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# Impact of Import and Export of High Technology Industries on Economic Growth of Iran

Mohammad Hassan Fotros[1] and Narges Ahmadvand[2]

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***Abstract:***
*Nowadays, the importance of using up- to- date technologies to industrialize developing countries that intend to inter in world economy is increasingly evident. High-technology commodities import is as a proxy variable for research and development (R&D) spillover effect and technology transfer that might increase the level of knowledge in developing countries. Also, this process might increase the share of high-tech industries in GDP and could improve their exportation. In this study, using Romer's endogenous growth model, the impact of import and export of high-tech industries has been studied on economic growth of Iran during the period of 2002-2012. In this regard, seasonal data were used in an autoregressive distributed lag (ARDL) model to examine the relationship between variables. Results indicated a positive and significant impact of import and export of high technology industries on Iran's economic growth. Also, other variables i.e. capital stock, employment and R&D expenditure have had positive and significant effects on Iran economic growth.*

**JEL** classification**:** F14, F43, O14

***Keywords:*** *Technology transfer, High- tech industries, Romer's endogenous growth model, Autoregressive distributed lag, Iran*



[1] Professor, (Corresponding Author) Department of Economics, Bu-Ali Sina university, Hamedan, I.R. of Iran. Email: (fotros@basu.ac.ir)
[2] MA of economics, Department of Economics, Bu-Ali Sina university, Iran.

## 1. Introduction

Technology as a reason of increasing the quality, diversity and reducing the cost of production, is an important factor in competition, i.e. it stands as a base of stability and success of an economy in modern complicated markets. Porter (1985) considered technology as a tool for converting inputs to outputs by creating value added stimulate competition. High-tech industries with two characteristics, economies of scale and imperfect competition, are the leading industries in technology improvement. The reasons of increasing the share of high-tech in the whole economy are the ability of this industry in creating and applying innovations, modern technology of information and improvement of management and creativity qualification (Saboniene & Laskiene, 2015: 159). Khalil (2000) described high-tech, whose rate of technology change is higher than other industries, as complicated industries benefiting modern technology. He stated that these industries are employed by the firms having the following characteristics:

- They have well-educated employees. In other words, their main body is composed of scientists and engineers.
- Innovation is the tool of competition in such firms.
- They spend considerable amount on R&D. Their R&D budget is almost twice the average R&D budget in an identical firm.
- They use technology for their fast development and new technologies endanger their existence.

Lall (2000) recognized high-tech industries as firms, which need products design, modern equipment and high expenditure of R&D. Furthermore, these types of products demand adequate technological infrastructures for assembling, because a user of this stage of production can transfer them to low-wage countries. In this context, Puga and Trefler (2010) point to the growth of export of high-tech industries in countries with lower wage levels that carry out the last stage of production in these industries.

On the other hand, R&D expenditure in high-tech industries would induce higher economic growth than other industries

(Han-Min Wang & Hui-Kuang & Hong-Quan, 2013: 1990). Therefore, because of all hidden advantages in these industries, developing countries seek to achieve them.

Technology transfer is a process in which a technology is used in places other than its original place for production, manufacture and creation of newer technologies (Zahtabchian & Naseri Giglo, 2010: 3). UN defines technology transfer as importing particular technologic agents by developing countries from developed countries in order to be able to procure and use new production equipment and develop available tools (Samadi Moghadam & Adib, 2011: 2). In this point of view, technology transfer is a long-term process that promotes the design and sale of technological capabilities in countries by enhancing application, adaptation and development of technology and finally improving in development (UNIDO, 2010: 4). Therefore, transferring science and technology is a way to reduce technological differences between developed and developing countries. In this context, Coe, Helpman and Hoffmaister (2008) believed that international trade is a transfer method of technology and science, so the importance of import in introducing the new technology to GDP is undeniable. Generally, developing countries, which have high rate of technological products import, will benefit more in productivity and economic growth than other countries. Beside import, export development strategy or outward looking strategy that is based on encouragement of exporting high added value product thorough development and diversity of export, improvement of product quality, management and technology reform, cost reduction and production in large scale and more foreign exchange earnings will cause resource allocation and total economic growth

