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Effect of Income Inequality on Demand for Grain Import in Iran

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ABSTRACT

Among the food products, grains play an important role in the consumption patterns of people, especially in the developing countries. Since Iran's main source of public dietary energy comes directly from grains, investigating and identifying the determinants of import of these products can be an important step towards food security. Most experimental studies consider import of grains as only a function of relative prices and real income, whereas, income inequality is also a variable affecting the import of grains. The present study evaluates the effect of income inequality on the import of grains in Iran's economy during the years 1969-2009. For this purpose, the relationship of grain import with gross domestic production (GDP), grain production, real exchange rate, and income inequality was evaluated for Iran by using the Vector Error Correction Model (VECM). The results indicate that the relationship between income inequality and grain import is positive and its coefficient is +0.55%. This implies that 1% increase in income inequality increases grain import by 0.55%. Also, the effect of gross domestic production on grains import is positive and the real exchange rate and grains production variables have a negative and significant effect on grains import.

Keywords: Grain, Gross domestic production, Real exchange rate, Vector error correction model (VECM).

INTRODUCTION

Among the food products, grains play an important role in the consumption patterns of people, especially in the developing countries. Since Iran's main source of public dietary energy comes directly from grains, investigating and identifying the determinants of import of these products can be an important step towards food security. Also today, due to population growth and limited production resources, the supply of nutrients needed by people is considered as the most important factor in the achievement of economic independence. Among the food products, grains play an important role in every country's consumption pattern, especially in the developing countries. Since the ancient times, wheat, barley, maize, rice, and millet have been the main grains that have had a significant role in the nutrition of human and livestock. These grains have some advantages such as farmers' high efficiency in production, requiring less labor, easy production, storage, and transportation, and adaptation to different climates, thus, they have been introduced as safe food sources for humans. It is noteworthy that continuous and reliable access to food is not a spontaneous process; rather, it requires a wide range of efforts. The importance of these products mainly relates to food security and their strategic-ness, particularly for low and middle income households.

Food security -specially grain security- has always been a concern for generations, and continues to be high on the global policy

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agenda. Grain security is not only affecting the national political security, but also the economic security and social stability (Su *et al*., 2012). Food security requires an adequate supply of nutrients and also overseeing the equitable distribution of food and income among all sects of people. Here, the governments can take appropriate actions to achieve the right of adequate food and a fair distribution of income. Therefore, the governments may attempt to provide these products and control their prices. While controlling the prices in the developed countries is mainly done through the use of new technologies towards increasing yield per hectare, in many other countries, especially those developing countries including Iran that rely on oil wealth, the lower price of imported goods, e.g. grains, causes the domestic production to lose its home market.

For example, the United Nations' Food and Agricultural Organization (FAO) announced that the total grain production of Iran for the crop year of 2011 was about 20 million tons, which was increased by about 300 thousand tons (equivalent to 1.5%) in comparison to the previous year. Parallel to increase in domestic production, Iran's grain import decreased about 200 thousand tons and dropped to 6 million tons in 2011. In fact, in this year, the share of domestic production in the total consumption of grains was 76% and the share of grain import in the total consumption of grains was 24%. Iran's grain import was 6.2 million tons in 2010 while its grain export reached 200 thousand tons in the same year. Iran exported over 500 thousand tons of grains in 2010 (FAO, 2012). Therefore, identifying the determinants of grain import could be a major step towards a systematic planning for evaluation of production and food security.

The main purpose of this study was to find out the relationship between income inequality and grain import demand in Iran. There is no consensus among the economists about the impact of income inequality on grain import. This means that some groups acknowledge the existence of positive relationship, some others suggest a negative relationship, and still there are others who see no relationship between these two variables. Therefore, we examined the effect of changes in income inequality on the demand for grain import by using a model of trade in vertically-differentiated products in which household income determined the quality of goods demanded (Flam and Helpman, 1987). The domestic country is assumed to have comparative advantage and high-quality (and high-price) varieties of differentiated products export to the rest of the world (ROW, whereas it imports low-quality (and low-price) varieties that are consumed by low income households.

