

## Corn Import Demand Model in Iran; Political Factors Application

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**Abstract:** The aim of this study is the corn import demand estimation for the Iranian economy. The specification of corn import has been estimated using the least squares estimators and a conventional set of explanatory variables. The elasticity estimates of corn import flow with respect to their regressors are also reported. Corn import are determined by the corn relative prices, per capita national disposable income, corn domestic product, corn domestic consumption, governmental stock corn in previous year and corn insurance in a statistically significant manner. The analysis reveals all variables as significant determinants of import, except per capita national disposable income. In this article, corn supporting price (as relative prices), governmental stock corn and corn insurance has been considered as government politics. According to results, if corn relative prices and stock corn by governments, whichever, increases by 1%, corn import demand decreases by 0.31 and 0.81%, respectively. So, governmental stock corn has more impacts on corn import demand. Therefore, a basic policy proposal for decreasing the corn import demand is to increase stock corn by governments.

**Key words:** Import demand • Corn • Government politics

### INTRODUCTION

Determinants of import flow are always attracted researchers in both academic area and policy-making institutions. In economic policy analysis, investigating import demand function is important to know the macroeconomic models and effectiveness and efficiency of Iranian trade politics. Corn crops play major roles in the Iranian agriculture sector. Corn has important role in linkages within the agricultural sector among various crops and between crops and live stocks. Corn is also the largest feed grain used by the livestock sector. Because of corn's role and its proportion of 65-70% in commixture

of food ration for birds, implant of corn in Iran has outspread day by day and necessity of increasing in its production is clearer than before in these days as corn's acreage has increased from 10 thousand hectares to 205 thousand hectares during 1980-2005. The yield of corn has increased from 32 thousands tones to 500 thousands tones during 1980-2005 [2]. The quantity of corn import has been about 1763991 tones in 2004 in Iran and its worth has been equal 2680 Billion Rials-Local currency [3]. Based on published statistics, 40% of Iranian demands of grain corn are provided by import [7]. So because of increasing in Iran's population and hence increase of food needs (corn as food, seed, bird's food ration) and also

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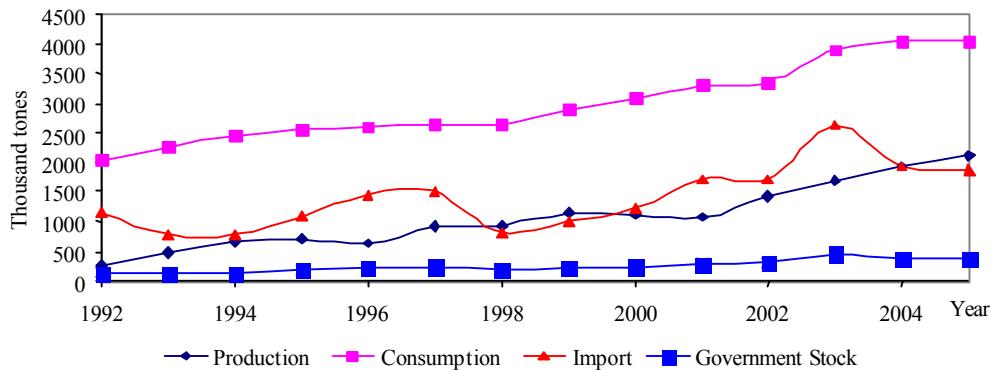


Fig. 1: Quantity of Corn Production, Consumption, Import and Governmental stock Trend in Iran during 1992-2005 [2]

because of increasing in usage of corn in industry (corn oil and so on) and having appropriate qualification for corn producing, the Iran's ministry of agriculture have codification a precise design for increasing in corn product (both of acreage and yield). According to this project, Iran will be one of corn producer up to 2011 and will produce all of country's need after this year and what is more, it will not import any amount of corn after that year. Thus knowing the effective components on producing and so on importing the corn is very important. This study is a fresh attempt to model the corn import flow of Iran and analyzing effective components on that, designated as a strategic product import.

Corn yields, consumption, import and governmental stock is shown in Fig. 1. According to this figure, corn consumption that is composed of governmental stocks, quantity of production and amount of import, has an increasing trend during 1992-2005. During these years, 1992-2005, the amount of corn import shows some fluctuations. Although trend of production is increasing but, the amount of imported corn is more than domestic product except 1998-2000 and the years after 2004 (the project of IAO in Iran has been started at 2002).