Industrial and export development has been the main context in most development plans in Iran and it is mentioned as the shortest way to terminate technological and economic retardation and dependence on oil income. Clauses 33 and 37 of forth development plan (in the period of the current research) emphasize on increasing the share of high-tech industry export from 2 to 6 percent, and also, increasing the R&D for diversification of products to strengthen the competition power of export products in international markets and create appropriate foundations to for technology transfer (Zaribaf & et al., 2007: 7). In this issue, economic, social and environmental parameters such as energy and natural resources are effective on growth rate of high-tech industries (UNIDO, 2016: 23).

Iran export and import data in the period of this study shows that export of high-tech industries was very low and decreasing such that it's share decreased from 1.2 percentage in 2004 to 0.6 percentage in 2014. On the other hand, import increased form 10.1 percentage in 2004 to 13.1 in 2014 (Institute of Business Research, 2015: 3).

Statistics shows that technology does not play a significant role in the current economy and supporting organizations and policy makers do not pay attention to export and import of high-tech industries. Therefore, industrial policy making in Iran should be moving toward the development of technological capabilities through R&D in modern industries and improving the application of technology.

This study tries to investigate the effect of import and export of high-tech on economic growth by using Romer's endogenous growth model, during the period of 2002-2012 based on the seasonal data via Autoregressive Distributed Lag method (ARDL) and hypothesis test.

Accordingly, the paper has been divided into five parts. After introduction, the first part includes the theoretical bases of exogenous and endogenous growth models and relation between import and export of high-tech industries and economic growth. In the third part, literature subject is reviewed and in the fourth, the econometrics model and findings are illustrated, and finally the conclusion is discussed.

## 2. Literature Review

In this part, briefly the theoretical bases of exogenous and endogenous growth models are discussed. Beside the limitation of exogenous growth models, on effect of technology, its overflow in endogenous growth models is emphasized. Then, literature review is brought in this part.

### 2.1. Theoretical Background

One of the important and effective factors in globalization of economy is development and universalism of technology. There are two approaches in the context of technology effects on economic growth of countries. The first one is neoclassical growth models. In this approach, most works has been performing based on the Solow growth model (1956). They believe that technology advancement is an exogenous factor in production growth that is based on general characteristic of science. In other word, using science in a firm will not prevent other firms from using it. They say that countries, despite the complete competition in market, use of their resources efficiently. In addition, the Cob-Douglas function has constant productivity to scales. In these models same technological chances and long-term convergence of countries development has mentioned, and it is because of content productivity relation to scale and final decreasing productivity in investment that will result in higher growth in poor countries than rich countries (Zenooz et al., 1999: 18). Therefore, convergence of countries growth, exogenous technology, similar technological opportunities of countries, technological advances as pure general product and complete competition are weaknesses of neoclassical models.

In response to shortcomings of neoclassical models, the second approach, endogenous growth models based on exclusive rent and endogenous technology advance as a general product and people's achievements were developed in the 1980s. They rejected the assumptions of neoclassic about perfect markets (complete competition) and decreasing productivity of reproducible factors especially capital. They consider the external consequences of production factors, too (Romer (1986) & Lucas (1988)). On the other hand, different technological opportunities and conditions in countries and parts are the most emphasized parts of this approach; Aghion & Howitt (1996), Dosi (1997), Greenhalgh, Longland & Bosworth (2001) quoted from Han-min Wang et al., 2012: 1990). In this approach, activities based on innovation and toward the business in response to economic motives are the main factors for technological advancement and economic growth (Pajooyan & Nasiri, 2009: 103).