This argument can be understood by the example of a hypothetical mean- preserving increase in income inequality. Let there be an income level μ such that all households with income up to this level maximize their utility (which depends on the quality of the vertically-differentiated products and the quantity of homogeneous non-traded goods) by purchasing low-quality, low-price imported varieties. Similarly, the households with income greater than μ consume high-quality domestically produced varieties. Now, consider a case in which the income of some households, which initially had incomes greater than μ, drops to a level below μ, whereas the income of some households (which was initially far greater than μ) rises further, so that the average income remains intact. The effect of these changes will be an increase in the import since the households whose income has dropped below μ will switch their demand to imported varieties, whereas the households whose income has increased will continue to consume domestically-produced varieties. The reader will have by now thought of counter examples in which a mean-preserving increase in income inequality results in the demand reduction for import; this intuitively confirms the ambiguous effect of income inequality on the demand for import (Katsimi and Motous, 2006).

In fact, with the reduction of income, the demand for essential goods such as grain increases. Thus, the country will face excess demand, part of which is offset by higher domestic production; however, since the ability of responding to all of the newly created needs in the domestic markets is usually lacking, the government is forced to import from other countries.

Many empirical studies have so far been done on the determinants of import demand; however, some of them have only considered the import demand as a function of GDP and the relative prices. Hence, no comprehensive study has been done in the field of income inequality impact yet.

Katsimi and Moutos (2011) examined the effect of income inequality on the US import demand in the period 1948-2007. They found that not only was there a stable long-run relationship between import, income, relative prices, and inequality, but also the influence of inequality was quantitatively very important. This result appears robust both to changes in the level of aggregation of real import and across alternative methods of estimating co-integration equations. They stated that income inequality had a great and positive effect on import demand. Uzunoz and Akcay (2009) analyzed the factors affecting wheat import demand in Turkey during the years 1984-2006. They considered Turkey's wheat import as a function of domestic prices, GDP per capita, exchange rate, domestic demand, and lag of import amount of wheat production. Based on the estimated results, change in domestic price of wheat has strong effect on the wheat import demand. Yazdani *et al* (2008) investigated the corn import demand function of Iran during the period 1980-2005. They considered Iran's corn import demand as a function of GDP, relative prices, domestic production of corn, the amount of corn consumption, and the amount of corn stockpiles by the government in the previous year. The results indicated that all variables were significant, except GDP. Adam *et al.* (2008) examined the empirical importance of changes in income inequality on import demand in 36 developing and developed countries during the years 1980-1997. They found significant evidence supporting their prediction that inequality had a large influence on the demand for import. Moreover, they noticed that, in line with the predictions of their theoretical model, this influence was positive for high-income countries and negative for low-income countries. Katsimi and Moutos (2006) found no evidence for the existence of a long-run relationship between aggregated import, income, and competitiveness in the US. However, the addition of US income inequality as a determinant of the aggregate demand for import improves the picture significantly. Another strand of this literature challenges the conventional wisdom by arguing that the standard import demand function may be miss-specified due to the omission of other determinants of a long-run import equation. Abedullah *et al.* (2005) investigated Pakistan's wheat import demand within 1970-2003. The results indicated that wheat import was strongly affected by the wheat production of the current year and previous year. Wongun (2005) calculated the elasticity of import demand for 32 agricultural products in South Korea during 1991-2004. The findings suggested that import price elasticity of some grains was statistically significant in the grains sector, except for corn and soybeans. Tang (2003) used the concept of co-integration for analyzing the long-run relationship of import demand function for China during the years 1970-1999. Using the Conditional Error Correction Model (CECM), he showed that there was a long-run relationship between the domestic activities (including such variables as GDP, non-export GDP, and marginal expenditures for the public and private sectors) and the aggregate import.

