



## An Analysis of the Relationship of Imports and Economic Growth in Iran (Comparison of Systematic and Unsystematic Cointegration Methods with Neural Network)

Nasser Ebrahimi\*

Department of Economics and Theoretical, Faculty of Management and Economics, Payame Noor University, Tehran, West Branch, Iran. \*Email: [nasserebrahimi60@yahoo.com](mailto:nasserebrahimi60@yahoo.com)

### ABSTRACT

The present study is intended to analyze the relationship of imports and economic growth in Iran using systematic and unsystematic cointegration methods and neural networks and to compare them with each other. The data used in this study are the real gross domestic product (GDP) and the total imports of Islamic Republic of Iran during the years 1961 to 2010. In this study, the concerned time series were tested by unit root testing. Then the data were examined and the results were analyzed using an autoregressive distributed lag modeling, error correction model, and maximum likelihood method of Johansen-Julius. The statistical and estimated processes of the present study were carried out using Microfit and EViews 7 software. The artificial neural networks were also modeled by MATLAB software. The findings show that no cointegration relationship is supported between GDP and imports when the real GDP is a dependent variable and total import is an independent variable. However, the existence of cointegration relationship between total import and real GDP is supported when the total import is a dependent variable and the GDP is an independent variable. The use of neural network for modeling of the relationship of two variables shows a reliable result.

**Keywords:** Economic Growth, Total Import, Autoregressive Distributed Lab Modelling, Error Correction Model, Artificial Neural Networks

**JEL Classifications:** F1, F4

### 1. INTRODUCTION

One of the main issues that has been under discussion among economists in recent decades is economic growth. The goal of growth theories is to explain and clarify the factors that determine and affect growth rate of countries and to explain why growth rates and per capita incomes are different among countries. One of the factors that had a significant impact on economic growth of developing countries and attracted the attention of many economists to itself is reliance on foreign trade for growing.

The role of foreign trade is more important in economic structure of third world countries. These countries have a great need for both export incomes and import of all kinds of products and materials that are needed for foundation of industrial structure. There are many other reasons based on which it can be said that inattention to the role of foreign trade faces the models and definitions of growth with defects and problems.

In the second half of the twentieth century we witnessed a considerable increase in the growth of theories and studies on the relationship of politics-commerce and economic growth. Despite disagreements on the direction of their relationship, much evidence shows that commerce improves economic growth. Some scientists tried to show in their studies that the reason of economic growth is export. While some other tried to show the theory that the reason of export is growth. Another group believe that import is the main director of the process of economic growth. Different frameworks proposed some theories for explanation of differential rate of economic growth for similar nations. Open economic models are rooted in endogenous growth models (Romer, 1996; Lucas, 1988) and focused on determining factors of growth (Brro et al., 1995; Roubini et al., 1995).

Despite increasing concern about injustice in income distribution, advanced emerging economies have benefited from external effects of open trade policy (Bhagwati et al., 2002; Wacziarg, 2003;

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**AQI** Spannu, 2003; Harrison, 1996). According to the findings of researchers, 85% of transportation devices and machinery needed by emerging economies are imported from developed world and this has an important role in their economic growth (Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1993). Edwards (1992) studied the relationship of trade orientation and trade diversion in endogenous model and concluded that “open economies grow faster because they are able to invest on provision and use of imported machinery which are cheaper” (Mazumdar, 2001).

**AQI** According to Delong and Summers theory, investment on machinery increases growth. Foreign imported machinery are more efficient than their similar domestic ones (Quah and Helpman, 1995; Krishna et al., 2003; Mazumdar, 2001). “Therefore, the research experience and the total material collected earlier shows that the total studies carried out make a theoretical background for believing the positive impact of foreign trade on economic growth. These theories particularly support the consumer goods import of industry that are commonly referred to as ‘Intermediate Goods’ or ‘Investment Goods’ (Lee et al., 1995. p. 92).” Krueger states that “a decrease in import of investment goods leads to a decrease in growth rate and a decrease in import of raw materials and intermediate goods leads to the decrease of employment and output.”

With regard to the forgoing it is clear that despite relative acceptance of a general existence of a positive and effective relationship between imports and economic growth, no exact response and estimation has been achieved for the type and direction of the relationship between imports and economic growth and in order to find a more appropriate response it is better to analyze and model the long-run relationship of imports and economic growth. Thus, insufficiency of research on existence and direction of cointegration relationship between import variables and economic growth variables is evident and this study intends to analyze the relationship of imports and economic growth from this point of view.

## 2. THEORETICAL BACKGROUND

Many scientists believe that international trade policies can increase income growth rates. Recently, many researchers designed different patterns for open economy that show foreign goods import have a significant importance in determination of the relationship of trade and growth.

Grossman and Helpman (1991), Rivera-Batiz (1990), Romer (1990) and Quah and Rauch (1990) showed that international trade can speed up the growth rate by providing a wide range of intermediate inputs which facilitate further research and development via learning-by-doing.

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According to Summers and Heston data of national and dollar price indices for total goods group, 60 countries were categorized into six groups according to their per capital income. The data used in Table 1 shows the ratio of total price to international price and the difference between domestic price and international price in each general goods group and country. It is worth mentioning that the criterion for categorization of each six income groups is gross domestic product (GDP) of the United States, so that the countries whose GDP is <10% of the GDP of the United States are categorized as low income countries and the countries whose GDP is more than 75% of the GDP of the United States are categorized as rich and high income countries. For example, the national prices of domestic investment goods in the first group, which comprises low income countries, are relatively expensive and are compared, showing figure 155, with the international price which is the price of the United States.

