimated) values of $\hat{p}$ and $\hat{q}_i, i = 1,2,\dots,k$. The long run coefficients are estimated by:

$$\pi = \frac{\hat{\lambda}(\hat{p},\hat{q}_1,\hat{q}_2,\dots,\hat{q}_k)}{1 - \hat{\alpha}_1 - \hat{\alpha}_2 - \dots - \hat{\alpha}_p}$$

Where $\hat{\lambda}(\hat{p},\hat{q}_1,\hat{q}_2,\dots,\hat{q}_k)$ denotes the OLS estimates of λ in the equation * for the selected ARDL model.

The ARDL approach involves two steps for estimating long run relationship (Pesaran et al., 2001). The first step is to investigate the existence of long run relationship among all variables in the equation under estimation. The ARDL method estimates (p + 1)k number of regressions in order to obtain optimal lag length for each variable, where p is the maximum number of lags to be used and k is the number of variables in the equation. The second step is to estimate the long-run relationship and short-run bi-directional causality between running actors. We run second step only if we find a long run relationship in the first step (Shahbaz et al., 2008). This study uses a more general formula of ECM with unrestricted intercept and unrestricted trends (Pesaran et al., 2001):

$$\Delta y_t = c_0 + c_1 t + \pi_{yy} y_{t-1} + \pi_{yxx} x_{t-1} + \sum_{i=1}^{p-1} \acute{\psi}_i \Delta z_{t-1} + \acute{w} \Delta X_t + \mu_t$$

2 For determining the order of integration of each variable/series we performed the ADF test to test the null of unit root against the alternative of stationary both at level and first differences of each variable/series. The estimated ADF statistics are reported in table 1. For finding the optimal number of lag hanon queen criteria has been used.

Where c0≠ 0 and c1≠ 0. The Wald test (F-statistics) for the null hypothesis$H_0^{\pi_{yy}}: \pi_{yy} = 0$, $H_0^{\pi_{yx.x}}: \pi_{yx.x} = 0$ and alternative hypothesis '$H_1^{\pi_{yy}}: \pi_{yy} \neq 0$,$H_0^{\pi_{yx.x}}: \pi_{yx.x} \neq 0$. Hence the joint null hypothesis of the interest in above equation is given by:$H_0 = H_0^{\pi_{yy}} \cap H_0^{\pi_{yx.x}}$, and alternative hypothesis is correspondingly stated as: $H_0 = H_1^{\pi_{yy}} \cap H_1^{\pi_{yx.x}}$.

The asymptotic distributions of the F-statistics are non-standard under the null hypothesis of no cointegration relationship between the examined variables, irrespective of whether the variables are purely I(0) or I(1), or mutually co-integrated. Two sets of asymptotic critical values are provided by Pesaran and Pesaran (1997). The first set assumes that all variables are I(0) while the second set assumes that all variables are I(1). If the computed F-statistics is greater than the upper bound critical value, and then we reject the null hypothesis of no cointegration and conclude that there exists steady state equilibrium between the variables. If the computed F-statistics is less than the lower bound critical value, then we cannot reject the null of no cointegration. If the computed F-statistics falls within the lower and upper bound critical values, then the result is inconclusive (Shahbaz et al., 2008). After the discussion of theoretical model regarding the ARDL technique, we employed the Pesaran et al (2001) procedure to investigate the existence of a long-run relationship in the form of the unrestricted error correction model for each variable as follows regarding our issues:

Ordinary Least Squares Approach

The general approach of multivariate single-equation regression models requires that there is only one dependent variable in each regression, i.e.

$$y_i = X_i \beta_i + \varepsilon_i$$

where y_i is the a vector of the N observations of the ith dependent variable, X_i is an $N \times k_i$ matrix of the regressors of the ith equation (including potentially a column of ones), βi is the vector of the k_i parameters of the ith equation, k_i is the number of regressors (including potentially a constant) of the ith equation, and ε_i is the vector of error terms of the ith equation, which is assumed to be normally distributed. The OLS estimator assumes that all coefficients in the model are unknown and are estimated from data by$\beta_i^{OLS} = (\acute{X}_i X_i)^{-1} \acute{X}_i y_i$.