Governmental stocks have had a constant trend during 1992-2001, but after 2002 and by starting the IAO project, it had a nearly increasing trend.

The main purpose of the function that is estimated is to know influential factors on corn import demand and investigating effectiveness level of government politics on corn import demand in Iran. Some recent public debates regarding the structural dependence of different sectors of Iranian economy on agricultural product imports. So this study provides a simple resolution to this debate, as well.

Firstly, we have researched for a statistical representation of corn import using up-to-date data so as to reflect the effects of the latest developments in the

Iranian economy. In a simple statistical framework and using a fairly parsimonious set of explanatory variables, we have demonstrated that the import flow to Iran can be explained adequately. It is important to note that parsimony of the regressors is crucial to have a clear-cut view of the import flow. Secondly, we assess government politics and finally, we get suggestions about politics.

Our single equation model indicate that corn import can be explained by the corn relative prices, per capita national disposable income, corn domestic product, corn domestic consumption, Governmental stock corn in previous year and a dummy variable as corn insurance. Some recent changes in the overall trend of series are evident and well-captured in and reflected on the estimates.

Regarding the governmental stock corn in previous years as a central issue in the public and policy-making debate, it should be mentioned that governmental stock corn is revealed as a significant determinant of import. This observation might suggest that governmental stock corn has negative effect on corn import demand.

In the next section, a brief review of the leading literature as well as of some recent studies is provided. Section 3 provides the single equation estimates of the import flow and Section 4 concludes the study and covers the further research agenda.

**Literature in Brief:** In the literature, the investigations of the determinants of import demand are basically directed toward assessing the effects of government politics on import demand. Elasticity approach has used to investigate the effectiveness factors on import demand. In this section, we will provide a non-exhausting list of the leading studies in the economics literature. In addition to this, some recent studies regarding the Iranian case of imports will be reviewed.

From an econometric point of view, the elasticity approach is based on estimating the import demand function. In most studies, import volumes are regressed on effective exchange rates, relative import price and domestic real income. Goldstein and Khan [6] provides a survey of studies on income and price affects in foreign trade, with an excellent discussion of the specification and econometric issues in trade modeling, as well as a summary of various estimates of price and income elasticity and related policy issues. We will first discuss a small subset of recent studies.

Khan [1] has investigated for the period 1951-1969 employing annual data for individual countries<sup>1</sup> using the following model specification:

$$\ln M_i^d = a_0 + a_1 \ln(PM_i / PD_i) + a_2 \ln Y_i + U_i, \quad (1)$$

Is the important demand function, where  $M_i^d$  is the quantity of imports of country  $i$ ,  $PM_i$  is the unit value of import in country  $i$ ,  $PD_i$  is the domestic price level of country  $i$ ,  $Y_i$  is the real GNP of country  $i$  and  $U_i$  is an error term associated with each observation. Since each variable is defined in logarithmic terms, the estimated coefficients are the elasticity of imports with respect to the corresponding variables. Having estimated this function using OLS, Khan [1] reported that the prices did play an important role in the determination of imports of developing countries and Marshall-Lerner Condition is satisfied<sup>2</sup>.

Warner and Kreinin [2] have also employed a similar model, but their approach is different from Khan [1] in two respects: Firstly, there are two distinct investigation periods, the periods of fixed and flexible exchange rate regimes, to analyze the behavior of the model in the two periods. Secondly, Warner and Kreinin [2] estimated the import demand function as Khan [1] did, but they also repeated the estimation after excluding the petroleum products. Quarterly data for the periods 1957:1-1970:4 (fixed exchange rate period) and 1972:1-1980:4 (floating

exchange rate period) separately<sup>3</sup> have been employed to estimate the model. Import demand function in Warner and Kreinin [2] for the 1957:1-1970:4 periods is given by:

$$\ln M = c + a_1 \ln Y + a_2 \ln(PM / PD) \quad (2)$$

$$\ln M = c + b_1 \ln Y + b_2 \ln PD + b_3 \ln PM \quad (3)$$

Import demand function for the 1972:1-1980:4 periods:

