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Analysis of Rice Import Trend and it`s Economic Factors: Case of Iran

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Abstract

Rice comes second after wheat in Iran`s food consumption economy. However Iran is one of the greatest rice importer countries all over the world because of it`s rising population and recent growth in GDP. This paper presents an analysis of cointegration test between rice import and it`s economic factors over the period 1990-2011, employing Engle-Granger model. At first, Dickey-Fuller test shows that all variables are non-stationary at data level, so their first difference (that are stationary series) are used. Secondly, Engle-Granger testing presents existence of a long-run relationship between rice import and it`s economic factors including per capita GDP, foreign exchange rate and domestic price. At last, rice import model was estimated using OLS method which proves that all independent variables are significant at high level and the sign of coefficients are consistent with theoretical expectations So that import of rice positively correlates with Per capita GDP, domestic price and negatively correlates with foreigh exchange rate. With respect to increasing demand for rice, government should keep domestic policies for the rise of rice production so that the need for import falls in the long-run.

Keywords:
Iran, Rice import, Economic factors, Cointegration

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INTRODUCTION

Rice has been an important cereal for human being over the history. Farmers first started growing rice in East and South Asia as long as 15,000 years ago, when people began to settle in river deltas and domesticated wild rice. Remains of early cultivated rice have been found in the Yangtze valley dating to about 8500 BC. Today rice is grown practically everywhere, except Antarctica. Rice is grown on flooded land and on dry land, in tropical rain forests of Africa and in arid deserts of the Middle East, on coastal plains and on the Himalayan mountains. In the year 2011, the world produced about 854 million tones of paddy rice. Most of that - about 771 million tones- was grown in Asia. It has been estimated that half the world's population subsists wholly or partially on rice. Ninety percent of the world crop is grown and consumed in Asia. Rice provides 27% of people's energy intake and 20% of their dietary protein. Its by-products are used for making straw and rope, paper, wine, crackers, beer, cosmetics, packing material, and even toothpaste.

In Iran, however, Rice is the only major cereal crop that is primarily consumed by humans directly as harvested, and only wheat and corn are produced in comparable quantity. Rice production is very difficult work and required a large number of field as well as several experts. Iranian people eat an average of 40 kilogram of rice every year. Iran ranks eleventh producer of rice in the world with an annual production 2000000 tones (2011), but the third importer of rice in the world.

Studying the trend of rice production and import during the period is very fruitful. Table 1 shows rice economy in Iran during 1986-2011. As table 1 shows, rice domestic production has an increasing trend as a result of increase in area under rice and use of high yield varieties. Despite this fact, domestic production has been always left behind consumption and this gap has been usually filled by import. High population and national income growth – resulting from sharp increase in postwar oil income – may be

Table 1: Rice economy, 1986-2011.

Year	Production (ton)	Import (ton)	Export (ton)	Price index($)
1986	981000	586556	-	-
1987	1605000	431988	-	0.135
1988	1216000	621709	-	0.137
1989	1484000	587383	-	0.152
1990	1776000	538713	-	0.155
1991	1784000	492679	-	0.247
1992	1803000	807442	-	0.246
1993	1419000	338287	-	0.239
1994	1854000	881503	-	0.351
1995	1981000	793657	-	0.355
1996	2357000	559708	20	0.398
1997	2364000	943837	2116	0.474
1998	2281000	1157508	3437	0.452
1999	2259000	481551	197	0.658
2000	2301000	1146698	1630	1.57
2001	2685000	915229	26	1.064
2002	2350000	637498	231	1.09
2003	2771000	631293	12	2.17
2004	2348000	1021836	425	3.11
2005	1971000	1167217	488	1.94
2006	1990000	698925	184	2.38
2007	2931300	1047499	448	3.02
2008	2888000	8750180	327	3.14
2009	1300000	6712638	-	4.11
2010	2931400	1044659	-	3.51
2011	2000000	1216192	-	-

Source: Iranian Statistical Headquarter

the main cause of such rise in rice consumption as the common food among Iranian families. Rice import is also considered as the best policy to control the domestic market as price goes up sharply. (i.e., see years 2007 and 2009). That is why government has maintained increasing rice import in order to equilibrate the domestic market. For instance, largest import belongs to year 2008 as a result of noticeable fall in domestic production and rise in domestic price.

The most important issue here is to determine which factors can significantly explain such great increase in rice import among variables such as domestic price, foreign exchange rate, domestic production and so on. This research tries to analyze Iranian rice import trend and it`s economic factors.