The data of first row show that the price of consumer goods is decreased with income. In contrary the third row shows that the price of investment goods with respect to consumer goods is dramatically decreased with per capital income. Therefore, the relative price of investment goods with respect to consumer goods is higher in low income countries.

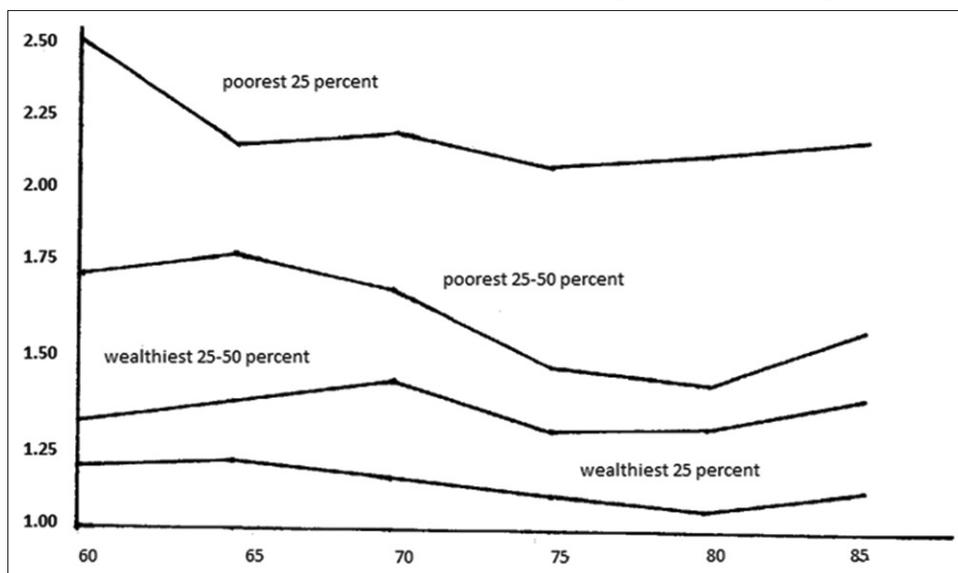
However, price indices are limited for showing the relative price trend of investment goods over time. For this reason it is not possible to cover a wide range of countries especially for coming years. For the analysis of this problem that the negative relationship of relative price of investment goods and per capita income continues over time, the relative price of adjusted investment to adjusted consumption are stated in the four groups of countries which are categorized with per capita income of 1960. Figure 1 shows the negative relationship of relative price of investment goods and per capita GDP is stable overtime in income groups and the countries with low income have a higher relative price of investment goods. However, all the evidences show that investment goods are relatively cheaper in rich countries. Thus developing countries import investment goods from developed

**Table 1: Relative price of consumer goods and investment goods in countries with different income groups 1980**

Group of countries	1	2	3	4	5	6	Total
Number of countries	12	14	10	10	8	6	60
Per capita GDP (a percent of the United States GDP)	>10%	10-20	20-35	35-60	60-75	<75%	
Consumer goods (A)	106	105	106	102	96	91	104
Investment goods							
Domestic investment (B)	155	146	112	95	93	94	115
Durable production (C)	149	172	131	115	84	84	124
Equipment (D)	170	135	98	87	99	100	110
Relative price of investment goods to consumer goods							
B/A	1.46	1.39	1.06	0.93	0.97	1.03	1.11
C/A	1.41	1.64	1.24	1.13	0.88	0.92	1.19
D/A	1.60	1.29	0.92	0.85	1.03	1.09	1.06

Resource: Summers and Heston. GDP: Gross domestic product

**Figure 1:** Price of investment with respect to adjusted consumption by income groups of 1960-85



countries and blend them with their domestic investment goods and produce the investment good section. Therefore, cheaper investment goods speed up growth in less developed countries and consequently the growth rate is higher in those countries that use imported investment input more than domestic produced input in investment (Jong-Whalee, 1995).

### 3. LITERATURE REVIEW

#### 3.1. Domestic Literature Review

Sameti et al. (2004) studied “The Effects of Globalization on Iranian Importing Patterns” in an article (1959-2002). They based their studies based on two assumptions: (A) The traditional pattern of exogenous relative price is not a proper pattern for estimation of the function of import demand due to import restrictions. (B) Globalization has a positive impact on the function of Iranian import demand and tested their theories using econometric models. The findings of this study show that the variable coefficient of import relative price in the import demand model is not a significant linear form. According to the findings of this estimation, it seems that the globalization process and global economic integration makes an increase in Iranian imports.

Mahmoodzadeh and Mohseni (2006) analyzed the long-run and short-run impacts of imported technologies on Iranian economy during 1959-2003 in their article entitled “An Analysis of the Impact of Imported Technology on Iranian Economic Growth” using Johansen’s cointegration methodology (1998) and vector error correction model (ECM). They state in their article that import of proper technology is the basis of industrial and social evolution for transferring from traditional production to industrial production and moving through the stages of economic development. They further used forecast error variance decomposition and impulse response function to analyze dynamics and concluded that there is no cause and effect relationship between intermediate import and non-oil GDP in the short-run but there is weak cause and effect relationship between investment import and GDP. The impact of

imported intermediate and investment inputs for 5% in the long-run is considerable.