Generally, endogenous growth models are divided into two groups: AK and R&D (Jones, 1995). The first wave of these models, are, Romer model (1987), Reble (1987, 1991), Barro (1991), Benhabib and Jovanic (1991).Charles Jones defined them as AK models. These models are in the form of Y=AK. A is the main factor of technology and K is physical and human capital. This model does not decrease returns to capital because of two reasons: first, because of some externalities created by the hidden technology in capital that neutralizes the tendency to decreasing productivity. Second, increasing diversity or improving quality of machinery or intermediate factors neutralizes the tendency to decreasing productivity. In this interpretation, K represents diversity or quality of agents. To reach this diversity, R&D is necessary and firms assign skilled labour to these activities. The firms that work in exclusive competitive markets pay the expenditure of R&D (Romer (1990); Grossman & Helpman (1991) quoted from Rabiee, 2009: 127-128).

The second wave of models is based on R&D, which emphasize on endogenous technology for long-term growth. This pattern presents the combination of capital and labour by using of storage of knowledge and instead of following the assumptions of neoclassic theory and effects of exogenous technological changes; it seeks to describe effective forces and technological changes that is an advantage for this pattern. In these models for a specific level of technology, content returns to scale is constant for $L_y$ and K and for a certain number of firms they result in more production level. Technological innovation in human resources and R&D effects on storage of knowledge. Storage of knowledge is used in production of final product that results in increment of production growth rate (Haji Mohammadi, 2015: 5). In these models, innovation is the motive for growth and technological investment via business and direct external investment as the approaches for technology transfer. Also, the overflow of R&D will increase potentials of technology imitation, productivity and growth.

Generally, the expenditure of R&D for increasing diversity and quality of products stimulates and improves growth in two ways: Direct (innovation) and indirect (increasing the ability of absorption and transfer of technology) (Rahnamaie Gharamaleki et al., 2012: 33).

Investment of a firm on R&D induces other firms, which buy the intermediate and capital products, not to pay the expenditure of R&D but to use R&D, which is hidden in products.

Therefore, theoretically there are two ways based on which foreign business increases internal productivity. First, it makes domestic production possible via out of country science and technology. Second, it makes the reception of information non-cost paying (Javadi, 2005: 4).

In this study, the export and import of high-tech industry, which is embedded in part A, of Romer's function, is a way of technology and expenditure of domestic R&D transfer and as a storage of knowledge will increase the productivity.

Romer equation has the following form:

$$Y = K^{\alpha} (AL_y) \alpha - 1 \quad (1)$$

$$\frac{A^{o}}{A} = \partial L_A \quad (2)$$

In which, Y is production, A is productivity or knowledge and K is capital stock. Labour force is used in both activities, production (Ly) and innovation ($L_A$). So L is the total labour in economy. In these models, the labour in R&D ($L_A$) is related with rate of technological knowledge ($A_0$/A) (Zenooz et al., 1997: 26).

Romer, Grossman, Helpman, Aghion and Howitt assume that the amounts of labour is constant so economy is in monotonic condition and it follows the balanced growth path when the share of employed labour force in R&D is constant. In this growth path, per capita product and the rate of capital to work increases with same rate and these rate with rate of total productivity growth are:

$$g_y = g_A = g = \delta s^* l \qquad (3)$$

In which S*, is the share of labour work in R&D in monotonic condition, and L, is total labour force in economy (Anooshe, 2011: 67).

Romer (1990), Grossman and Helpman (1991), Aghion and Howitt (1992), Delong and summers (1991), Fagerberg, Verspagen and Caniels (1996) examined R&D model in some cases, the results show, this model isn't confirmed by experimental analysis (javadi, 2005: 69).

After Romer, Falk (2007) is one of the economists who added high-tech industries to shortage of knowledge, in addition to the expenditure of R&D to Romer model and achieved its positive effects on per capita GDP.

Also, Grossman and Helpman (1991), Aghion and Howitt (1992), Co and Helpman (1995), Howitt and Mayer-Foulkes (2005) and Ha and Howitt (2007) performed abundant cross-country estimates and studies on the overflow of R&D.