If the parameters of each equation are estimated separately by OLS, a potential correlation between the equations is not taken into account. Hence, it is implicitly assumed that the error terms are not contemporaneously correlated, i.e. $E(\varepsilon_{it}\varepsilon_{jt}) = 0 \; \forall i \neq j$, where subscripts i and j indicate the equation and subscript t denotes the observation.

SUR Approach

Zellner (1962) developed the Seeming Unrelated Regression (SUR) estimator for estimating models with p > 1 dependent variables that allow for different regressor matrices in each equation (e.g. $X_i \neq X_j$) and account for contemporaneous correlation, i.e. $E(\varepsilon it \varepsilon jt) \neq 0$. In order to simplify notation, all equations are stacked into a single equation:

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_p \end{bmatrix} = \begin{bmatrix} X_1 & 0 & 0 & 0 \\ 0 & X_2 & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & X_p \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_p \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_p \end{bmatrix}$$

that can be re-written as Y =Xβ +ε , where the $Y = (y_1', y_2', \dots, y_p')'$ is a vector of all stacked dependent variables, X is a block diagonal design matrix with the i^{th} design matrix X_i on the ii^{th}

block, $\beta = (\beta_1', \beta_2', \dots, \beta_p')'$ is the vector of the stacked coefficient vectors of all equations, the total number of parameters estimated for all p submodels is $K = \sum_{i=1}^{p} k_i$ and $\varepsilon = (\varepsilon_1', \varepsilon_2', \dots, \varepsilon_p')'$ is the vector of the stacked error vectors of all equations.

The same estimates as by separate single-equation OLS estimations can be obtained by an OLS estimation of the entire system of equations, i.e. $\beta^{OLS} = (X'X)^{-1}X'y$. The SUR estimator that accounts for interrelations between the single submodels can be obtained by $\beta^{SUR} = [\acute{X}\Omega^{-1}X][\acute{X}\Omega^{-1}Y]$, where Ω^{-1} is a weighting matrix based on the covariance matrix of the error terms $\sum$. This covariance matrix $\sum = [\sigma_{ij}]$ has the elements $\sigma_{ij} = E[\varepsilon_{in}\varepsilon_{jn}]$, where ε_{in} is the error term of the n^{th} observation of the i^{th} equation. Finally, the inverse of the weighting matrix can be calculated by $\Omega = \sum \otimes I_N$, where I_N is an N × N identity matrix and $\otimes$ denotes the Kronecker product. However, as the true error terms ε are unknown, they are often replaced by observed residuals, e.g. obtained from OLS estimates, i.e. $\hat{\varepsilon}_i = y_i - X_i\beta_i^{OLS}$ so that the elements of the covariance matrix can be calculated by[3]

$$\hat{\sigma}_{ij} = \frac{\hat{\acute{\varepsilon}}_i \hat{\varepsilon}_j}{N}$$

Thus, a SUR model is an application of the generalized least squares (GLS) approach and the unknown residual covariance matrix is estimated from the data (Cadavez, Henningsen, 2011)

Data and estimation method

The data on the wheat statistics used in fitting the model are obtained from the ministry of agriculture of IRAN and various FAO sources. The time period selected for this study is from 1981 to 2008. If the classical assumptions are satisfied, the parameters for these equations can be estimated by OLS, ARDL and SUR methods.

Unit Roots Results

This study uses ADF unit root test in order to check and make sure that the dependent variables is of I(1) in level and none of the variables is of I(2) or higher order.

Results

Supply equation

The supply equation was nested in the more general partial adjustment-adaptive expectation (PAAE) model. To diagnose the appropriate specification, the procedure outlined by Doran (1988) that used likelihood based principles was used in this analysis. The general results rejected adaptive expectation (AE) model in favor of partial adjustment (PA) to examine the supply response. The preferred model for the supply equation that appears in table 2 meets two other diagnostic tests: linear specification and autocorrelation.