Tehranchian (2006) in an article entitled “Impact of Imports on Iranian Economic Growth” studied the impact of import of investment, intermediate and consumer goods on Iranian economic growth during the years 1973-2006. He used Rati Ram’s model for the analysis of the impact of import types on economic growth and collected his data on a library-based research. By analyzing the country’s import trend, Tehranchian showed in his article that despite an increase in the import of said three groups of goods, particularly after implementation of development plans, the composition of imported goods is changed to the benefit of intermediate and investment goods. Further, according to the proposed econometric model, the coefficients of economic growth trend is estimated to be 0.06 compared to investment and intermediate goods and 0.22 compared to consumer goods. This indicates the direct impact of import of investment and intermediate goods and the indirect and decreasing impact of import of consumer goods on Iranian economic growth index.

Dadgar and Nazari (2010) analyzed in an article entitled “Analysis of Import Demand Function in Iran” the function of import demand using vector autoregression approach for 1974-2007. According to the findings of this study, the impact of non-oil GDP and oil incomes is positive on import but the impact of relative price is negative on import.

Bastani and Njafian (2011) analyzed the country’s import in past plans in an article entitled “An Analysis of Import Function and Forecast” and explained the great objectives and proper approaches, policies and strategies for achieving the determined goal. The two researchers are trying to find a proper import composition for Iran in order to make a positive impact on Iranian economic growth. They analyzed the current status of import and the fifth development plan and believe that the current composition of the type of goods that are imported to the country is not proper for development and does not meet the requirements of Iranian economic forecast and

for the purpose of fast economic growth not only the import volume shall be increased, but the imported goods composition shall be changed to the benefit of investment and intermediate goods, so that imports will have more impact on production. However, they also pointed out in their study the problem of smuggling and the damage it causes to the role of import in economic growth.

**AQI** At the same time, **Esfahani (2012)** analyzed the impact of commerce on economic growth (1960-86) using the statistics and figures of 13 industrial countries and a system of equations and showed that import of intermediate goods has had a positive and significant impact on the growth of those countries and import restrictions on such goods will have a negative impact on their economic growth.

### 3.2. Foreign Literature Review

**AQI** **Rodrigues (2010)** studied the import experience in Latin America during the years 1950 to 1980 in a study entitled “Import Substitution and Economic Growth.” The importing policy had been restricted in that period. In this study, the time series data are analyzed in the Heckscher–Ohlin model considering the ratio of advantage to capital scale. At the beginning of this period the economy is an open economy and the statistics show that manufacturing of user products are confirmed. Further, trade policy is modeled according to a movement towards closed economy. The model which is designed in this article is completely suitable for the experience of Latin America and is more suitable and efficient for small countries which do not experience a long-run income growth but experience a capital growth.

Kogid et al. (2011) studied the role of import in economic growth of Malaysia in an article entitled “Does Import Affect Economic Growth in Malaysia?” They used the systemic cointegration method and the causality test based on Engle-Granger two-step method, Yvanson method, and Toda-Yomada method of Granger for the analysis of the relationship of these two variables in the time series of 1970-2007. The findings show that there is no correlation between imports and economic growth. The findings also show that imports affect economic growth indirectly but economic growth affects imports directly.

**AQI** **Priede (2012)** studied the relationship of increased import volume and regional GDP per capita in a paper entitled “Import Impact of Economic Growth on Regional Economies” over 10 years period between 1995 and 2005 in several European countries. The researcher believes that increased import area and increased import volume are usually reducing factors of income. However, contrary to public belief, the results of this study showed that these two factors had a positive impact on the increase of regional income. Thus, the researcher does not recommend any import substitution.

**AQI** **Owen et al. (2012)** analyses the economic data of the United States in 2009 in an analytical article entitled “Imports and Economic Growth.” They first focus on a 7.5% increase in GDP in the fourth quarter of 2009 and try to determine the contribution of imports in different parts of the United States economy and Commerce Department by data analysis. Slow consumption of inventory alone added a 3.7% points to GDP growth rate and increased export,

personal consumption expenditure, and business and residential investment together added 3.4% points to GDP growth rate. In contrast to these two factors, increased import decreased the GDP growth rate by 1.4%.

In an article entitled “Impact of Imports, Exports, and Foreign Direct Investment on the GDP Growth,” **Atif (2012)** studied the same issues for the period 1980-2009 in Pakistan. He points out in his article that the GDP growth is an economic growth index as a dependent variable. In this study scatterplot matrices are used to analyze the relationship of variables. His findings show that as it was expected, the coefficients of all four statistical coefficients are significantly positive. The impact of foreign investment on economic growth of Pakistan had been low and insignificant. This shows that there has not been sufficient policies in this regard for benefiting from foreign investment. However, this has not been considered a problem in the period under question. Exports showed a significant impact on the increase of economic growth. Also, import of different kinds of services and goods showed a significant impact on increase of economic growth.

## 4. OBJECTIVES

The main objective of present study is the analysis of existence and direction of cointegration relationship between imports and economic growth in Iran. To this end, two systematic and unsystematic cointegration methods and neural networks are used for the analysis of the subject under question and the two methods are compared for presentation of a better model.

## 5. HYPOTHESES

- A. There is a long-run cointegration relationship between real GDP as an independent variable and total import as a dependent variable
- B. There is a long-run cointegration relationship between total import as an independent variable and real GDP as a dependent variable.

## 6. RESEARCH METHODOLOGY

The purpose of this study is to analyze the relationship of imports and economic growth in Iran. To this end, one of the most suitable econometric models that helps the researcher to achieve his purpose to a great extent is chosen. In the present study, the autoregressive distributed lag modeling (ARDL) is used as an unsystematic cointegration model compared to maximum likelihood model as a systematic cointegration model for the analysis of the relationship of variables. As time series are analyzed in this study, the reliability of variables is first studied by Dickey-Fuller test and then the two methods are tested for the analysis of the relationship of variables and the results are examined.

