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THE STUDY OF THE RELATIONSHIP BETWEEN ECONOMIC GROWTH, INDUSTRIALIZATION, URBANIZATION AND TRADE ON ENERGY CONSUMPTION IN IRAN

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Abstract: *Energy consumption as one of the most important production factors, can have an effective role in economic growth and hence, studying the relationship between energy consumption and economic growth,especially in economic sectors, has a great importance. And one of most important population phenomenon resulting from economic development and growth and industrialization of a country is rapid growth of cities and urban population which has numerous economic and social effects and outcomes; however, its most important effect targets energy consumption pattern in particular. The aim of the present study is to explore the impact of economic growth and trade on energy consumption with an emphasis on urbanization and industrialization in Iran for the timeframe of 1967 - 2012. The dependent variable of this study is energy consumption and independent variables are: economic growth, trade, urbanization and industrialization. The econometric method used in this study is Vector Error Correction Method (VECM). Before estimating the long-term relationship between model variables, for assuring the reliability of the results, it is studied whether variables are stationary or not. Then, for studying the short-term and long-term relationshipVAR method was used. Results indicated that the relationship between economic growth variable and dependent variable of energy consumption is positive and significant. Results also indicated that the variable of urbanization has a positive and significant effect on the dependentvariable of energy consumption. In other words, urbanization development leads to increased need to energy as a production factor and it eventually increases energy consumption. Industrialization indicator has a positive and significant effect on the dependent variable of energy consumption. Trade has a negative and significant effect on dependent variable of energy consumption.*

Key words: *Energy consumption, economic growth, urbanization, industrialization, Vector Error Correction*

INTRODUCTION

Energy is thevital force of any modern economy which enhancesproductivity and efficiency of any country. Development of industrialization, urbanization and increased population,specially in developing countries, have led to higher consumption of energy. Increasing dependency to energy has caused a kind of

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interaction between this sector with other economic sectors, in a way that in recent decades, economic growth and industrializationtrendhave increased energy consumption demand. The relationship between energy consumption and economic growth in previous decade has been studied extensively and has attracted so much attention from scholars. In spite of this, there is no consensus about the relationship and direction of this relationship between energy consumption and economic development. In economy and on a large scale, energy is needed in agricultural, transportation, public and trade services and operations of industrial sectors. Energy is also needed by families as a tool for achieving their fundamental economic needs for cooking, lighting, cleaning and recreational activities. Considering the fact that energy is one of the fundamentally and basic necessities for improving economic and social conditions in every country and that, it plays an important role in achieving third millennium's goals, energy should be demanded based on optimized and appropriate usage for national development and for increasing life standards; and the present situation of our country in this regard indicates to an improper image of energy situation of our country in future and demands a number of initiatives in order to be able to supply the increasing demand for energy. For managing the direction of this demand, it is necessary to be aware of the fact that energy demand in Iran should be directed to what direction. Few studies have been conducted regarding the factors effective on energy in Iran; however, these studies have addressed the demands for a certain type of energy at a household level or a national level and they haven't provided any information for total energy demand situation at country level. In addition to this, industrial growth and development also increase demands for manpower which in turn increases income. Increased income is accompanied by increased energy consumption, therefore, the need for conducting more studies for studying total demand of energy in our country is felt. Trade and trade relations between counties include exports and imports of goods and services between countries and we cannot find a country which satisfies all its needs and necessities without having any trade relations with other countries. Considering the role of energy in economy of all the developed or developing countries, without any doubt having trade relations can affect energy consumption. In this study, the main aim is to explore the relationship between economic growth, industrialization, urbanization and trade on energy consumption in Iran.

THEORETICAL PRINCIPLES

Energy consumption and economic growth

Economic changes in recent centuries have been accompanied by expanded usage of various types of energy. Considering the effects that petroleum crisis has had during the last 3 decades of 20^{th} century on macroeconomic variables, including economic growth in energy producer and consumer countries and also consideringincreased dependency of various economic sectors, including industry, agricultural and service sectors, on energy, the idea that energy as an effective producing factor can play an important role in economic growth and development of countries has been enhanced.