Therefore, international relations of a country make the simulation of foreign technology and transfer it based on domestic conditions.They increase productivity indirectly by developing new technology (Yadollahzade Tabari et al., 2013: 4).

In this study, technology levels are classified based on the organisation for economic co-operation and development criteria (OECD). In this classification, R&D expenditure intensity criterion is used. R&D intensity is domestic R&D expenditure to turn over in that period. When this value is less than 1%, R&D intensity is low, between one to four percent it is medium and larger than 4% R&D intensity is high (OECD, 2007). This classification has been shown in table1:

**Table 1:** OECD classification of manufacturing industry according to intensity of technology

| Coded based industries ISIC four-digit code | Average rate annual growth (Percent) | Industry | Industries according to intensity of technology |
|---|---|---|---|
| 3530, 3312, 3220,2423, 3000, 3230, 3210, 3320, 3330, 3311, 3313 | 13.8 | Pharmacy | High-Tech Industries |
| | 7.9 | Scientific measuring instruments | |
| | 7.2 | Communications, television, radio | |
| | 6 | Airplane and spaceship | |
| | 4.4 | Computers and machinery | |
| 2421, 2422, 2424, 2411, 2412, 2413, 2429, 2430, 2923, 2924, 2912, 2926, 2911, 2927, 2922, 2913, 2915, 2919, 2921, 2930, 2914, 2925, 2929, 3130, 3190, 3140, 3110, 3120, 3150, 3420, 3410, 3430, 3591, 3599, 3592, 3520, 3530 | 7.4 | Transport and railway equipment | Medium-High-Tech Industries |
| | 7 | Motor vehicles | Medium-High-Tech Industries |
| | 6.5 | chemical materials | |
| | 6.2 | Electrical machinery | |
| | 5.2 | equipment and machinery | |
| 2320, 2310, 2330, 2520, 2519 ,2511 2611, 2696, 2697, 2698, 2612, 2692, 2691, 2699, 2694, 2695, 2721, 2710, 2732, 2722, 2731, 2723, 2812, 2811, 2891, 2892, 2813, 2893, 2899, 3511, 3512 | 12.2 | oil refining | Medium-Low-Tech Industries |
| | 7 | Shipbuilding | |
| | 6.8 | Plastic and rubber | |
| | 6.5 | Metal products and basic metals | |
| | 4.7 | Non-metallic minerals | |
| 1516, 1542, 1519, 1520, 1512, 1514, 1515, 1543, 1544, 1545, 1546, 1517, 1518, 1531, 1551, 1552, 1532, 1553 1555, 1533, 1556, 1547, 1548, 1600, 1721, 1723, 1724, 1725, 1726, 1712, 1729, 1731, 1732, 1711,1820, 1810, 1912, 1911, 1920, 2029, 2010, 2023, 2021, 2022, 2101, 2102, 2109, 2213, 2219, 2221, 2212, 2211, 2222, 2230, 3691, 3693, 3610, 3692, 3699, 3694, 3710, 3720 | 3.5 | Of clothing and textiles | Low-Tech Industries |
| | 3.5 | Paper and printing | |
| | 4.2 | Food, beverages and tobacco | |
| | 4.3 | Wood | |
| | 6.3 | Other products | |

Source: OECD, STAN Indicators Database, International Trade by Commodity Statistics, May 2007, www.oecd.org/sti/stan/indicators.

### 2.2. Literature Review

In this part, the studies about the effect of export and import of high-tech industries on global economic growth and that of Iran are investigated.

Yung (1991) emphasized that in order to develop technology, export products must have advanced technology. In addition, Lucas (1998) stated that if a country specializes in high-tech products, the effect of exporting these products on growth will be more than low-tech products. Mody & Yilmaz (2002) believed that innovation is the basic need for being a competitive country. It can be achieved by importing technology, which in time should be replaced by domestic technology. Awokus (2007) stated that international trade is the main cause of science and technology transfer and it can be converted to domestic technology. Then by creating conditions for using technology, the foundation for increment of production and productivity will be built.