## 7. NEURAL NETWORKS

Artificial neural networks are intelligent systems that are inspired by biological neural networks. Artificial neural networks are actually

## 10. FINDINGS OF RESEARCH

### 10.1. Analysis of Time Series

As in econometric methods, reliable analyses are based on the assumption of reliability of time series analyses, it is necessary that the model under question be examined with respect to reliability beforehand. One of the most common tests that is used today for determination of reliability of variables in a time series process is Dickey-Fuller test for unit root (Table 2).

The condition for reliability of variables in this test is unit root in which absolute value of augmented Dickey-Fuller (ADF) critical value shall be larger than the absolute value of ADF statistic. As it is shown in Table 1, for all the variables a unit root test was first carried out with the model without intercept or trend. The results showed (with comparison to obtained statistic and critical values) that both variables were unreliable and it can be concluded that the two time series variables under question has a unit root. Then the unit root test was repeated with a model without intercept and trend for first differencing of two variables and the results showed that the first differencing of the two variables without trend or intercept is reliable.

### 10.2. Optimal Interruption Determination Test

Due to the high sensitivity of ARDL method to the number of interruptions, the correct number of interruptions shall be first tested. Akaike information criterion (AIC) is used here for determination of optimal interruptions. Table 3 shows the optimal interruption test. According to the AIC, the number of optimal interruptions in this study is 4 interruptions.

### 10.3. Cointegration Test When the Real GDP is a Dependent Variable

Table 3 shows boundary testing for existence or nonexistence of cointegration relationship when the real GDP is a dependent variable and total import is an independent variable.

According to the results shown in Table 4, when the RGDP is a dependent variable and the IM is an independent variable, the existence of long-run cointegration relationship between variables is rejected because the computed F-statistic (1.79) is less than upper and lower boundaries in all significance levels.

### 10.4. Cointegration Test When Import is a Dependent Variable

Table 4 shows the boundary testing for existence or nonexistence of cointegration relationship when total import is a dependent variable and economic growth is an independent variable.

According to the results shown in Table 5 when total import is a dependent variable and real GDP is an independent variable,

an attempt for movement from Von Neumann computational model to a model which is designed according to the function and characteristics of human brain. Although Von Neumann model is widely used, it suffers from some shortcomings which has been tried to be overcome in the artificial neural networks. A neural network learns by determining the relationship of inputs and outputs. This relationship is determined by computation of the relative importance of inputs and outputs. According to trial and error, the systems compares its results with the results presented by the specialist until it reaches a certain level of accuracy. With each test weights, the ratio of inputs changes until a desired result is achieved (Hyken, 1999).

## 8. SAMPLING AND STATISTICAL POPULATION

The present study analyzes the data of total value of real GDP and total import using the annual time series in a 49-year period (1961-2010) in order to examine the relationship of these variables.

## 9. METHOD OF ANALYSIS

The neural network model used in this study is a multilayer perceptron with error back propagation learning algorithm. One neuron was used as input variable, 5 neurons were used for transfer of learning function and one neuron was used as output variable for the design and network training. "tansig" function was used for the transfer of input data to the hidden layer and "pureline" function was used for transfer of data from hidden layer to output layer. Levenberg Matquart learning algorithm was also used for network training. It is worth mentioning that these conditions were considered quite stable for modeling of impact of imports on economic growth and vice versa (Figure 2).

Figure 2: The neural network design used in this study

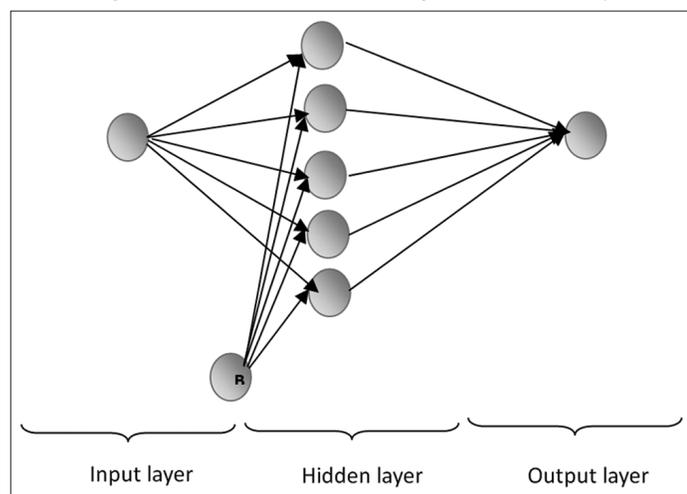


Table 2: Results of ADF test on variable algorithms

Variable	Without differencing			After differencing		
	ADF statistic	ADF critical value at 5% level	Status	ADF statistic	ADF critical value at 5% level	Status
Ly	-2.24	-3.50	Unreliable	-2.96	-2.92	Reliable
Lim	-2.29	-3.50	Unreliable	-3.85	-3.51	Reliable

ADF: Augmented Dickey-Fuller

the existence of long-run relationship between variables is supported at the 10% level because the computed F-statistics (5.20) is more than upper and lower boundaries at significance level of 10%.

### 10.5. Johansen Cointegration Test ( $\lambda_{max}$ and $\lambda_{trace}$ )

For applying the fully modified ordinary least squares method and obtaining long-run parameters, there should be a cointegration relationship between a set of I(1) variables. As it is seen in Tables 6 and 7, existence of a cointegration vector is determined according to  $\lambda_{max}$  and  $\lambda_{trace}$ .