Iran also, as a developing country and a country having rich energy resources and large oil reservoirs, large underground mines and potential energy, is one of the manifestations of growth model with pressure on natural resources. Therefore, planning for optimized productionand consumption of energy has a great importance. The relationship between energy consumption and economic growth in term of production which indicates to technical relationship between production level with the level of each of the mentioned factors, can be studied. If we take energy similar to other factors of production (such as labor and capital) in production function framework, increased energy consumption will increase the level of production. The effect of energy consumption on production and economic growth can be studied from different aspects and angles:

Inflationary effects of increased energy price:On one hand, increased price of energy carriers, causes an increase in households' consumption and in turn causes the emergence of inflationary effects. (direct inflationary effects of energy) on the other hand, increases the price of energy carriers which in turn increases production costs. Indirect inflationary effects of energy also, increased production costs resulting from increased energy price which in turn can shift the curve of aggregate supply of economy to the left and at the same time can increase unemployment and inflation (stagflation). (energy balance sheet, 2004, p. 25).

*The role of energy in enhancement of productivity and growth:*Another effect of increased energy prices is that its relative price increases comparing to manpower and capital and causes a number of manufacturing methods to become unjustified which were developed and justified at current and conventional prices of energy and reduces consumers demands of products which needs so much of energy to be produced and creates unused capacity in manufacturing industries. Interactive effects of energy and economic growth on one another had led to the formation of a new subjects in economy known as causality relationship; that in recent decades have attracted so many discussions. In this framework, studying the interconnectedness between energy demand and economic growth in economy of Iran also has gained a considerable importance (Behboudi *et al.*, 2004).

High level of energy consumption in economy

One of the most common energy indicators used in economy is level of energy consumption indicator. Level of energy consumption refers to the level of energy consumed for producing a unit of gross domestic product. To be more exact, this indicator tells us that how many barrels of oil are used for producing $ 1,000 product.

$$Level\, of\ energy\, consumption = \frac{Energy\, consumption}{Gross\ domestic\ product} = \frac{E}{GDP}$$

We might ask yourself that why level of energy consumption is important?

The most simple answer is that in overall evaluation of the effects of economic crises, level of energy consumption in fact indicates to our dependency on energy.

Level of energy consumption

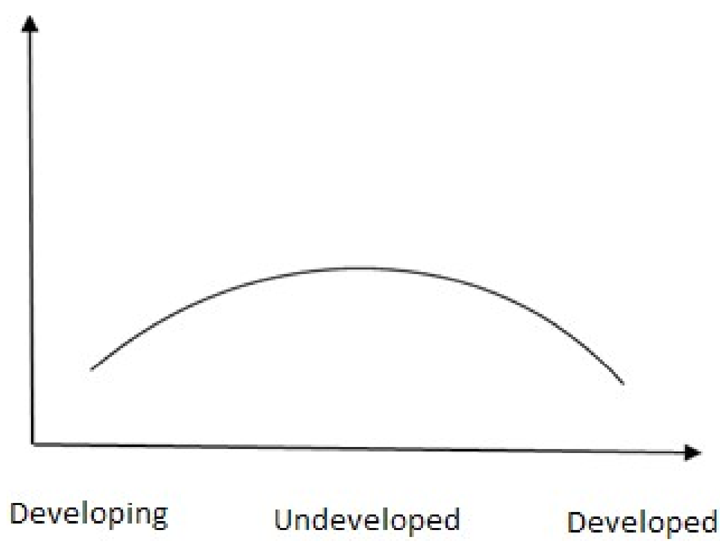

Figure 1: The indicator of level of energy consumption in different stage of economic growth

In every economy, along with economic growth, some structural changes are caused in consumption patterns as well as in the way products/services are manufactured. Assuming a certain degree of technical changes, the role of relative prices in this process is an obvious matter. Increased production corresponds to higher level of energy consumption. In this way, level of energy consumption indicators is mainly used for evaluating the level and manner of energy consumption and its efficiency. Empirical evidences indicate that the curve of level of energy consumption for a country, first increases and after reaching a certain level of industrialization and urbanization reduces. (kheirkhahan, 1994).