Kilavuz & Altaytopcu (2012) investigated the effect of export and import of different technology levels on economic growth in 22 developing countries during the period of 1998-2006 via panel data method in two models. Results from the first model showed that between the export and import of high and low-tech industries, investment and population, only high-tech export and investment had positive effects on production. In the second model, in addition to export, import was included and results showed that high-tech export, low-tech import and investment had positive effects on production and population whereas low-tech export and high-tech import had negative effects on growth.

Falk (2009) investigated the effect of changing the share of high-tech industry export on economic growth of 22 countries, which were the members of OECD in the period of 1980-2004. In the study, panel data model (GMM) was used to estimate R&D intensity of business, education for population in working, export of high-tech industry and investment on growth. By using the estimator system of GMM panel, they found out that both intensity of R&D in trade and share of high-tech export have positive and significant effects on GPD. Both have significant estimating capabilities, but R&D intensity has larger effects on trade than export of high-tech industries.

Cuaresma & Worz (2005) investigated the relation between factory industries export and growth based on infrastructure of factory industries. In the study, the hypothesis of different qualities between export of high and low-tech factory industries in relation to growth were investigated via panel data method for 54 developed and developing countries in the period of 1981-1997. The results showed that the export of high-tech industries has a positive and significant effect on GDP while the export of factory industries with low technology has an insignificant effect.

Schneider (2005), in a research paper named "international business, economic growth and intellectual property right", examined the role of high-tech business products, intellectual property right and direct foreign investment in determination of innovation rate and economic growth via panel data method in 47 developing and developed countries in the period of 1970-1990. The results of this study are: (1) the import of high-tech products is related to domestic innovation and increment of economic growth in developing and developed countries. (2) Foreign technology has stronger effects on growth of GPD than domestic technology.

Maleki (2010) investigated the effect of technological combination of export on economic growth by using Feder’s model, which needs to convert the coordinated customs system codes to international standard codes of industrial activities and then to technological codes (high, medium high, medium low, low and non-technological), in the economy of Iran, which is performed for a period of 69 seasons (1992 spring to spring of 2009). The results of two methods, simple and generalized least squares, proved the assumption of different productivity by using of production factors in technological section and stated that the export of high-tech products has more effects on growth such that the effect of high and low-tech is positive and significant; specifically this effect is larger in low-tech industries. In addition, he mentioned the negative and significant effect of non-industrial export.

Fatahi and Rezaie (2015) by using the panel data method and GMM algorithm investigated the effect of export and import of different levels of technology on factory industries growth in Iran during the period of 1991-2011. The results showed that because Iran is a developing country, high-tech import does not have a positive effect on growth. However, high-tech export has a positive and significant effect on growth. Beside the import and export of high-tech industries, low-tech import has a positive and significant effect. However, low-tech export has a positive but insignificant effect on growth that implies in low-tech industries import has a more important role compared to export.

Most experimental studies in export and import of high-tech industries showed their positive effect on growth. In these studies, R&D, labour, investment, high-tech import and export were the effective parameters on growth. In the current research, the import and export of high-tech industries is considered as the main parameters. Also, a difference between this study and other ones is the classification of industries such that in those studies high-medium-tech industries were included in high-tech group but here all types of industries are placed on their right class. Furthermore, the period and the applied model in this study are different from the previous studies.

## 3. Econometrics Algorithm and Results

In this section, the statistical population and data gathering tools are introduced and in the second part, in order to assess the stationary of parameters and necessity of using ARDL method, the generalized Dickey-Fuller hypothesis is used and finally the evaluation of model and results are evaluated.

### 3.1. Statistical population and data gathering tools

This study is performed by an analytical-descriptive method and using Romer R&D based model, which were explained previously, Iran's economic growth model for seasonal data in the period of 2002-2012 is evaluated. In choosing the parameters, the studies in the literature review (Maleki, Fatahi & Rezaie, Cuaresma & Worz) and theoretical bases (the endogenous growth model and technology overflow from business way) sections were used.