The two methods of Johansen-Julius testing support the existence of a long-run cointegration relationship when the total import variable is a dependent variable and the real GDP is an independent variable and shows that unsystematic cointegration test (boundaries testing) and systematic cointegration test (Johansen-Julius testing) will show similar results with regard to existence of a long-run cointegration relationship when the total import is a dependent variable and the GDP is an independent variable.

**Table 3: Optimal interruption test when the real GDP is a dependent variable**

SBC	AIC	LL	Interruption
56.33	60.73	65.73	0
56.63	60.15	64.15	1
58.0	60.64	63.64	2
53.55	55.32	57.32	3

SBC: Schwarz's Bayesian criterion, AIC: Akaike information criterion, LL: Log likelihood

**Table 4: Results of boundary testing when the real GDP is dependent variable**

Upper and lower boundaries		Significance level (%)	Interruption	Numerical value of F-statistics (P value)	Statistical test
I (1)	I (0)				
7.81	7.05	1	4	1.79 (0.183)	F-statistics
5.76	4.93	5			
4.78	4.04	10			

GDP: Gross domestic product

**Table 5: Cointegration test when total import is a dependent variable**

Upper and lower boundaries		Significance level (%)	Interruption	Numerical value of F-statistics (P value)	Statistical test
I (1)	I (0)				
7.81	7.05	1	4	5.20 (0.011)	F-statistics
5.764	4.934	5			
4.788	4.042	10			

**Table 6: Quantities of  $\lambda_{trace}$  for determination of the number of cointegration vectors**

Hypothesis $H_0$	Hypothesis $H_1$	$\lambda_{max}$	Critical value 0.05
$r=0$	$r \geq 1$	14.6528	11.0300
$r \leq 1$	$r \geq 2$	0.72731	9.2800

### 10.6. Estimation of a Long-run Relationship between Total Import and Real GDP

In cointegration tests carried out during the stages of this study, the existence of cointegration relationship between total import variable and economic growth variable was supported, provided that total import is a dependent variable and economic growth is an independent variable. Now, the long-run relationship of the research model can be estimated as the second stage of ARDL method. The Table 8 shows the estimation of long-run coefficients.

As the findings show the trend of total import compared to real GDP is 1.68. In other words, 1% increase in economic growth of Iran makes a 1.68% increase in total imports. Similarly, the t-statistics show that the estimated coefficient is statistically significant at the 1% level.

### 10.7. Goodness of Fit Test

Before estimation of long-run coefficients, some diagnostic tests shall be conducted on the research model. Table 9 shows the results of goodness of fit diagnostic tests. According to the findings of this table, the linear regression with regard to bias (autocorrelation), consequential form, normality of residuals, and homogeneity of variance are all classical assumptions and pass all the goodness of fit test.

### 10.8. Estimated Coefficient Stability Test

There are different tests for examination of stability of regression estimated coefficients. One of these tests is Chow test. In this test, a break point must be chosen in advance. However, in most applied studies such information is not available in advance. In such case, diagnostic tests are used based on autoregression analysis. Cumulative sum of recursive of recursive residuals (CUSUMSQ)

**Table 7: Quantities of  $\lambda_{max}$  testing for determination of the number of cointegration vectors**

Hypothesis $H_0$	Hypothesis $H_1$	$\lambda_{max}$	Critical value 0.05
$r=0$	$r \geq 1$	14.7326	12.3600
$r \leq 1$	$r \geq 2$	0.079731	10.2500

**Table 8: Estimation of long-run relationship of total import and real GDP**

Variable	Estimated coefficient	P value	t-statistics
C	-11.73	0.005	-2.94
Real GDP logarithm (Ly)	1.68	0.000	5.17

GDP: Gross domestic product

**Table 9: Goodness of fit tests in ARDL model**

Characteristic	CHSQ	F-statistics
Bias (autocorrelation)	[0.164], 1.9380=(1)	[0.188], 1.7935=(38.1)
Consequential form	[0.891], 1.18827=(1)	[0.898], 0.016646=(38.1)
Normality of residuals	[0.953], 0.09647=(2)	Not applicable
Homogeneity of variance	[0.242], 1.3692=(1)	[0.252], 1.3484=(41.1)

ARDL: Autoregressive distributed lag modeling, CHSQ: ???

and cumulative sum of square residuals (CUSUM) are two of these tests. Pesaran and Chin (1997) proposed the use of CUSUMSQ and CUSUM tests for determination of stability of short-run and also long-run parameters in the ECM.

Figures 3 and 4 show the statistical data of economic growth and total import which are estimated with respect to stability during time. The straight lines in charts represent the 5% significance level. As it can be seen in these charts, the movement path of test statistics in both variables is so that they are constantly within straight lines and do not indicate instability of the model. According to these tests, the hypothesis of coefficient stability at 5% significance level cannot be rejected for any of the variables and it can be concluded that the function of economic growth and total imports has been stable during the period under question.

### 11. SHORT-RUN DYNAMICS

Now, the short-run dynamics can be analyzed with the use of a long-run equilibrium relationship. This is referred to as ECM. The ECM relates the short-run changes of variables to their long-run values. Macrofit has a feature that can present a related ECM when the long-run equilibrium model is extracted in relation to ARDL model of Pesaran and Chin. The results of short-run ECM is shown in Table 10.