However, it can be stated that despite the fact that numerous studies have ignored the effect of income inequality on grain import, the main empirical implication of our theoretical model is that income inequality is an important determinant for grain import demand. As a result, omitting the level of inequality may be one reason why most previous studies have failed to provide strong evidence of a stable long-run imported grain demand function (Katsimi and Moutos, 2011). Based on Katsimi and Moutos (2006, 2011) and Adam *et al.* (2008) studies, income inequality is an effective component in grain import. Therefore, in the present study, we investigated the effect of income inequality on grain import in Iran during the years 1969-2009. In other words, we aimed to include income inequality variable in the model to distinguish this research from other studies conducted in the field of grain import.

MATERIALS AND METHODS

Since late 1980s, with the study of Engle and Granger (1987), with the spread of new methods in econometrics and significant progress of co-integration tests for examining the long-run relationship between variables, most empirical studies about the import demand function of the developing countries have accepted the traditional specification of import demand, i.e. "import as a function of GDP and relative prices". In this study, the complete substitution pattern has been used in which imported and domestic products are substituted.

General form of import demand is as follows, (Warner and Kreini (1983), Magee (1975) and Goldstein and Mohsins (1985):

$$M_t = f(Y_t, RP_t) \quad (1)$$

Where, M_t represents the volume of import, Y_t is the gross domestic product, and RP_t is the relative price of import that is obtained by the division of import price index (PM) by the domestic price index (PD). According to most of the empirical studies, import demand has been considered as a function of these two variables; however, Katsimi and Moutos (2006, 2011) and Adam *et al.* (2008) added the variable of income inequality to the import demand equation. They stated that perhaps one of the reasons that most of the previous studies had not provided a strong evidence for stability of import demand in long-run was the absence of income inequality.

Increase in income inequality will lead to changes in the composition of the consumer goods; one of these consumer goods is grains with low elasticity. Thus, with increase in income inequality, consumption of lower-middle and poor strata will change to the consumption of grains that have relatively lower prices.

According to the empirical studies of Katsimi and Moutos (2011) and Adam *et al.* (2008), grain import demand equation is presented as follows:

$$IM_t = f(Y_t, GP, ER_t, IN_t) \quad (2)$$

Where, IM_t is the volume of import, Y_t is the gross domestic product, GP represents the volume of domestic grain production, ER_t is the real exchange rate, and IN_t indicates the income inequality. According to the theoretical framework, it is expected that:

$$\frac{\partial IM}{\partial ER} \prec 0 \text{ ، } \frac{\partial IM}{\partial Y} \succ 0 \text{ ، } \frac{\partial IM}{\partial GP} \prec 0$$

Also, $\frac{\partial IM}{\partial IN}$

can be either positive or negative.

It is worth mentioning that the real exchange rate is obtained from the following equation:

$$RER = ER . \frac{CPI_f}{CPI_{ir}} \quad (3)$$

Where, RER is the real exchange rate, ER is the official exchange rate, CPI_{if} represents the consumer price index of the major trading partners of Iran, and CPI_{ir} is Iran's consumer price index. Therefore, the grain import equation can be expressed as below:

$$LM_t = \beta_0 + \beta_1 LY_t + \beta_2 LGP_t + \beta_3 LRER_t + \beta_4 LIN_t + e_t \quad (4)$$

Where, LM is the natural logarithm of grain import as dependent variable of the model, LY is the natural logarithm of the gross domestic product of last year, LGP is the natural logarithm of domestic grain product volume, $LRER$ is the natural logarithm of real exchange rate, and *LIN* is the natural logarithm of Gini index as the estimator index of income inequality.

It is to be noted the most common index of income inequality used in the experimental studies is Gini index. In the presented model, Gini index introduces income inequality. Since Gini index with respect to other indexes of income inequality has features like convenient estimating, transparent content and concept, and limited variation range between zero and one, this study considers it as the estimation indicator of income inequality.

In this study, Vector Auto Regressive (VAR) model has been used for finding the short-run and long-run effects. Also, in order to determine the correct form of model, non-nested test embedded in the Microfit software was used, which ultimately led to superiority of the logarithmic model.

It is noteworthy that the data related to grain import, GDP (million US $), official exchange rate, and Gini index were collected from Iran's Central Bank website (http://tsd.cbi.ir), the data about the domestic production of grains were obtained from the Food and Agricultural Organization (FAO) of the United Nations, and the data related to Iran's consumer price index and its major trading partners were taken from World Development Indicators (WDI) (http://data.worldbank.org) for the years 1969-2009. Also, EViews6 software was used to estimate the model.