Time series data of parameters including GDP, capital stock in the price of the base year 1997 (the central bank website), employment in industry section (statistical centre of Iran), R&D expenditure (Management and Planning Organization of Iran) were used. Classified ISIC301 Data related to the value of high-tech import and export industries (HTI, HTE) are extracted from annual statistics of Iran customs, and calculations are performed by MS-EXCEL. In addition, Eviews is used to analyse existing capital stock and R&D expenditure data.

### 3.2. Generalized Dickey-Fuller Hypothesis

In the next step, to recognize the type of model in time series data, stationary tests are used. Augmented Dickey-Fuller test is one of the common tests, which are used to recognize stationary data. In this test, if the absolute value of ADF statistic is larger than the absolute value of critical MacKinnon then H0 hypothesis is rejected and data is stationary. Results of this test have been illustrated in table 2.

**Table 2:** Check static variables by using Augmented Dickey-Fuller test in level (Sorry origin)

| Variables | LGDP | LK | LL | LR&D | LHTI | LHTE |
|---|---|---|---|---|---|---|
| StatisticsADF | -2.75843 | -1.75943 | -0.45982 | -1.90441 | -2.19079 | -5.53184 |
| level %1 | -3.60559 | -3.60559 | -3.60098 | -3.59661 | -3.59661 | -3.59246 |
| level %5 | -2.93624 | -2.93694 | -2.93500 | -2.93315 | -2.93315 | -2.93140 |

| | | | | | | |
|---|---|---|---|---|---|---|
| level %10 | -2.60685 | -2.60685 | -2.60583 | -2.60486 | -2.60486 | -2.60394 |
| Stationary surface | I(1) | I(1) | I(1) | I(1) | I(1) | I(0) |

Source: Research results

Results show that some parameters like GDP, capital stock, employment in industry section, R&D expenditure and high-tech import industries are in non-stationary level and will be stationery by one differencing data.

Time series parameters in the model are persistent in different levels I (1) and I (0) so the estimation method will be ARDL, which is an auto-descriptive model. Analysis in this model is based on three dynamic short-term, long-term and error correction equations. In the current study the first, the short-term equation will be Estimate for models, and then long-term coefficients and error correction models will be Estimate by their long-term equations. It should be mentioned that in this method before estimating the long-term coefficients, bound test developed by Pesaran & Pesaran, (1996) must be used to evaluate long-term convergence and the long-term equation derived by this method is not false. In this method, the presence of a long-term relation between the parameters is tested by F statistics for testing the significance of levels. The point here is that the above-mentioned F distribution is non-standard. Pesaran and Pesaran (1997) calculated the appropriate critical values corresponding to the number of repressors despite or not the y-intercept and trend of the model. They presented two groups of critical values: the first one is based on the fact that all parameters are stationary and in the second one all data is non-stationary (they become stationary after one differencing). When the calculated F is out of this bound, one certain decision is made without knowing if the parameters are I(0) or I(1). When the calculated F is beyond the upper bound of H0 hypothesis, lack of a long-term relation is rejected and when it is under bound, the H0 hypothesis will be accepted. If the calculated F be between two the bound, the results are uncertain and dependent on if the parameters are I (0) or I (1) (Tashkini, 2005).

### 3.3. Patterns Estimation and Results

According to the method of estimation, ARDL form for this study based on Romer pattern of growth is as follows:

$$LGDP = \alpha_0 + \sum_{i=0}^{n} \alpha_i LGDP_{t-i} + \sum_{j=0}^{n} \beta_{1j} LK_{t-j} + \sum_{j=0}^{n} \beta_{2j} LL_{t-j} + \sum_{j=0}^{n} \beta_{3j} LR\&D_{t-j} + \sum_{j=0}^{n} \beta_{4j} LHTI_{t-j} + \sum_{j=0}^{n} \beta_{5j} LHTE_{t-j} + u_t \quad (4)$$