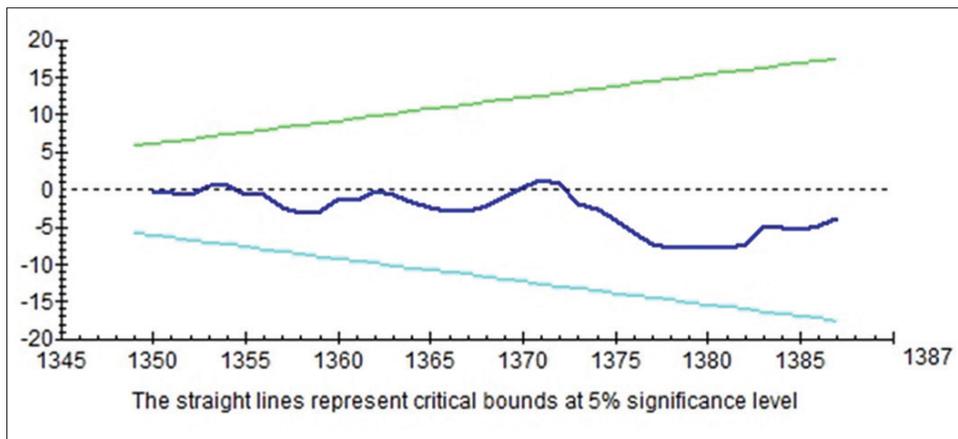
According to results shown in Table 10, the coefficient of error correction sentence shows that in each period some percent of short-run non-equilibrium of economic growth is adjusted to reach the long-run equilibrium. In other words, this coefficient shows that it takes several periods until it reaches its long-run trend. Therefore, as the results of ECM shows the coefficient of error correction sentence in ECM is  $-0.18$  and the low numerical value of this figure reveals that the equilibrium speed is too slow for reaching a long-run equilibrium. By observing the results shown above, it can be seen that the short-run coefficient of real GDP is  $2.26$  and is statistically significant at 1% confidence level. Comparison of this coefficient with long-run coefficient shows that the impact of real GDP on total imports in Iran is bigger in a short-run period than a long-run period ( $1.68$ ). In other words, if the real GDP is increased by 1%, the total imports will be increased by 2.26% in a short-run period.

**Table 10: Short-run dynamics of total import and real GDP**

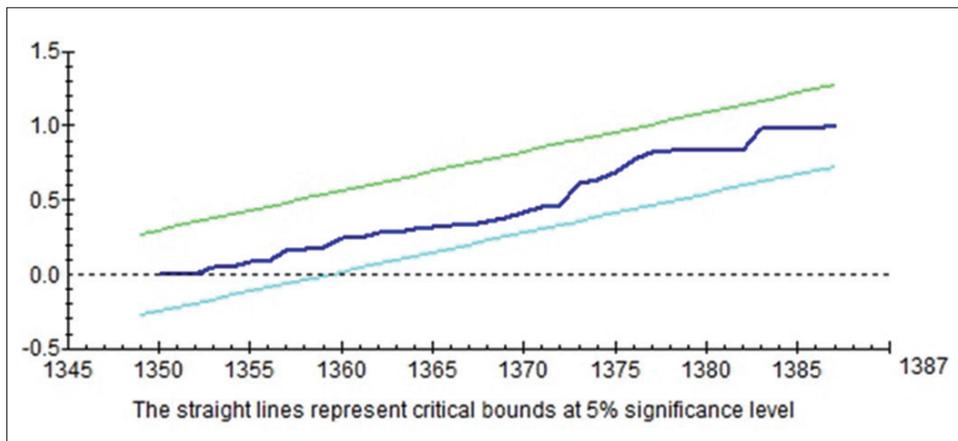
Variable	Estimated coefficient	P value	t-statistics	Standard deviation
DLY	2.26	0.000	4.1021	0.55187
C	-2.12	0.088	-1.74641	1.2139
ECM (-1)	-0.18	0.053	-199281	0.090677