In this model all of the variables are statistically significant except intercept. The lagged area under harvested and the lagged producer price of wheat are significant at 5 per cent level and the lagged quantity of supply is significant at 1 per cent level and all of them had the expected positive sign.

3 Other possibilities for calculating the covariance matrix of the error terms are described in, e.g. Henningsen andHamann (2007).

Table1: Augment Dickey- Fuller Test (ADE)

Equation	Variable	Augmented Dickey-Fuller Test (ADF)	
		Intercept	Intercept and Trend
Supply	S	-1.8488 (0.3501)	-1.9946 (0.5779)
	ΔS	-5.4182 (0.0002)	
	A	-2.4842 (0.1302)	-2.3785 (0.3815)
	ΔA	-3.7526 (0.0091)	
	PFW	-2.3415 (0.1673)	-2.6427 (0.2661)
	ΔPFW	-6.3414 (0.0000)	
	PFB	-3.0413 (0.0446)	-3.1023 (0.1273)
	Rain	-4.0626 (0.0044)	-4.7568 (0.0041)
	Su	-3.0790 (0.0418)	-0.5968 (0.9698)
Production	Y	-1.8551 (0.3473)	-2.3098 (0.4149)
	ΔY	-3.5534 (0.0144)	
	Seed	-0.9147 (0.7491)	-5.2322 (0.0044)
	Lab	-1.0924 (0.6776)	-4.330483 (0.0233)
	Koodshi	-3.4520 (0.0756)	
	Koodh	-3.992 (0.0454)	
Demand	Qper	-2.8295 (0.1053)	-2.5184 (0.3173)
	Δqper	-5.3118 (0.0003)	
	ConI	1.1651 (0.9970)	-3.3394 (0.0860)
	Pnan	-2.6230 (0.1013)	-1.5433 (0.7874)
	ΔPnan	-2.9149 (0.0578)	
	QperR	-4.9335 (0.0006)	
Import	M	-3.6841 (0.0110)	
	GDP	1.7169 (0.9992)	1.9873 (1.3241)
	ΔGDP	-2.985 (0.0643)	
	Pm/Pd	-2.0604 (0.2611)	-3.3325 (0.0824)

Table 2: Results of the supply function

Variable	Coefficient	Standard errors
Constant	0.855	1.0515
A(-1)	0.203**	0.0993
PPW(-1)	-0.237**	1.1007
S(-1)	0.798***	0.050
H=-0.255	$\bar{R}^2 = 0.95$ $R^2 = 0.96$	F=176.91

Note: figures in parenthesis denote standard errors. The price variable deflated by CPI (2004=100).

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The estimated short run price elasticity is not fairly low and is 0/2 with negative sign (Shahnooshi et al (2004) affirm that the price of wheat is insignificant in supply equation of this good, but the time period of their article is 1983-2002 that in this period, our results about price elasticity is like their results) because wheat is a strategic good that government has the responsibility of its supply, so with increasing its price, government follow some strategies to decrease the amount of wheat that had been supplied4, on the other hand, price elasticity of supply is not low and is significant at five percent level that it denotes that the amount of supply affected largely from producer price in last period.

Zulfiqar & Chishti (2010) do such estimation in an article with title "Development of supply and demand functions of Pakistan's wheat crop". The estimated domestic wheat supply equation in that article (Sd = -8458.219 + 2.4879Â + 0.41528Pd + 2.4625FNTWT) reflects that the area under harvested (Â) along with the wholesale wheat price (Pd) and nutrient fertilizers (FNTWT) used determines the domestic production/supply of wheat in Pakistan.

Production equation

The results of production function analysis across of wheat are presented in table 3. The analysis clearly indicated that the estimated production function parameters were significantly different from each other.