The estimation of equation (4) with ARDL Method is in table-3. Based the estimation, capital, employment in business section, expenditure of R&D, high-tech import and export have significant positive effects on economic growth of Iran. Results are similar to theoretical bases. Also, it is important to include import with lag (4) in the model and the reasons are:

- The time-consuming process of product clearance in import section which are due to repetitive issue of laws and instructions.
- The difficulties related to receiving the IRAN-CODE at the time of order, testing the products in standard and health organizations, lack of fund for payments, not following up by the owner, having judicial cases, losing the document, changes in company owners, financial issues in clearance and disagreement between the owner and the bank.

Complex and modern technology in high-tech industries, in order to import and use high-tech in production circle makes the country need appropriate basics making such as skilled labours, training and learning the technology, management supervision and maintenance skills, and creation of suitable foundations for backup and assigning a part of governmental budgets to R&D centres. Creating such basics is very time-consuming and lengthens the time of affecting of these industries on growth. The mentioned parameters make the process of products importing, time-consuming and the products in customs would be eroded.

So, modern technology would be inaccessible compared to other countries. On the other hand, the country in its production circle always uses the technology of the previous year and this affects its growth. As a result, the entrance of imported technology into the production circle and the effect on growth would happen with four months lag (Taherinejad, & Asdat Farnodi, 2012: 23).

**Table 3:** Results of Iran's economic growth model ARDL(2,2,0,0,0,0)

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| LGDP(-1) | 0.257712 | 0.064363 | 4.004052 | 0.0004 |
| LGDP(-2) | -0.183464 | 0.051578 | -3.557044 | 0.0013 |
| LK | 1.271636 | 0.223407 | 5.692020 | 0.0000 |
| LK(-1) | 2.822055 | 0.149308 | 18.90092 | 0.0000 |
| LK(-2) | -3.487673 | 0.315008 | -11.07169 | 0.0000 |
| LL | 0.444489 | 0.155839 | 2.852235 | 0.0079 |
| LRD | 0.093708 | 0.021079 | 4.445664 | 0.0001 |
| LHTI(-4) | 0.017187 | 0.007358 | 2.335700 | 0.0266 |
| LHTE | 0.009122 | 0.004462 | 2.044344 | 0.0501 |
| C | -1.505758 | 0.611952 | -2.460583 | 0.0201 |

Source: Research results

To overcome probable difficulties, autocorrelation tests, the assumption that distribution of residuals is normal, heterogeneity of variance and Ramzi test for evaluation of regression error or accuracy of subdominant form of the model were performed. The results have been shown in table-4.

**Table 4:** Results of the detection statistics

| Test type | Breusch-Godfrey Serial Correlation LM test | Heteroskedasticity test: White | Ramsey RESET test | Hypothesis testing normality of residuals |
|---|---|---|---|---|
| statistic | 0.049209 | 1.371231 | 0.048291 | 0.979339 |
| prob | 0.9521 | 0.2460 | 0.8277 | 0.612829 |

Source: Research results

As shown in table-4, because the level of significance of all statistics are larger than 0.05, in 95% confidence level, there is no heterogeneity of variance and autocorrelation in esteemed model and there is no evidence of non-normality of residuals and error in model. After estimation of ARDL model and making sure of classic assumptions, co-integration of model should be assured. For convergence test of model and finding the long-term relation between pattern parameters the bound test, which is developed by Pesaran and Pesaran (1996), is used. Results have been shown in table-5. F- Statistic in all levels is larger than critical values in two groups and H0 hypothesis, i.e. non-existence of a long-term relation is rejected, and it can be concluded that there is a long-term relation between pattern parameters.