Energy consumption and urbanization

Urbanization refers to the process of population and manpower movement from rural areas to urban areas in a country and mainly includes the arrival of farmers to cities and theiremployment in industrial sectors as well as in service jobs related to these sectors. Urbanization which occurs following industrialization, is one of the main characteristics of economic development (Donald Jones, 2004). The consequences of immigration and emergence of urbanization phenomenon in relation with energy consumption can be studied from another point of view as well. Development of industrial and urban activities is accompanied with the manpower movement from agricultural sector to industrial sector. This reduces the ratio of agricultural products producers to the consumers of these products which in turn places the import of foodstuffs at top of the list of a country's plans priorities. On the other hand, replacement of food imports is possible with enhancement of agriculturaltechnologies. Technical changes in agriculture also causes farmers to abandon their farming activities and shift to urban activities. These changes are followed by direct and indirect increased energy consumption by mechanized equipments and abundant usage of chemical fertilizers as well. Hence, increased per capita of energy consumption as well as consumption for per each unit of production due to urbanization appears to be obvious (Isazadeh & Mehranfar, 2012). Urbanization increases residential energy consumption mainly due to two reasons. First, movement toward cities, increases households access to electricity. Second, energy consumption of households who have moved from rural areas to urban areas increases due to their higher usage of electrical devices. (Holtedahal & Jouts, 2004). Urbanization,through changing economic structure, also affects demands for energy consumption. This effects works through income effect mechanisms- population concentration and change in agriculture and need to infrastructures and overtime shifts demand curve toward up. In summary, the above mechanism can be described as below:

Effect of expected income:Individuals in households due to living in a city expect an increase in their income in the same period or next periods. This expected and actual increase in income, lead households to purchase more electrical devices comparing to households living in rural areas. Therefore, increased energy consumption, directly and indirectly due to increased home appliances related to urbanization, increase industrial productions related to these types of appliances and following that increases energy consumption in industrial productions comparing to total productions. (Jones, 2004)

Concentration of population: High concentration of population leads to specialization of labor. Considering the high concentration and density of population, long distances for manpower to reach to labor markets have caused high level of energy consumption in transportation of manpower. (ibid)

Change in agriculture: Urbanization has led to food production in larger scales and with higher efficiency, however, production of these foodstuffs due to mechanization of production is accompanied with high level of energy consumption. Mechanized agriculture is accompanied with higher demands for agricultural machineries and tools and indirectly throughindustrial productions, these machineries and tools increased industrial production growth and consumed energy in this sector. (ibid)

Infrastructures: Due to high concentration and density of urban population, for improving manpower productivity, creating and maintaininginfrastructures such as highways, connecting bridges, buildings, urban services and ... are necessary, that in addition to high level of energy consumption for these constructions, they require energy consumption in production and transport of raw materials. Therefore, all the above mentioned effects indicate that urbanization changes energy consumption demand and is one of the most important effective factors on energy consumption. (ibid)

Research background

Economic growth in developed countries indicate the extensive consumption of energy and other natural resources, in a way that environmental economists believe that access to energy plays a key role in growth and development of economies. While, demand for energy at global level rapidly is increasing, so many countries are facing with lack of energy which strongly affects their economic growth and hence, this topic has attracted the attention of so many researchers.

Asadikia *et al.* (2009), have presented a model in which the variablesareper capita of carbon dioxide, GDP per capita of Iran, the number of passenger vehicles, openness degree of economy, population and virtual variables of development programs . They have studied the Grossman and Krueger's model in Iran's economy for the timeframe of 2005 - 1979. In their analyses they have shown that there is a significant and positive relationship between all the independent variables except openness with carbon dioxide. The relationshipbetween openness and per capita ofcarbon dioxide emissions has found to be negative. Also, they have concluded that development plan is the most effective program in Iran for reducing air pollution.