Table 3: Results of the production function

Variable	Coefficient	Standard errors
Constant	-13.507***	4.378
A	1.914***	0.312
Fer	-1.084*	0.585
Pes	0.380*	0.194
Seed	2.284**	0.910
DW= 1.358	$\bar{R}^2 = 0.846$ $R^2 = 0.803$	F=19.371

Note: figures in parenthesis denote standard errors.

The results of production regression show that the coefficient of labour that used in wheat production was not significant so we omitted it from our estimation. Regarding to the culture of Iran agriculture and usual cultivation activity that all farmers have the same usage of labour per acre and it doesn't related to the kind of product, insignificancy of this coefficient is not unexpected. Hoseinzade & Salami (2004) in an article examine different kinds of production function for wheat in Iran and their results about labour were as same as our results. The regression for area under

4 Some strategies that government follow in this situation is:

- Substitute other cereal instead of wheat
- Increase the quality of wheat flour to decrease its wastage and supply

harvested was significant at one per cent, coefficient for fertilizer and pesticides were significant at ten per cent, and coefficient for seed was significant at five per cent. The preferred model for the production equation that appears in table 3 meets two other diagnostic tests: linear specification and autocorrelation either. The Durbin Watson statistics showed the probability of autocorrelation but with using LM test, this probability had been rejected.

The share of input variables to wheat production was estimated by using OLS technique. The value of F test in OLS estimation indicated that the model is significant at 1%. The value of adjusted R2 is 0.80 which reveals that the model has explained 80% of total variation in wheat production due to the variation in area, pesticides, fertilizer and seeds. According to Gujarati (1995), the coefficient of determination (adjusted R2) is a summary measure that tells how well the sample regression line fits the data. The fit of the model is said to be better the closer is R2 to 1. Therefore, in this model 80% variation in wheat production has been defined by independent variables included in the model. The intercept is significant at 1% level which implies the level of output when the value of all independent variables is zero. The coefficient of wheat area is positive and significant at 1% level which implies that, other factors keeping constant, one per cent increase in area would result in 1.91% increase in wheat production. Similarly, ceteris paribus, one per cent increase in fertilizer, would result into 1.08%, decrease in production and one per cent increase in pesticides, seeds use would results into 0.38 and 2.28% increase in production from the use of respective variables.

The fertilizer effect on production is significant at 10% level and has negative value which indicates the excess application and the variety which is responsive to higher dose of fertilizer; however the dose of pesticides can be increased. Similarly, the human or labour force has not any significant effect in production.

The demand equation

The consumption side of the model was specified with per capita consumption of wheat as a function of retail prices for wheat and barley and also consumer income. A trend variable is also included to capture changes in consumer's taste and preference.

Table 4: Results of the demand function

Variable	Coefficient	Standard errors
Constant	-2.602***	0.399
Pwr	0.106	0.113
Pjo	0.558***	0.154
ConI	-0.776***	0.196
T	0.019**	0.007
DW=2.27	$\overline{R}^2 = 0.68$ $R^2 = 0.57$	F=5.95

Note: figures in parenthesis denote standard errors. The price variable deflated by CPI (2004=100).

The results showed that own price elasticity for wheat is 0.106, however it's not significant but the sign of it showed that with increasing price of wheat, the quantity of demand will increase. This indicates that wheat is a Giffen good in IRAN. Tarmast et al., (2000) do such a study and they estimated the demand function of some comestible in Iran with using two methods: ISUR & I3SLS. Their results show that with using ISUR method, bread is an Inferior good but with using I3SLS method, bread is an Inferior and also a Giffen good.

However the results of a study in Libya showed that Income and prices are important variables in determining the level of wheat consumption in that country, so wheat is not a Giffen or Inferior yield in Libya (Ramadan Elbeydi, 2005).