MATERIALS AND METHODS

Time-series data is needed to be integrated in the long period of time. The study of short-run dynamics is often done by first eliminating trends in the variables, usually by differencing. This procedure, however, throws away potential valuable information about long-run relationships about which economic theories have a lot to say.

Unit root test

Most of economic series have a unit root in the long-run .This fact has developed the theory of non-stationary time series analysis. A time series is stationary if the series mean, variance and autocovariances are independent of time. Variance and covariance of non-stationary series are changing over time; hence standard t tests in regression are no longer valid. Dicky and Fuller proved that if a series has a unit root , then t statistic for parameter estimates in a regression is no longer distributed as a student t. In order to avoid problem of non-stationary we should use the first or higher differentiated data. The Augmented Dickey-Fuller (ADF) test developed by Dickey and Fuller (1979) and Dickey and Fuller (1981) and Philips (1987). This test is based on the following regression:

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 t + \sum_{i=1}^{n} \beta \Delta y_{t-i} + u_i$$

$$u_t \sim \text{iid}\ (0, \sigma_\varepsilon^2) \qquad (1)$$

where Δ is the difference operator, y is the natural logarithm of the series, t is a trend variable, α and β are the parameters to be estimated and u_i is the error term.

In equation above series is non-stationary when α_1 is zero:

H_0: $\alpha_1 = 0$

H_1: $\alpha_1 \neq 0$

In ADF unit root test the null hypothesis shows that the series is non-stationary and has a unit root. It is shown as: $y_t \sim I(1)$. H_1 hypothesis shows that the series is stationary and shown as: $y_t \sim I(0)$.

If the t-statistic on the α_1 coefficient exceeds the critical value, the series are stationary. Critical values for this t statistic are given in Mackinnon (2010).

Cointegration test

Although economic series might be non-stationary in the long-run, there may exist a linear combination of the individual series that are stationary. Cointegration is a statistical concept to test for long-run relationship among various non-stationary series. The purpose of the cointegration test is to determine whether a group of non-stationary series is cointegrated or not. The theory of cointegration developed in Granger (1983) and elaborated in Engle and Granger and Weiss (1983) and Moenning (2001) addresses this issue of integrating short-run dynamics with long-run equilibrium. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship among the variables. Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary.

Suppose *xt* and *yt* are two random walks and hence are not stationary.That is, *yt* ~ I(1) and *xt*~I(1). Then *yt* and *xt* are said to be cointegrated if there exist a leaner vector of *yt* and *xt* that is stationary and we can find out that there is a long-run relationship between the trends in *yt* and *xt*. In general, it is expect that a linear combination of *xt* and *yt* would also be a random walk Yet, the two series may have the property

Table 2: ADF test for data (level and difference).

	Variables	t-value	Mackinnon value	p-value
Level	Rice import	-3.03	-3.24	0.000
	Per capita GDP	3.03	-3.24	0.000
	Domestic price index	-3.05	-3.25	0.000
	Foreign exchange rate	-1.93	-2.64	0.000
Difference	Rice import	-3.28	-2.99	0.000
	Per capita GDP	-4.79	-4.44	0.000
	Domestic price index	-5.91	-4.46	0.000
	Foreign exchange rate	-3.25	-3.01	0.000

Source: Research results

that a particular linear combination of them is stationary.

Several tests are proposed for examining the hypothesis that two time series are not cointegrated. The simplest one is based on testing the stationary of the error terms.

Using ADF test for the the error terms of equati

$$\Delta u_t = \alpha_0 + \alpha_1 u_{t-1} + \alpha_2 t + \sum_{i=1}^{n} \beta \Delta u_{t-i} + \varepsilon_i \qquad (2)$$

where α and β are the estimated parameters and ε is the error term. The number of lags (n) chosen in equation (2) should be sufficient to ensure that the error term ε, is white noise. The choice of n is based on the modified Lagrange Multiplier (LM) statistic. The test for cointegration involves the significance of the estimated coefficient. Again the null hypothesis is that the error terms are non-stationary and acceptance of this hypothesis indicates that the series are not integrated.

VECM Correction

A vector error correction (VEC) model is a restricted VAR that has cointegration restrictions built into the specification, so that it is designed for use with non-stationary series that are known to be cointegrated. The VEC specification restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short-run dynamics. As the VEC specification only applies to cointegrated series, you should run the Johansen cointegration test prior to VEC specification. The cointegration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. Pesaran & Smith (2001).