Behbodi *et al.* (2009), in another effort have studied the relationship between energy consumption, economic growth, urban population, trade liberalization and dioxide carbon emission with the help of VAR method. In this study, by using Toda-Yamamoto approach, the Granger causality relationship between energy consumption in different economic sectors (domestic and commercial, industrial, transportation and agriculture) and economic growth in Iran in the timeframe of 1967-2006 is studied. Results obtained from this study indicate to a positiverelationship between all the independent variables with dioxide carbon in iran.

Fetres & Mabodi (2010) in an article with the title of "casualty relationship between energy consumption, urban population and environmental pollution in Iran in the timeframe of 1971 - 2006" have shown that the hump-shaped hypothesis applies to environmental pollution and gross domestic product in Iran. Elasticity of dioxide carbon emission compared to urban population is positive and less than a unit. Also, elasticity of dioxide carbon emission compared to energy consumption is positive and larger than a unit.

Fetres *et al.* (2012), in a research work have studied the relationship between air pollution, energy intensity and openness of the economy of Iran by using ARDL. Their main aim was tostudy the relationship of CO2, energy intensity and openness degree of economy. For this purpose, time series data of Iran in the timeframe of 1967 - 2007 were used. Results indicate that there is a positive and significant relationship between energy intensity and air pollution and a positive relationship between economic openness and air pollution in long term.

Sadrosky, in 2010 has conducted a study with the title of "the impact of financial markets development on energy consumption growth in emerging economies" and has studied the impact of financial markets' development on energy demand growth by using panel data and generalized method of moments (GMM) for 22 emerging economies that uses time interval data for the timeframe of 1990-2008. Result of this study indicate that development of financial markets in long term affects energy consumption; however, its effect in short-term is negligible. Results of granger causality relationship also indicate that, that is an unidirectional causality relationship from the indicator of financialmarketdevelopment toward energy consumption.

Chandaran *et al.* (2010), by using bounds test approach to cointegration and autoregressive distributed lag model have studied the causality relationship between electricity usage and economicgrowth and haveestimatedtheir long-term coefficients in demand-side model framework during 1971-2003 for Malaysia. Due to not having the price of electricity, they have used consumer price index as the replacement variable and results indicated that there is a long-term relationship from electricity consumption toward economic growth.

Yu *et al.*, 2010, in theirarticles have studied the changes in energy consumption intensity in Jiangsu in 1998-2008; and have analyzed energy consumption intensity to the effect of FDI scale, effect of FDIstructure and effect of FDI analysis technology by using IMDI model. Results of this analysis indicated that the scale effect of FDI, reduces energy consumption intensity. FDI structure and technology effect are fluctuating and in general doesn't increase the reduction of energy consumption intensity; therefore, reducing energy consumption intensity in Jiangsu province, it is recommended that at the same time with expanding the scale of foreign direct investment, we should be united in saving energy and promoting reduced need to foreign direct investment companies. At the same time, we should increase the ratio of foreign investments in technologicalindustries and encourage foreign direct investment companies for using and sharing advance energy saving technology. In addition, we should adjust FDI distribution industry structure for optimizing industrial structure adjustment.

AslamFardiol *et al.,* in 2011, have studied the causality relationship between the variables of energy consumption, population growth, total production and development of financial markets for Malaysia. In this study, the existence of cointegration between research variables has been studied by using ARDL method and VECM model also has been used for determining the direction of causality relationship. Results of this study indicated that energy consumption is affected by the variables of economic growth and development of financial market both in short-term and long-term. (Sattar, 2012).

Li *et al.,* 2012, in their study have analyzed the relationship between energy consumption and economicdevelopment based on VAR model by sin time series data in china in 1990-2009 and then have used impulse response function and variance analysis for illustrating the relationship between economic growth and energy consumption. Results indicate that the unidirectional causality relationship from energy consumption to gross domestic product and energy consumption can increased economic development.