$$\ln M = c + a_1 \ln Y + a_2 \ln(PM / PD) \quad (4)$$

$$\ln M = c + b_1 \ln Y + b_2 \ln PD + b_3 \ln PM \quad (5)$$

$$\ln M = c + c_1 \ln Y + c_2 \ln PD + c_3 \ln PM^{FC} + c_4 \ln E \quad (6)$$

Where,  $PM^{FC}$  is the important price in foreign currencies,  $M$  is the volume of imports on a per capita basis,  $Y$  is the real GNP on a per capita basis,  $PD$  is domestic prices,  $PM/PD$  denotes the relative prices and  $E$  stands for the exchange rate. As all the variables are expressed in logarithms, the parameters of this model are again interpreted as the elasticity of the dependent variable with respect to the independent variables. Exchange rate was included in the model only for the floating exchange rates period and it was calculated as an import-weighted effective exchange rate.

Bahmani-Oskooee used quarterly data for 1973-1980 periods<sup>4</sup> and provided the estimates of aggregate import demand function for seven developing countries[3]. They also provided estimates of price and exchange rate response patterns by introducing a distributed lag structure on the relative prices and on effective exchange rate, applying the Almon procedure. Since the dynamics of the determination of the trade flows are involved, Bahmani-Oskooee presented a more realistic setup [4]. The equations used in this study are:

$$\ln M_t^d = a + b \ln Y_t + c \ln(PM / PD)_t + h \ln E_t + u_t \quad (7)$$

<sup>1</sup> Included Countries are Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Ghana, India, Morocco, Pakistan, Peru, The Philippines, Sri Lanka, Turkey and Uruguay

<sup>2</sup> In Goldstein and Khan [4], all import quantity and unit value data were obtained from IMF/IFS various issues, except for two countries: For Argentina, data from Central Bank of Argentina, Comercio Exterior, and for Pakistan, data from the Institute of Development Economics was used. Nominal GNP data were taken from IMF/IFS and real GNP data were taken from the UN, Statistical Yearbook, implicit that deflator being generated. World income and prices were defined as real GNP reported by the OECD and the OECD GNP deflator respectively. All data are USD denominated

<sup>3</sup> Included countries are the United States, Germany, France, Japan, the United Kingdom, Canada, Italy, Netherlands, Belgium, Sweden, Denmark, Switzerland, Norway, Finland, Austria, Spain, Ireland and the New Zealand.

<sup>4</sup> Included countries are Brazil, Greece, India, Israel, Korea, South Africa and Thailand

<sup>5</sup> Data were taken from IMF Direction of Trade Statistics, IMF/IFS and OECD Statistics of Foreign Trade, Series A.

Where,  $M_t^d$  is the quantity of imports,  $PM$  is the import prices,  $PD$  is the domestic price level,  $Y_t$  is the real GNP and  $E_t$  is the export weighted effective exchange rate. After introducing lags the equation becomes:

$$\ln M_t^d = a + \ln Y_t + \sum_{i=0}^{n1} c_i (PM / PD)_{t-i} + \sum_{i=0}^{n2} h_i \ln E_{t-i} + u_t \quad (8)$$

Based on the estimates of these models<sup>5</sup>, Orcutt [11]'s earlier conjecture that trade flows adjust differently to different price stimuli was supported. Namely, according to Bahmani-Oskooee [4]'s findings, import flow are more responsive to changes in the relative prices than to changes in the exchange rates in the long-run.

The two of the most recent studies in this area are Bahmani-Oskooee and Niroomand and Bahmani-Oskooee [3, 4]. As far as the data and variable definitions are considered, these two follow the previous literature without any modifications, while both studies employ the Perron, Johansen and Johansen-Juselius [5, 6, 7] cointegration analyses. The mail idea behind the cointegration analysis is that if a linear combination of a set of non-stationary variables is stationary, those variables are said to be co integrated. The Johansen-Juselius technique is based on the maximum-likelihood estimation procedure and allows for feedback effects among a set of variables. It basically provides two test statistics for determining the number of co integrating vectors in addition to their estimates. An important feature we observe in Bahmani-Oskooee and Niroomand and Bahmani-Oskooee is the emphasis put on the match between the long-run characteristics of the Marshall-Lerner Condition and the cointegration analysis [3,4].

Bahmani-Oskooee and Niroomand has the following model specification, for a study period of 1960-1992 annually[4]:

$$\log M_t = a + \log(PM/PD)_t + c \log Y_t + e_t \quad (9)$$

Where,  $M_t$  is the volume of imports, nominal imports are deflated by import price index,  $PM$  is import prices, index of unit value of imports,  $PD$  is the domestic price level, indices of domestic price level measured by CPI,  $Y_t$  is the domestic income, real GDP or GNP.