GDP: Gross domestic product, ECM: Error correction model

**Figure 3:** Economic growth stability test for autoregressive distributed lag modeling model



**Figure 4:** Total import stability test for autoregressive distributed lag modeling model

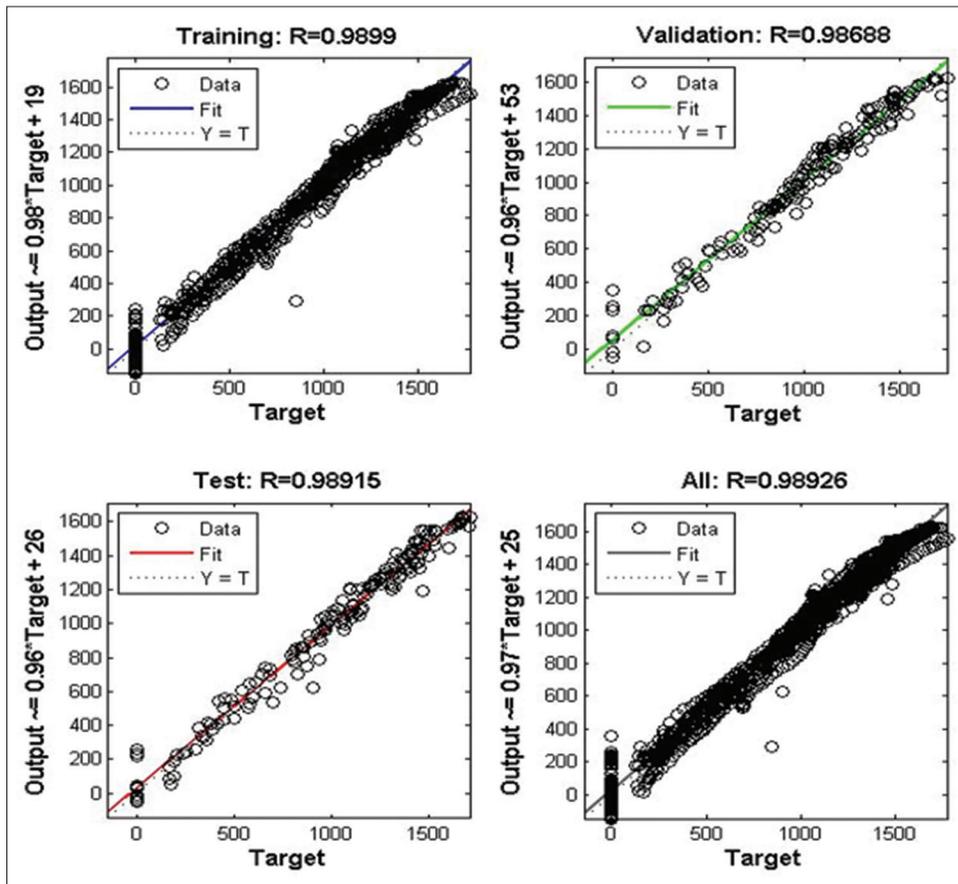


## 12. NEURAL NETWORK MODELS

Figure 5 shows the goodness of fit testing for neural network of impact of imports on economic growth for training data and assessment and validation. As it can be seen in figures, R is up 0.9 in all the three categories. Figure 6 also contains such information as the total R of the model, comparison of model data and real data, and the error histogram.

Figure 7 shows the goodness of fit for neural network model of impact of economic growth on imports for training data, assessment and validation. As it can be seen in figures, R is up 0.9 in all the three categories. Figure 8 also contains such information as the total R of the model, comparison of model data and real data, and the error histogram. It can be inferred from all the figures that the model presented for impact of economic growth on imports by neural network is a desirable model.

**Figure 5:** Goodness of fit testing for design data of neural network model of impact of imports on economic growth



**Figure 6:** Neural network model of impact of imports on economic growth

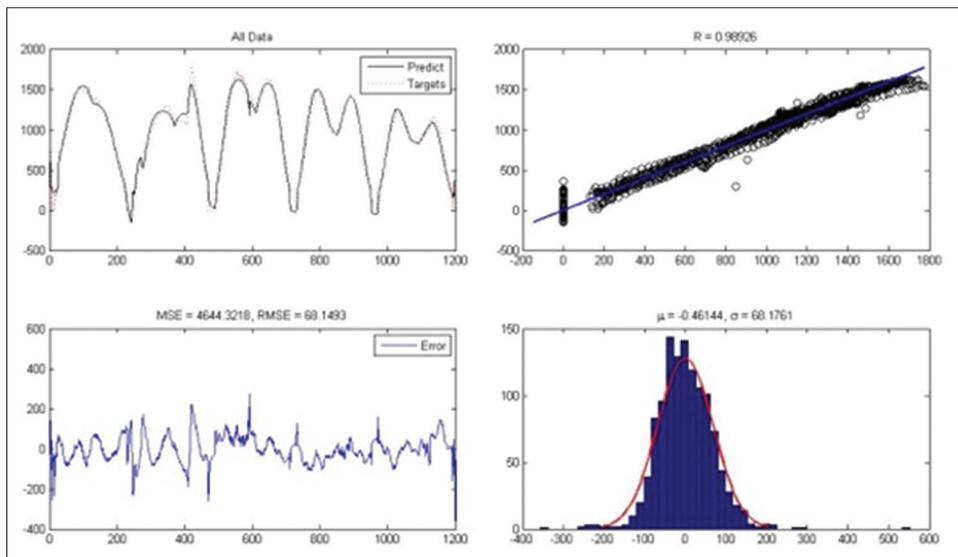


Figure 7: Goodness of fit testing for design data of neural network model of impact of economic growth on imports