Zibadi *et al.,* 2013, in their study with the title of "predicting energy consumption in agricultural sector ofIran with neural networkapproach for 1974-2008, have found that energy consumption intensity in agricultural sector has a decisive importance and has a positive and significant effect on increasing value added in agricultural sector.

Shahbaz & Lin in 2012, in their article have studied the role of financial market development along with the variables of industrialization and urbanization on increased energy consumption in Tunisia. In this study they have used annual data (1971-2008) and autoregressive model technique as well as Granger causality test. Results of this study indicate that there is a long-term causality relationship between financial market development and energy consumption, energy consumption and economic growth and industrialization and urbanization. Also, they have found a bidirectional causality relationship between development of financial market and energy consumption, development of financial market and industrialization, industrialization and energy consumption.

Noral *et al.* in 2011, have studied the causality relationship between the variables of energy consumption, population growth, total production and development of financial markets for Malaysia. In this study, by using ARDL they have studied whether there is cointegration between researchvriables or not and have used VECM for determining the direction of causality relationship. Results of this study indicate that energy consumption is affected through the variables of economic growth and development of financial market both in short-term and long-term.

Sbiaa *et al.*, 2014, in their article have studied the relationship between foreign direct investment, pure energy, extensive trade, carbon emission and economic growth in United ArabEmirates in the timeframe of 1975-2011. They have tested the unique and common properties of research variables at the time of structural changes. In the test method of ARDL jumps, with by adopting the foundations of structural changes in every series, they have studied cointegration. With the use of granger causality method of VECM, they have also studied the causality relationship between research variables. Theirempiricalfindings confirms the existence of cointegration among series. They have found that foreign direct investment, extensive trade and carbon emission, reduces energy demand and that economic growth and pure energy have a positive effect on energy consumption.

Adnan &Yavuz (2014), in their study with the title of "exploring the causality relationship between economic growth, energy consumption, trade, urbanization and dioxide carbon emission in member and candidate states of Europe union, for the timeframe of 1992-2010 by using panel analysis method and their results indicate that Kuznets hypothesis is confirmed for the countries being studied. Hence, there is a reverse u-shaped relationship for dioxide carbon emission to economic growth.

MODEL PRESENTATION

Vector Error Correction Model (VECM)

The model that in fact relates short-term fluctuations of variables to their long-term balanced values, is known as error correction model. For relating short-term behavior of y_t in matrix form of VAR model, this model can be presented in forms of a vector error correction model (VECM) as below:

$$\Delta y_t = \beta_1 \Delta y_{t-1} + \beta_2 y \Delta_{t-2} + \cdots + \beta_{p-1} \Delta y_{t-p-1} + \pi y_{t-p} + u_t \qquad (4\text{-}1)$$

$$\beta_i = -(I - A_1 - A_2 - \ldots - A_i) \qquad i = (1, \ldots, p-1)$$

$$\pi = -(I - A_1 - A_2 - \ldots - A_P)$$

In the above equation, matrix π contains information about long-term equilibrium relation. In fact, we have $\pi = \alpha\beta'$, where, α is adjustment factor and indicates adjustment speed toward long-term equilibrium and β is long-term equilibrium relationship coefficient matrix (Nouferesti, 1999). $B' y_{t-p}$ term is equal to error correction term in single equation model of $u_t = y_t - \beta x_t$, only with the difference that it has maximum a number of (k-1) independent vectors.

Cointegration test by using Johansen and Juselius method

In the previous sections, test methods of cointegration and cointegrated vector estimation with the use of least squares method were described, which were so much simple and easy to understand. In Johansen and Juselius method, estimation is performed with the help of maximum likelihood and the advantage of this method is that it identifies more than one long-term relation, in case of existence, between two or multiple variables. There are three important limitations in using ordinary least squares method for estimation of long-term equilibrium relation, which are solved in maximum likelihood method. These limitations are:

1- Estimations do not have asymptotic efficiency.

2 - Hypothesis test cannot be performed directly on coefficients.

3- If there is more than one long-term equilibrium relation, OLS method, does not give compatible estimations for any of the cointegration vectors (Abrishami and Mehrara, 2009).