Estimating the equation for 30 countries, the authors concluded that for almost all cases devaluations could improve the trade balance.

Bahmani-Oskooee [3] uses quarterly data for the period 1973-1990 with a slight modification of the import demand equation in Bahmani-Oskooee and Noroomand [5] through the addition of nominal effective exchange rate variable as a regressor.

Winter and Frohberg [8], in their study entitled "Using flexible McFadden export supply and import demand functions for bilateral trade policy analysis", investigated the limitations in employing the CES and CET functions for modeling bilateral trade flows as is commonly done in trade models. They suggested use a flexible form such as the Symmetric Generalized McFadden Function (SGMF) which is flexible from second order.

Having provided the basic literature using the elasticity approach, we can emphasized the major common points of these strand studies. Firstly, all major studies that regress import volumes on relative import prices and real domestic income. While doing this, the underlying framework is the imperfect substitute model of the trade literature. As it was discussed in Goldstein and Khan's work in detail, if domestic and foreign goods were perfect substitutions, then we should observe either of the goods having market share of unity and each country acts as an importer or exporter of a traded good but not both [9]. Theoretically, price and income elasticity are expected to have negative and positive signs, respectively. We expect the import volume to shrink as the relative import price increases and expand as domestic real GDP increases.

Secondly, all elasticity approach models given above, focus on aggregate data for volume variables, such as import volumes and real incomes. Here two related questions can be posed as in [10, 9, 11]. First, is it really necessary to estimate the disaggregated relationships and then to collect them together to get an aggregate estimate? Second, if our answer to the first question is positive, how should be this task carried out? The answer to the former was formulated in the Goldstein and Khan survey [9]. They argued that when the effect of the determining variables is exactly the same in aggregate and disaggregated models, or if there is a stable relationship between the components and aggregate explanatory variables, then we can be indifferent between aggregate and disaggregated questions.

Third, all studies discussed earlier, except Bahmani-Oskooee [3], use a static framework. Use of static models in trade econometrics is consistent with the formulation of Marshall-Lerner stability condition, which did not involve any dynamics.

Finally, we may safely conclude that one only may find agreement on whether Marshall-Lerner stability condition is satisfied. The satisfaction of the condition is dependent on the type of formulation employed, variables involved and sample period. Therefore, each econometric case of trade flows can be perceived as an island in itself.

## MATERIALS AND METHODS

We have estimated our models using series data covering the period from 1991 to 2005. Data are obtained from Iranian Agricultural Organization (IAO). The data set consists of the following items: corn import demand,  $LM^C$  is defined as the natural logarithms of the corresponding import quantity indices with the base year of 1990. Corn domestic products is denoted with  $L(DP)$  and defined as the natural logarithm of the real GDP index for corn with the base year of 1990. Import price,  $L(PM)$  is defined as the natural logarithm of the import price index (1990=100). Corn domestic price,  $L(DP)$  is defined as the natural logarithm of the domestic price index of corn (1990=100). Per capita national disposable income  $L(DI)$  is defined as the natural logarithm of the per capita national disposable income index. Corn domestic consumption,  $L(C_d)$  is defined as the natural logarithm of CPI index. Governmental stock corn in previous year  $L(IM_{t-1})$  is defined as the natural logarithm of the governmental stock corn volume of previous year.

We have also used a dummy variable,  $D_1$  in our equation to account corn insurance, as a government politic, in the estimated relationships.

An essential point to be considered is that the forecast results will strongly depend on government politics for the investigated period due to their elasticity as presented in the estimated model.

**Empirical Specification:** On comparing several models and using the Ramsey regression equation specification error test (Reset) and Jarque-Bera normality test, we elected the logarithmic model as the best model for the evolution of government politics effect on corn import demand in the Iranian economy. Our model is specified as:

$$\begin{aligned} \ln(M_t^C) = & a_0 + a_1 \ln(PM / PD)_t^C + a_2 \ln(Y_t) + a_3 \ln(Q_t^C) \\ & + a_4 \ln(C_t^C) + a_5 \ln(IM_{t-1}^C) + a_6 D_1 \end{aligned} \quad (10)$$