Cross elasticity with respect to the price of barley is o.55 this means that each 1 percent increase in the price of barley contributes to the annual increase in demand for barley by approximately 0.55 per cent. Mosavi & Sadrolashrafi (2007) wrote an article about globalization that works on supply, demand and imports of wheat in. They use rice for substitute product of wheat and they discussed that cross elasticity with respect to the price of rice is 1.044. Although they use the price of bread in the place of wheat and the coefficient of bread price was 0.134, so their results confirm our article results.

Income elasticity of demand for wheat can obtain from this model and it is -0.77. It means that each 1 percent increase in consumer income contributes to the annual decrease approximately 0.77 per cent in demand for wheat. This indicated that wheat is an Inferior good in Iran either. The coefficient of trend variable and its significance and sign showed that consumer taste and preferences to wheat is going to increase year by year.

The wheat import equation

The formulation of the import equation assumed that imported and domestic wheat are substitutes. Thus the import demand function can be viewed as an excess demand schedule5. The results of the wheat import equation are presented in table 5.

Table 5: Results of the wheat import function

Variable	Coefficient	Standard errors
Constant	55.22***	19.31
Pm/Pd	-0.001	0.005
GDP	-1.64	1.69
Y	-2.16**	1.05
AR(1)	0.78***	0.14
DW= 1.83	$\bar{R}^2 = 0.73$ $R^2 = 0.779$	F=17.67

Note: figures in parenthesis denote standard errors. The price variable deflated by CPI (2004=100).

The model explained 78 per cent of the variation in wheat imports. The import model showed that the import domestic price ratio and GDP have negative sign but they're not significant. The production coefficient also has negative sign but is significant. It shows that with improving the amount of domestic production, import quantity will reduce. The negative signs of the price ratios and GDP are related to wheat quiddity in human nutrition (wheat is a strategic good). Accordingly, it looks logistic that the amount of import doesn't have any relation with our country income and the price ratios.

Zubaidi Bahramshah (1991), discussed about rice import in his article. His results show that the coefficient of the domestic price was found to be negative and statistically significant at five percent level. The estimated price elasticity is high, indicating that domestic price has significant influence on the imports of rice. His results suggest that imports decrease with increases in domestic price. His results also suggest that the Malaysia government sets the level of imports according to the supply in the previous period.

Discussion and conclusion

The PAAE model was used to investigate the wheat supply response in Iran. The model was diagnosed for appropriate specification and the results of the diagnostic tests suggest that the PA model is the preferred specification to examine the supply response. Another model that was

5 Production variable with one lag was insignificant, so it omitted from this model.

investigated in this study is production function equation that is a Cobb- Douglus kind of production model. The preferred model for the supply equation met two other diagnostic tests: log linear specification and autocorrelation. For demand specification we used a linear unique demand functional form. The last model that specified in this study was import demand function that we used Khan (1975) form of these models. The preferred model in each par met two other diagnostic tests: log linear specification and autocorrelation.

Despite the simplicity of the model and data problems, an examination of the econometric model leads to several conclusions with possible important policy implications for the wheat economy in Iran. The estimated short run price elasticity is not fairly low and is 0/2 with negative sign because wheat is a strategic good that government has the responsibility of its supply, so with increasing its price, government follow some strategies to decrease the amount of wheat that had been supplied, on the other hand, price elasticity of supply is not low and is significant at five percent level that it denotes that the amount of supply affected largely from producer price in last period.

The results obtained from production function is that all the factors have positive effect on production except fertilizer that have negative effect on wheat production and with decreasing the amount of fertilizer in wheat production, yield will increase.

The demand function showed that wheat is a Giffen good and barley is an appropriate substantial good for wheat. Income elasticity of demand for wheat can obtain from this model and it is -0.77. It means that each 1 percent increase in consumer income contributes to the annual decrease in demand for wheat approximately 0.77 per cent. This indicated that wheat is an Inferior good in Iran either. The coefficient of trend variable and its significance and sign showed that consumer taste and preferences to wheat is going to increase year by year.

The import demand function of wheat that estimated in this study showed that import doesn't influence from domestic price ratio and gross domestic product and the unique parameter that can decrease the amount of import is domestic production.

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