RESULTS AND DISCUSSION

Initially, stationary of the variables should be examined. Where all data series were stationary, then VAR model was used at the variables level; however, where one or more of the variables were non-stationary, then we used the co-integration test between the variables. Where there was co-integration between the variables, Vector Error Correction Model (VECM) was used for estimation, and by the lack of co-integration, VAR model was used in the difference of variables that had unit root.

First, we tested the unit root hypothesis for each of the individual components of the vector stochastic process {Z}; where, $Z'_t = (IM_t, Y_t, Gp_t, RER_t, IN_t)$.

Standard unit root test of Dickey and Fuller (1981) rejected the unit root null for all of the four series under consideration in level, but failed to reject the unit root null for all of the five series with 1st difference. Therefore, we proceeded by assuming that the process {Z} consists of I(1) components. Then, we moved on to multivariate analysis within Johansen's (1991) and Hansen and Johansen (1998) co-integration framework. Next, the following steps were taken: (i) since Johansen's procedure is based on the estimation of a VAR(p) model, we first chose the optimal lag-length of VAR; (ii) in the context of the VEC representation of VAR(p), we tested for co-integration by using the trace and the maximum Eigen value statistic, (iii) having determined the co-integration rank, we re-estimated the VEC model with the co-integration rank restriction imposed on the long-run matrix of the model. In this framework, we estimated both the long-run and the short-run dynamics of the system. More specifically, let us assume the stochastic process $\{Z_t\}$ in which $Z'_t = (IM_t, Y_t, Gp_t, RER_t, IN_t)$ is generated by the following VAR(p) model:

$$Z_t = A_0 + \sum_{i=1}^{p} A_i Z_{t-i} + U_t \quad (5)$$

Where, VEC representation takes the following form:

$$\Delta Z_t = A_0 + \Pi Z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Z_{t-i} + U_t \quad (6)$$

In which, $U_t \sim NI(0, \Omega)$.

The process {Zt} is co-integrated if the matrix $\prod$ is of reduced rank (in our case $r(\Pi) = r \prec 5$). The rank of $\prod$ describes the number of co-integrating vectors in the system. If the matrix $\prod$ is of full rank, that is $r(\Pi) = r \prec 5$, then VAR(p) is stable VAR in level, and there are no unit roots in the system. Note that this case contradicts the assumption that each of the five series is I(1). Finally, if $r(\Pi)=0$, then the number of unit roots in the system is equal to five, and the series are not co-integrated. Let us assume that $r(\Pi)=1$. In this case, the long-run matrix $\prod$ can be decomposed into:

$$\prod = c\,b' \quad (7)$$

Where, ***c*** and ***b*** are (5×1) vectors. Then, the system (2) becomes as below:

$$\Delta Z_t = A_0 + \begin{bmatrix} c_{11} \\ c_{21} \\ c_{31} \\ c_{41} \\ c_{51} \end{bmatrix} \left[b_{11}\, b_{21} b_{31} b_{41}\, b_{51} \right] Z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Z_{t-i} + U_t \quad (8)$$

It can be seen that vector *b* contains long-run parameters of the system, whereas vector ***c*** contains the adjustment coefficients of each of the five variables IM_t, Y_t, GP_t, LER_t and IN_t to the disequilibrium error of the previous period.

The results of unit root test are reported in Table 1.The unit root tests of Dickey-Fuller (ADF) and Phillips-Perron (PP) have been used for stationary analysis. The unit root test results in Table 1 show that all variables are unstable in level except for the grain import. Based on the stability test results, all independent variables are stationary, and non-stability hypothesis is rejected at 0.05 level. Therefore, all model variables, except the grain import, are of the first order I(1).

At first, the optimal lag of model was examined based on the Akaike, Schwartz and Hannan -Quinn criteria. The results with different lags are shown in Table 2. As can be observed, all of the three criteria have introduced one lag as the optimal lag of the model. Therefore, optimal lag of the model is considered one.