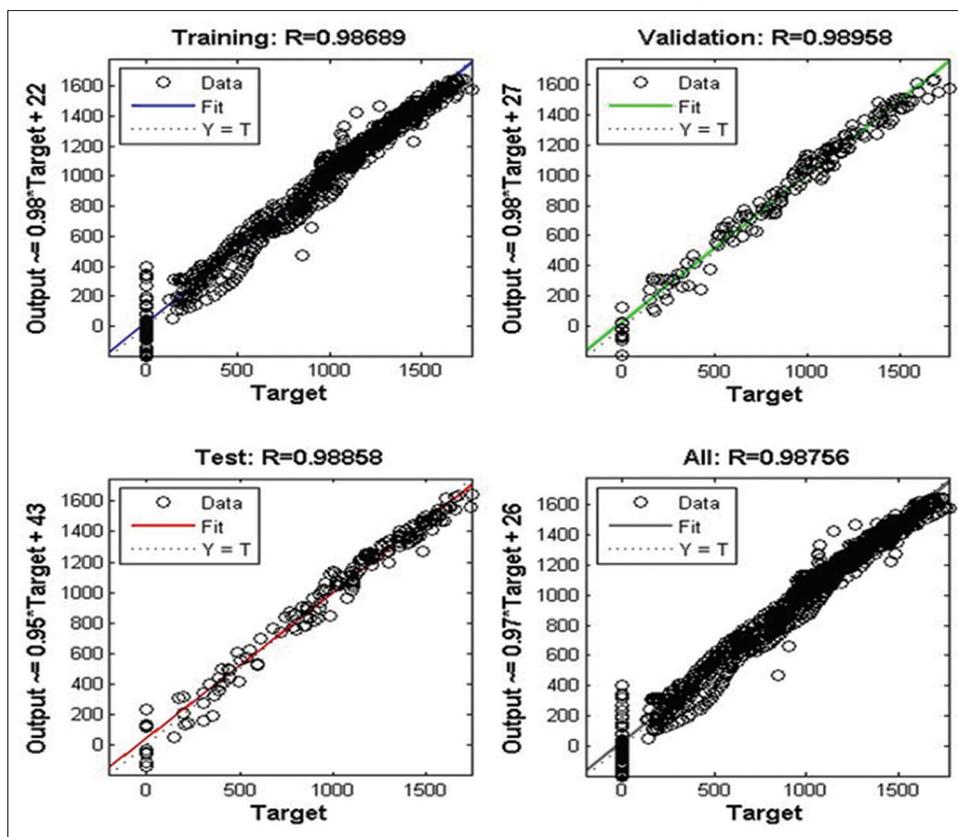
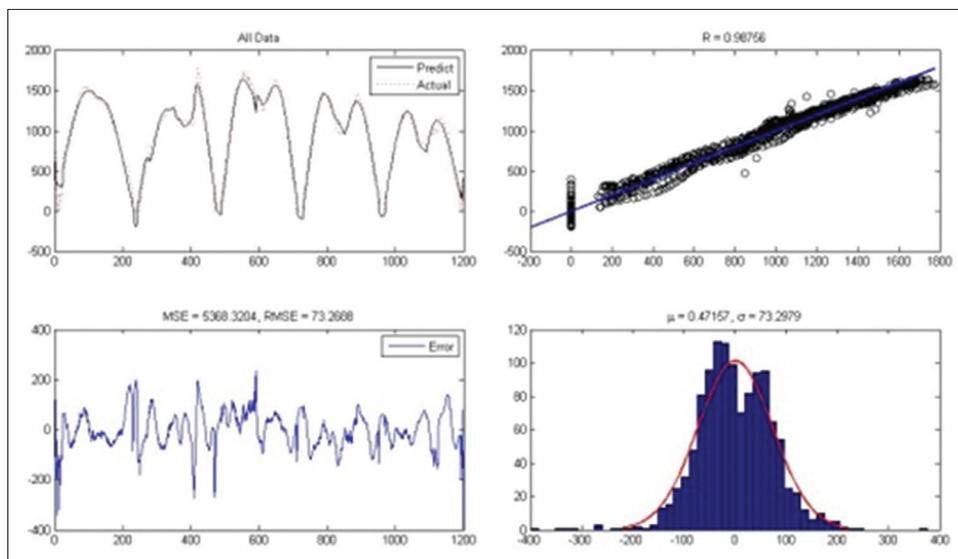


Figure 8: Neural network model of impact of economic growth on imports



### 13. CONCLUSION AND SUGGESTIONS

The hypotheses of this study were analyzed using the annual time series of the period 1961 to 2010. The variables under question in this study include total import and real GDP which is referred to as economic growth. This data is collected from the Central Bank of Islamic Republic of Iran and Statistical Centre of Iran. In order to analyze the data in a short-run period, the error correction mechanism and autoregressive method were used with distributed interruptions and in order to analyze the data in a long-run period,

boundary testing and Johansen-Julius testing and neural network modeling were used.

According to the reported results of boundaries cointegration testing, the existence of cointegration relationship between total import and real GDP is supported when total import is considered as a dependent variable and real GDP is considered as an independent variable. Therefore, there is no reason for rejection of the first hypothesis of the research. Moreover, the Johansen-Julius systematic cointegration testing reflected in tables indicates that

this test firmly supports existence of cointegration relationship in this situation.

It is also worth mentioning that according to the report results of boundaries cointegration testing, the existence of cointegration relationship between GDP and total import is not supported when the real GDP is a dependent variable and total import is an independent variable. Therefore, the second hypothesis of this research is rejected.

Moreover, with regard to modeling with the use of neural networks, it can be said that the results achieved for analysis of the impact of imports on economic growth and impact of economic growth on imports have a high accuracy and this method can be used for analysis of impact of these variables on each other at high confidence level of 90%.

Total import and its relationship with other economic sections of countries has been important from ancient times until now and has been under discussion and analysis and revealed its importance over the years more and more. One of the factors that has affected total import and can be influenced by that factor is economic growth of a country. Today, we live in world in which with the population growth and change of the world natural structure, countries are more and more desired to achieve economic growth. Economic growth of countries is not just a one-dimensional concept with the meaning of growth but it has a comprehensive concept that brings power for a government and welfare for people besides economic growth of a country. Hence, governments are always seeking to achieve more economic growth.

Developed countries are always seeking to find new ways for achieving more speed in economic growth and less developed and developing countries are seeking to apply methods so as not to be lagged behind in economic growth.

Hence, Iran is naturally looking for a way to achieve more economic growth as developing country which has a proper potential for increase of economic growth. To this end and with a glance at developed countries it can be simply inferred that this goal cannot be achieved without correct understanding of the country's potential and a properly detailed plan, because exploiting the potentials of this country enables the future plans to be laid on a proper foundation.

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Some outstanding economists like Smith, Ricardo, Schumpeter, etc. proposed some theories on economic growth and its problems. What is important now is that while other plans can be used for achieving economic growth, the economic growth plan may be different for each time period and each country. One of factors that is considered as the major factor of economic growth in all countries is imports. Due to the importance of imports in economic structure of countries, governments should look deeper at imports with foresight. In order to achieve this goal, the researchers may play their role as key players in showing the pros and cons of different strategies.

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