Where  $M_t^C$  is the volume of corn import, nominal import is deflated by import price index,  $(PM / PD)_t^C$  is corn relative prices-  $PM$  is import price and  $PD$  is domestic or

Table 1: Variable used in estimated equation

Variable	Description	Unit
$M_t^C$	Quantity of corn Import	Tone
$(PM/PD)_t^C$	Corn relative prices	Rial(Local Currency)
$Y_t$	Per capita national disposable income	Rial(Local Currency)
$Q_t^C$	Quantity of domestic product(corn)	Tone
$C_t^C$	Quantity of domestic consumption(corn)	Tone
$IM_{t-1}^C$	First lag of Governmental Stock corn quantity	Tone
$D_1$	Dummy variable (corn insurance)	-

Source; The study finding

Table 2: Estimation of empirical equation (Equation 10)

Variable	Coefficient	S.E	t Static
Intercept	$\alpha_0$	-13.06***	5.77
$(PM/PD)_t^C$	$\alpha_1$	-0.31***	0.16
$Y_t$	$\alpha_2$	0.45	0.63
$Q_t^C$	$\alpha_3$	-0.88**	0.26
$C_t^C$	$\alpha_4$	2.60*	0.62
$IM_{t-1}^C$	$\alpha_5$	-0.81*	0.017
$D_1$	$\alpha_6$	-0.51*	0.12
D.W=1.9		$\bar{R}^2 = 0.94$	Normality Static(Nr)= 3.50***

\*\*\* = 0.01 level (1%), \*\* = 0.05 level (5%), \* = 0.1 level (10%)

supporting price-,  $Y_t$  is per capita national disposable income,  $Q_t^C$  is the domestic products,  $C_t^C$  is the domestic consumption,  $IM_{t-1}^C$  is the (volume) first lag volume of governmental stock corn and  $D_1$  is the dummy variable of corn insurance. We (descript) have described these variables in Table 1.

Based on our model estimates presented above, the elasticity of import with respect to their regressors is summarized in Table 2.

## RESULTS

In estimated equation, we use non-linear maximum likelihood (NL) by SHAZAM software. To determine multi-co linearity relation, heteroskedasticity and autocorrelation, we used the variance decomposition test, Breush-Pagan and Glejser tests and Durbin-Watson, respectively. We used the T-test for the significance level of variable determination. Table 2 indicates the coefficient and significance level of the empirical model.

According to Table 2, domestic consumption, governmental stock corn in previous year and the dummy variable are significant in 1%, level of domestic products is significant in 5%, level of relative price is significant in 10% and per capita national disposable income isn't significant. Regarding signs of variables, the positive

effect of domestic consumption on corn import demand is considerable. We observed the negative effects of relative price, domestic products and governmental stock corn in previous year on corn import demand. However, we should discuss the negative effect of government politics and pay attention to their coefficients.

We assessed the effects of variables from 1991 to 2005. Only the domestic consumption has a positive effect on corn import demand. We included a time trend in the corn import demand model to present variables (such as tastes and preferences) which may be relevant but omitted from the equation.

We presented the results of this paper in two sections. Section 1 is allocated to the assessment of the impacts of variables on corn import demand. In section 2, we considered the elasticity of effective variables on corn import demand.

**Impacts of Variables:** We have assessed the determinants of corn import demand for Iran. In our model, we have considered corn relative prices, per capita national disposable income, corn domestic consumption, corn domestic products, governmental stock corn in previous year and a dummy variable as explained variables. The results show that these variables can explain 97% our model. Also, the results show that per capita national disposable income isn't significant, domestic product has negative effect at 5% level of significance and domestic consumption has positive effect at 1% level of significance on corn import demand.

Recall that in this study, corn relative prices, governmental stock corn in previous year and insurance have been considered as government politics. We put insurance inform of a dummy variable. The results show that corn relative prices has negative effect at 10% level of significance and governmental stock corn in previous year has also negative effect but at 1% level of significance on corn import demand.

**Elasticity of Effective Variables:** After comparing different models in *SHAZAM* software, finally, the Cobb-Douglas function is selected in this study; therefore, coefficient of variables implies their elasticity. The results have been shown in Table 2. They means if corn relative prices, domestic product and governmental stock in previous year increase by 1%, the corn import demand decreases by 0.31, 0.88 and 0.81%, respectively. Also, if domestic consumption increases by 1%, the corn import demand increases by 2.60%. It means that, domestic consumption has the most effects on corn import demand.