Maximum likelihood method or ML does not have the above mentioned limitations. It should be noted that the difference between ML and Engel - Granger methods is only in estimation of long-term relation or cointegration vector. In ML method also, after calculating the residuals resulting from cointegrationregression, error correction model or ECM is estimated in second step by using OLS method (Abrishami and Mehrara, 2009). The important point is that the necessary condition for using Johansen and Juselius method is for the variables to be stationary from a certain rank onward(Tayebi&MesriNejad, 2002).

In this method, it is assumed that data are generated from a vector autoregressive system or VAR as below:

$$x_t = a_1 x_{t-1} + a, x_{t-2} + \ldots + a_p x_{t-p} + \varepsilon_t \quad (4\text{-}2)$$

Where, $x_t$includes series of $(x_{1t},\ldots,x_{nt})$ and a_i are n×n matrices.

$A_i : n\times n \varepsilon_t : n\times 1$

$X_t : n\times 1$ $\varepsilon_t \sim n(0, \sigma)$

In the above system, there are n equations. All the elements of x_t in general are assumed to be endogenous. The length of lags or p is selected in a way to create confidence, in every equation andthat, there are no consecutive autocorrelation and heterogeneous variance (Abrishami and Mehrara, 2009).

VAR model in the above equation has a Vector Error Correction model (VECM) which is shown as below:

$$\Delta \mathbf{X_t} = \boldsymbol{\pi}_1 \Delta x_{t-1} + \pi_2 \Delta x_{t-2} + \ldots + \pi_{p-1} \Delta x_{t-p-1} + \pi x_{t-p} + \varepsilon_t \rightarrow \Delta x_t = \sum_{i=1}^{p-1} \boldsymbol{\pi}_i \Delta \mathbf{x_{t-i}} - \pi x_{t-p} + \varepsilon_t \quad (4\text{-}3)$$

$$\boldsymbol{\pi_i} = -(\mathbf{i} - \mathbf{a}_1 - \mathbf{a}_2 - \cdots - \mathbf{ap} - {}_1) = -(\mathbf{i} - \sum_{i=1}^{p-1} \boldsymbol{A_i})$$

$$\boldsymbol{\pi} = -(\mathbf{i} - \mathbf{a}_1 - \mathbf{a}_2 - \cdots - \mathbf{ap}) = -(\mathbf{i} - \sum_{i=1}^{p} \mathbf{a_i})$$

In these relations, the variables of x_t are non-stationary and we consider $\Delta \boldsymbol{X_t} \sim \boldsymbol{I}(\mathbf{0})$.

Therefore, weshouldhave $\boldsymbol{\pi X_{t-p}} \sim \boldsymbol{I}(\mathbf{0})$, in order for the degree of cointegration to be equal at both sides of the equation. Long-term relations between model's variables are presentedby $u_t = \pi X_t$ We will have $\pi = 0$, in case that there is no long-term equilibirum relation. π matrix has nxn dimensions. If only there is one long-term relation, then, the rank of matrix would be equal to π times of a unit, which means that this matrix will only have one independent raw and the elements of each raw would be combinations of other rows. In this way, if there are r long-term relations, the rank of matrix would be equal to r.

It means that although we have $u_t = \pi X_t$, n which specify the long-term relationship, however, there are only r relationships and the rest is a linear combination of them. We always have $r \leq n - 1$ (Abrishami and Mehrara, 2009).

In general, if the rank of matrix π is shown with r, where, r is the number of linear combinations of independent series with zero rank, the following several modes can be studied:

1- If the rank of π is equal to zero, normal VAR method can be used.

2- If the rank of π is equal to n, in that case, π has full rank and the cointegration process is stationary.

3- If the rank of π is equal to 1,only there would be one cointegrated vector and in that case, πX_{t-p} is recognized as error correction factor.

4- If the rank of π is between 1 and n, there are several cointegrated vectors. In general, Johansen and Juselius believe that the rank of this matrix is equal to the number of non-zero characteristic roots (Atanosoglo and Bardaka, 2010).