RESULTS

It is not valid to perform OLS regression on non-stationary variables Because of the potential for spurious regression. For example, if the variables are all trending upwards then any correlation between them may simply reflect this fact rather than a genuine correlation between the variables. But we often want to test if there is a relationship between variables that are non-stationary. For this reason, we should use cointegration test to see if the variables have a common trend. If all the variables are trending upwards in a similar fashion, then they are genuinely correlated in some way. In this part of research, we examine the stationary of series involving in the rice import function including: rice import (as dependent variable), foreign exchange rate, Per capita GDP and domestic price index (as independent variables). Table 2 shows the result of ADF test for series above in their level and first differences. The results of the unit root tests demonstrate that all series are non-stationary in levels, but stationary in first differ-

Table 3: ADF test for residuals.

	Variable	t-value	Mackinnon value	p-value
Level	Error term	0.000	0.000	0.00

Source: Research results

Table 4: Result of estimation of rice import equation: 1986-2011.

Variables	Parameters	Standard Error
Per capita GDP	0.021 ***	0.038
Domestic price index	0.53 ***	0.22
Foreign exchange rate	-1.94 **	0.073

R^2=98 Method: OLS Number of Observation = 26 D.W=1.99

ences (they have a unit root). The t-statistics for all series are greater (less negative) than the critical values in levels leading to the acceptance of the null hypothesis of non-stationarity. Whereas the first difference results show that the null hypothesis can be easily rejected at the 5% significance level and hence acceptance that all the series are stationary when first differenced. The results show that all the series tested are not stationary in (log) levels but are stationary after being differenced once, fulfilling a necessary condition for cointegration. All the series are therefore assumed to be integrated of order one.

Testing for cointegration involves testing the residuals from an OLS regression for stationarity. A cointegrating relationship can only exist between I(1) variables, i.e. variables whose first difference is stationary. So unit root tests must be performed in order to establish the order of integration of the variables. Given a set of I(1) variables, testing for cointegration involves two steps: first, estimate an OLS regression on rice import equation; second, examine a unit root test on the residuals of this regression to study whether they are stationary or not. If the error term is tending to increase over time, the variables are not related - they are not cointegrated. As table 2 obviously shows the residuals of rice import equation are stationary using ADF test, because the t-statistics for residuals are less than the critical values in level. So, the null hypothesis of a unit root is rejected at the 5% significance level, the residuals are stationary, and thus a long-run, cointegrating relationship exists between the variables.

Estimation of rice import function

In the final step, rice import function is estimated using OLS method while confident about the correction of results. Although all series in rice import function are non-stationary, regression would not be spurious, because Engle-Granger test firmly demonstrated that all series are cointegrated. Estimation results of rice import function over the period 1986-2011 are presented in table 4 below. The overall fit of the equation is very good (R^2 = 0.97) and variables tend to have the expected signs at the highest level of significance.

As expected, rice import is positively correlated per capita income GDP and domestic price index a negatively correlated with foreign exchange rate. 1, 2 and 3 stars above parameters show significance at 10, 5 and 1 percent level respectively. Per capita GDP growth in a country with high income elasticity of demand for food- such as Iran- raise the demand for food considerably. On the production side, inelastic supply due to technological restrictions leads to a huge gap between demand and supply of food. Consequently the price of food goes up and import rise is inevitable in order to equilibrate the domestic market. On the other hand, money depreciation leads to reduction in foreign exchange rate, lowered the price of imported rice and raised the import.

CONCLUSION

Cointegration test between some variables is a test for existence of a long - term relationship between them. This research presented an analysis of cointegration test between rice import and it`s economic factors over 1986-2011, using Engle-Granger test. In the first step of results, a Dickey-Fuller test showed that all variables are non-stationary in levels, but stationary in their first differences. In the second step of results , Engle-Granger test confirmed the stationary of residuals of rice import function leading to the acceptance of cointegration between rice import and it`s economic factors including per capita GDP, foreign exchange rate and domestic price index. Finally rice import function was estimated using OLS method which demonstrated

that all independent variables were significant at high level and the sign of coefficients were all consistent with theoretical expectations. As we discussed the negative effect of foreign exchange rate on rice import, authorities must protect trade barriers as an economic stimulus for farmers and reduce inflation rate which rises foreign exchange rate and consequently the cost of rice import.

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