After determining the optimal lag of the model, the number of co-integration vectors is determined by using the maximum Eigen values and trace test; the results are shown in Table 3.

According to Tables 2 and 3, the number of co-integration vectors obtained from both maximum Eigen values and trace test is equal to one. Therefore, there is a long-run equilibrium relationship between the variables of the model; the regression of these variables is not spurious.

Then, the long-run relationship between the model variables is estimated, and the normalized vector to the first endogenous variable is selected as follows:

$$\underset{}{LM} = \underset{(0.881)}{0.795 LY_{t-1}} - \underset{(0.149)}{0.26 LGP} - \underset{(0.203)}{0.074 LRER} + \underset{(0.709)}{0.557 LIN} \quad (9)$$

It is worth noting that GDP is the lagged variable. According to the estimation results, the effect of GDP on grain import is positive, and its coefficient is 0.79%. This shows that by 1% increase in GDP, grain import increases by 0.79%; that is increase in GDP leads to the increase in grain import.

Table 1. The results of unit root test.

	The results of Dickey-Fuller (ADF) test				The results of Phillips-Perron (PP) test				
Variables	Constant		Constant+Liner trend		Constant		Constant+Liner trend		
	Statistic	Prob	Statistic	Prob	Statistic	Prob	Statistic	Prob	Integration order
Log (IM)	-4.88	0.00	-4.62	0.005	-6.88	0.000	-5.64	0.000	I(0)
Log (Y)	-3.36	0.19	-3.41	0.065	-3.54	0.038	-3.05	0.003	I(1)
Log (GP)	-3.38	0.018	-3.88	0.023	-3.83	0.000	-4.79	0.000	I(1)
Log(RER)	-5.91	0.000	-5.83	0.000	-6.61	0.000	-6.52	0.000	I(1)
Log (IN)	-4.80	0.002	-7.38	0.000	-8.47	0.000	-8.77	0.000	I(1)

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Table 2. Determining the optimal lag of model.

Number of lag	Hannan-Quinn criterion (HQ)	Schwartz criterion (SC)	Akaike criterion (AIC)
0	3.413	3.63	3.29
1 [a]	-0.646 [a]	0.01 [a]	-1.01 [a]
2	-0.33	0.77	-0.95
3	-0.67	0.92	-0.88
4	-0.16	1.89	1.12

[a] Indicates lag order selected by the criterion

Table 3. The results of Johansen and Juselius test by using maximum Eigen values and trace test.

H_0 Hypothesis	H_1 Hypothesis	Eigen value	Trace statistic	0.05 critical value	Prob.	Max-Eigen statistic	0.05 critical value	Prob
r = 0	r=1	0.71	68.63	47.85	0.00	47.42	27.58	0.00
r ≤ 1	r=2	0.37	21.21	29.79	0.34	17.59	21.13	0.14
r ≤2	r=3	0.06	3.61	15.49	0.93	2.64	14.26	0.96
r ≤ 3	r=4	0.02	0.97	3.84	0.32	0.97	3.84	0.32

Also, it can be stated that since the revenue from oil export has a determining role in GDP, increase in revenues earned from oil export in turn causes increase in GDP and grain import demand during the mentioned period.

However, the effect of income inequality on grain import is positive, and the estimated coefficient for this variable is 0.55%, implying that 1% increase in income inequality increases grain import by 0.55%. Increase in income inequality will lead to changes in the composition of consumer goods; one of these consumer goods is grains that have low elasticity. Thus, with increase in income inequality, because of the decline in the purchasing power, lower-middle and poor strata will shift to consume more grains with relatively lower price in order to meet their needed calorie. Consequently, grain import would increase. The results obtained in this study are similar to the findings of Katsimi and Moutos (2011, 2006) and Adam *et al.* (2008). Furthermore, the coefficient of domestic grain production will be negative (-0.26%). This means that 1% increase in domestic grain production will decrease the grain import by as much as 0.26%. This can be explained by the fact that the issues of consumption pattern, population growth, and increasing per capita consumption, which are always a problem in the developing countries, lead to increase in grain demand. The estimated coefficient of the real exchange rate is negative (-0.07%). In other words, 1% increase in the real exchange rate may lead to 0.07% reduction in the grain import. In fact, with increase in the real exchange rate, the domestic currency is weakened and grain import becomes more expensive; then, demand for grain import decreases. In this case, competitive ability of the domestic grain production versus the imported grains increases. It is to be noted that the main reason of cheap imported grain in comparison with the domestic grain production is the excessive valuation of the domestic currency against the foreign currency backed by oil wealth. Mohammadi *et al.* (2011) and Afzal (2007) acknowledge the inverse effect of the real exchange rate on import.