3-3 Tests for determining rank or the number of cointegrated vectors:

For determining r (determining rank), we can use the following tests presented by Johansen:

1- Test of effect or trace:

(4-4) $\lambda trace(q) = -n\sum_{i=q-1}^{p} \ln(1 - \hat{\lambda}i)$

2 - Maximal Eigen value

(4-5) $\lambda \max (q,q+1) = -n \ln(1- \hat{\lambda}_{i+1})$

The estimated values, are characteristic roots which are obtained from estimated matrix of π. In other words, if there is a long-term relationship, only an Eigen value of ($\hat{\lambda}_i$) has a significant difference from zero and the residual Eigen value of n-1 don't have a significant difference from zero. In the same way, if there are r cointegrated vector, r Eigen value of $\hat{\lambda}_1$ و $...\lambda_2\hat{}$ have significantdifference from zero.

The first test, tests $q \geq r$ hypothesis against the opposite hypothesis of $H_1 : r < q$ and the second test, tests $H_0 : r = q$against $h_1: r = q+1$. Critical values related to these tests are presented by Johansen when they are maximum of five times (Abrishami and Mehrara, 2009).

In this study considering the theoretical principles and based on the adopted model from EdjiKuwakual and SoleimanAbuaji (2014), the following model is presented for determining the effect of economic growth, industrialization, trade openness and urbanization on energy consumption.

$$E=f(U, Y, I, TR)$$

Where, e is energy consumption in form of a linear function of the variables of urbanization (U), economic growth (Y), industrialization (I) and trade (TR). If the above function is considered to be of logarithm form, this model will be turned into the following regression model.

$Le = b_0 + b_1 lu + b_2 ly + b_3 li + b_4 ltr + ei$

LE: Total energy consumption of the country

LU: Urban population

LY : Gross domestic product (without oil income)

LI: Share of industry sector from actual gross product

LTR: Sum of imports and exports is used as the degree of trade openness in this study for analyzing urbanization and gross domestic product and industrialization and trade from the data of central bank of Iran in the timeframe of 1967 - 2012 and the data related to energy consumption were extracted from energy balance sheet of 2012.

Model estimation and interpretation of results

Before estimating the model it is necessary to test durability of all the variables used in estimations, because, variables non-durability both regarding time-series data and regarding panel data cause the problem of false regression occurrence. However, contrary to what is common about time series data, for panel data we cannot used dickey-fuller and adjusted Dickey - Fuller (ADF) for testing durability and hence, collective durability of variables should be tested by using another method. First, it is necessary to test durability of model's variables. Adjusted Dickey-Fuller tests is performed in this study. This test tests unit root hypothesis (non-durability) against durability of the intended variable and in case the absolute value of test statistic (calculated) is larger than the critical absolute values, H0 is rejected and times series is found to be statistic. Results of this test is presented in table (1).

Table 1
Durability results of model's variables

Adjusted Dickey-Fuller Test

Variable	*Critical value at 5% level*	*t-value*	*Probability*	*Result*
LE	-2.94	-3.76	0.002	I(0)
LY	-2.94	-4.11	0.0009	I(1)
LU	-2.94	-7.42	0.0000	I(0)
LI	-2.94	-4.79	0.0001	I(1)
LTR	-2.94	-6.51	0.0000	I(0)

Based on the above table, considering the results of durability test with the use of Adjusted Dickey-Fuller, all variables are durable with a difference of one, except for the variables of le and LU.

For determining the rank of optimized model, Akiake, Schwartz and HananQuinn information criteria were used. Results of these three criteria were estimated up to three lags and are presented in table 1-2. As it is seen in table (2), optimized lag based on Schwartz and HannanQuinn criteriais equal to one and based on Akiake criterion is equal to three. However, since, Schwartz criterion has a higher level of saving in selecting the optimized lag and for time series smaller than 100, this criterion is used, so that freedom degree is not lost and therefore, the lag equal to one is taken as the optimized model lag.