The effect of insurance on import is negative and it means that if there were a good policy in insurance industry, then we can increase the amount of corn product and hence demand of import, decrease. Governmental stock has the same effect on imported corn but the effect of governmental stock is more than insurance industries and it is the most effective of government politics.

## DISCUSSION, RECOMMENDATIONS AND CONCLUSION

Because of corn is a strategic farming products, attention to it is necessary. After wheat and rice, corn allocates the highest farming lands to itself in the world. So attention to its import is important.

On the other hand, based on statistics provided by the Iranian Ministry of Agriculture, Iranian requirement of corn is about 3.7 to 4 million tones that 2.2 million tones has been produced inside and about 1/5 million tones has been provided by import [12]. Based on necessity of corn import, volume of import and time of its distribution, specially, are important for market balance. Therefore, this action must be done to prevent price fluctuations.

We have assessed the determinants of corn import demand for Iran, fundamentally for policy-making purposes. Firstly, we have estimated single equation model, the results of which indicated that corn import demand can be explained by corn relative prices, per capita national disposable income, domestic product, domestic consumption, governmental stock corn and a dummy variable (as insurance) during 1991-2005. In this way, some recent changes in the overall trend of series are evident and well-captured in and reflected on the estimates.

Regarding the central importance of government politics on corn import demand, it should specifically be mentioned that corn relative prices and governmental stock corn are revealed to be a statistically significant determinant of corn import demand. These observations might suggest that governmental stock corn is the most effectiveness factors on corn import demand by 1% level of significance. Also, results reveal if governmental stock corn increases by 1%, corn import demand decreases by 0.81%. The domestic consumption has the most positive effects on corn import demand by 1% level of significance.

According to results above, we suggest that government should emphasize more on governmental stock corn politic.

Further research agenda should be extended in several dimensions. Firstly, disaggregated imports should be taken into consideration in an initial attempt to figure out their determinants. Secondly, a forecasting module must be established upon these disaggregated models. Third, it is crucial to add to model the main items of the balance of corn demand and supply for having a better picture of the statistical properties of government politics.

## REFERENCES

1. Khan, M.S., 1974. Import and Export Demand in Developing Countries. IMF Staff Papers, 21: 678-693.
2. Warner, D. and M.E. Kreinin, 1983. Determinants of International Trade Flows. *Rev. Econom. Stat.*, 65:96-104.
3. Bahmani-Oskooee, M., 1985. Devaluation and the J-curve: Some Evidence from LDCs. *Rev. Econom. Stat.*, 67: 500-504.
4. Bahmani-Oskooee, M. and F. Niroomand, 1998. Long-run Price Elasticities and the Marshall-Lerner Condition Revisited. *Econom. Lett.*, 61(1): 101-109.
5. Perron, P., 1989. The Great Crash. The Oil Price Shock and the Unit Root Hypothesis. *Econometrica*, 57(6):1361-1401.
6. Johansen, S., 1988. Statistical Analysis of Cointegration Vectors. *J. Econom. Dynamics Control*, 12: 231-254.
7. Johansen, S. and K. Juselius, 1990. Maximum Likelihood Estimation and Inference on Cointegration-with Application to the Demand for Money, *Oxford Bulletin of Economics and Statistics*, 52: 169-210.
8. Winter, E. and K. Frohberg, 1993. Using flexible McFadden export supply and import demand functions for bilateral trade policy analysis. [www.ecomod.net/conferences/ecomod2004/ecomod2004\\_papers/376.pdf](http://www.ecomod.net/conferences/ecomod2004/ecomod2004_papers/376.pdf).
9. Goldstein, M. and M.S. Khan, 1985. Income and Price Effects in Foreign Trade. In *Handbook of International Economics*. Vol II: 1041-1105. Jones, R.W. and P.B. Kenen (Eds.), Elsevier Science Publishers B.V.
10. Aigner, D.J. and S.M. Goldfeld, 1974. Estimation and Prediction from Aggregate Data When Are Measured More Accurately Than Their Components. *Econometrica*, 42: 113-134.
11. Theil, H. 1954. Linear Aggregation of Economic Relations. (North-Holland, Amsterdam)
12. The Iranian Ministry of Agriculture, 2006. [www.Agrijahad.com.IAO](http://www.Agrijahad.com.IAO). Various years.