Next, the VECM model was estimated for examining the adjustment speed of short-run error. The estimation results are presented in Table (4). As shown, the adjustment speed of short-run error toward equilibrium and

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long-run value is 0.54٪, which is statistically significant at 10% level, indicating that the speed of adjustment is towards long-run equilibrium. Furthermore, in each period, about 50% of non-equilibrium related to the previous period of grain import is adjusted.

CONCLUSIONS

Decrease in income inequality and increase in the income level of the poor increase the demand for essential goods such as grains because the marginal propensity to consume in this group of food staff is high. Thus, the country will face excess demand, part of which is offset by higher domestic production. However, since usually the ability of preparing all of the newly created needs from the domestic sources is lacking, the government is forced to import from other countries. The main purpose of this study was to investigate the relationship between income inequality and the grain import demand in Iran. There is no consensus among the economists about the impact of income inequality on grain import. This means that some researchers acknowledge the existence of positive relationship, some others believe in the negative relationship, and others deny the existence of any relationship between these two variables. Many researchers believe that if the country does not have comparative advantage in grain production, increase in income inequality may increase the demand for grain import. The present study, using VECM, examined the relationship of grain import with GDP, domestic grain production volume, real exchange rate, and income inequality in Iran during the period 1969-2009. The results showed the effect of income inequality on grains import was positive. In fact, with improvement in income distribution status and reduction in income inequality, the demand for grain import decreased. Also, the effect of real exchange rate and domestic grain production on grain import was negative while GDP had positive effect on grain import. Overall, it can be concluded that increase in income inequality in Iran has a direct effect on grain import.

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اثر نابرابری درآمد بر تقاضای واردات غلات در اقتصاد ایران

ا. شاه‌آبادی، م. نعمتی، و ه. ثمری

چکیده

در میان محصولات غذایی، غلات نقش مهمی در الگوی مصرف کشورها، به‌ویژه کشورهای درحال توسعه ایفا می‌کنند. از آنجا که در ایران منبع عمده‌ی تأمین کالری مورد نیاز مردم به‌طور مستقیم از غلات تأمین می‌شود؛ لذا بررسی و شناسایی عوامل تعیین‌کننده واردات این محصولات می‌تواند گام مهمی در جهت حرکت به سمت امنیت غذایی باشد. اکثر مطالعات تجربی واردات غلات را تنها تابعی از قیمت‌های نسبی و درآمد واقعی در نظر گرفته‌اند، درحالیکه نابرابری درآمد نیز متغیر تأثیرگذار بر واردات غلات است. لذا پژوهش حاضر به بررسی اثر نابرابری درآمد بر واردات غلات در اقتصاد ایران طی سال‌های ۱۳۴۸ تا ۱۳۸۷ پرداخته است. بدین منظور وجود رابطه بین واردات غلات با متغیرهای تولید ناخالص داخلی، میزان تولید غلات، نرخ ارز واقعی و نابرابری درآمد با استفاده از روش تصحیح خطای برداری($VECM$) برای کشور ایران مورد بررسی قرار گرفت. یافته‌ها حاکی از آنکه بین نابرابری درآمد و واردات غلات، رابطه مثبت وجود دارد و ضریب آن (۰.۵۵+) است. همچنین تاثیر تولید ناخالص داخلی بر واردات غلات مثبت و تاثیر نرخ ارز واقعی و تولید غلات بر واردات غلات منفی و معنی‌دار است.

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