Table 2
Determining optimized lag

SBC	*AIC*	*HQIC*	*Lag*
-8.42	-8.62	-8.549	0
-21.96*	-23.19*	-22.74	1
-20.95	-23.21	-22.38	2
-20.36	-23.64*	-22.43	3

After performing unit root test among research variables and determining that all the existing variables in equation have a unit root, in the next step and for assuring that there is no false regression among research variables, cointegration test was performed among research variables.

In this section, for extractingcointegrated vectors, Johansen - Juselius method was used in which for obtaining long-term relation of variables, first with the use of maximum Eigen value and trace tests ,existence of cointegration and the number of cointegration relations were tested. In maximum Eigen value test, respectively, null hypothesis of lack of existence of a cointegration relation is tested against existence of a cointegrationrelation and existence of one of less cointegration relation against existence of one or more cointegrationrelation. If the values of this test related to these variables are larger than critical values at 5% level, opposite test is accepted and based on this basis, the number of cointegrated vectors is obtained:

Results obtained from performing trace and maximum eign values tests are presented in tables (3) and (4).

Table 3
Trace matrix

H0 hypothesis	*Opposite hypothesis*	*Statistical calculations*	*Critical value at 5% level*
R=0	R=1	110.85	77.74
R≤1	R=2	49.17	54.64
R≤2	R=3	26.10	34.55
R≤3	R=4	5.34	18.17

Table 4

H0 hypothesis	*Opposite hypothesis*	*Statistical calculations*	*Critical value at 5% level*
R=0	R=1	61.68	36.41
R≤1	R=2	23.06	30.33
R≤2	R=3	20.76	23.78
R≤3	R=4	5.31	16.87

As it is seen from above tables, in the 1st raw in both the tests, due to the fact that the value obtained from trace test and maximum Eigen value test are larger than critical values related to these two tests, hence, h0 hypothesis, indicatingto nonexistence of a long-term relation between research variables is rejected and the opposite hypothesis is accepted. It means that, there is a long-term relation between the existing variables in the equation and due to theperformance lag of this test, where H0 hypothesis is rejected, hence, hypothesis test for next rows of these two tests are not performed and the obtained co integratedvector is as below, which are all significant statically. Mathematical form of cointegration vector can be written as below:

LE = 0.3247557 LY – 0.0075379 LTR + 0.001042 LI + 1.929502 LU

Considering the results, it can be said that economic growth, urbanization and industrialization have positive effect on energy consumption and trade has a negative effect on energy consumption.

CONCLUSION

Economic growth has been accompanied by increased urbanization and increased urbanization has led to increased energy demand. Due to importance of energy and necessity of studying the determining factors of energy demand, in this study, the effect of urbanization along with the variables of industrialization of the country, economicgrowth and trade on energy consumption in Iranin the timeframe of 1967 - 2012 was studied by using econometric approach to vector autoregression and Johansen - Juseliuscointegration. With the application of vector error correction model, the relationships between variables were studied. Results obtained from regression test indicated that the independent variable of urbanization has a positive and significant effect on the dependent variable of energy consumption and therefore, it is recommended to use urban population tool for controlling energy consumption. According to research results also which indicated that increased industrialization index has a positive and significant effect on the dependent variable of energy consumption, it is recommended that industrialization index can be used as an effective factor on energy consumption for controlling energy consumption of a region. Results also indicated that trade has a negative and significant effect on energy consumption and it can be hence, predicted that with increased imports of industrial goods and reduced imports of consumer goods with affecting performance improvement in industry sector causes trade openness to exert a positive effect on energy consumption. Finally, consideringresearch results which indicated that increased gross domestic product has a positive and significant effect on the dependent variable of energy consumption and since, increased gross domestic product leads to increased need to energy as a production factor and also due to the fact that eventually energy consumption is increased, for increasing energy consumption, increased production policies (based on growth) can be adopted. In fact, if public policies are based on reducing energy consumption in our country, it should be noted that increased gross domestic product acts as an anti-policyand supply-side policies such as increased productivity are adopted.

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