**Table 5:** ARDL Bounds test

| Test Statistic | Value | k |
|---|---|---|
| F-statistic | 12.70788 | 5 |

Critical Value Bounds

| Significance | I0 Bound | I1 Bound |
|---|---|---|
| 10% | 2.26 | 3.35 |
| 5% | 2.62 | 3.79 |
| 2.5% | 2.96 | 4.18 |
| 1% | 3.41 | 4.68 |

Source: Research results

After assuring the existence of a long-term relation, it is estimated and evaluated. Results of estimation of a long-term relation have been shown in table-6. The results show that, the capital stock parameter has a positive coefficient and the most effect on economic growth of Iran compared to other parameters such that 1% increase of capital stock, increases the GPD by 0.65%. After capital stock, employment in industry section has a significant effect on growth such that 1% of increase in employment increases GPD by 0.48%. Despite all the efforts in recent years, R&D expenditure has increased the GPD by 0.10 %. Import and export of high-tech industries have positive and significant effect on economic growth of Iran. As shown, 1% of increase in import and export of high-tech industries increases GDP by 0.018% and 0.009 respectively. Positive effect of export in country is because of high competition power of scientific and medical instruments, electric machinery like radio, TV and telecommunication tools in the country and their exporting to the region (Karimi & Hassanpour, 2011: 107). On the other hand, in the statistical analysis of current parameters, most of the share of export and import of high-tech industries are related to medicine productions and other chemical materials, which are used in medicine and medicinal plant products. Because of the professional nature of these products and specific production circulation and using high-tech equipment in the production, these products are considered as sources of exchange income, increasing productivity and growth in the country. Possessing these industries is one the important criteria of development of countries (Zarei & et al., 2016: 40).

Import of high-tech industries in order to improve the quality of production, replacement of old equipment, absorption of domestic technology, improvement of productivity level of production parameters like labour and using the modern technology in creation of new production methods is needed for the country and has positive effects on growth.

**Table 6:** Results estimate the equation long-term economic growth

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| LK | 0.654622 | 0.046381 | 14.114004 | 0.0000 |
| LL | 0.480138 | 0.155412 | 3.089454 | 0.0044 |
| LRD | 0.101224 | 0.019893 | 5.088382 | 0.0000 |
| LHTI(-4) | 0.018565 | 0.007307 | 2.540706 | 0.0167 |
| LHTE | 0.009854 | 0.005453 | 1.807109 | 0.0811 |
| C | -1.626524 | 0.625996 | -2.598298 | 0.0146 |

Source: Research results

Existence of co-integration between groups of economic parameters prepares the statistical base for using error correction patterns. These patterns have good reputation in experimental works. The main reason is the reputation of error correction patterns, which relate the short-term fluctuations to the balanced long-term values (Nofarsati, 1999). Error correction model for Iran's economic growth is:

$$LGDP = d\alpha 0 + \beta 1 dlk + \beta 2\, dll + \beta 3\, dlR\&D + \beta 4\, dlHTI + \beta 5\, dlHTE + \beta 6\, dlECM(-1) \quad (5)$$

Estimation coefficients of error correction pattern, which explain the relation between GDP per capita and explaining parameters, have been shown in table-7. According to the table, all the coefficients relating to investment, employment in industry section, R&D expenditure, import and export of high-tech industries are significant. In these relations, elasticity of growth to capital stock is larger than other parameters. EMC (-1) coefficient in the model is estimated -0.92. This coefficient, which is statistically significant, shows that in each period, 92% of non-equilibrium in economic growth of Iran is adjusted to its long-term.

**Table 7:** The results of the estimation error correction model coefficients

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(LGDP(-1)) | 0.183464 | 0.051578 | 3.557044 | 0.0013 |
| D(LK) | 1.271636 | 0.223407 | 5.692020 | 0.0000 |
| D(LK(-1)) | 3.487673 | 0.315008 | 11.071687 | 0.0000 |
| D(LL) | 0.444489 | 0.155839 | 2.852235 | 0.0079 |
| D(LRD) | 0.093708 | 0.021079 | 4.445664 | 0.0001 |
| D(LHTI(-4)) | 0.017187 | 0.007358 | 2.335700 | 0.0266 |
| D(LHTE) | 0.009122 | 0.004462 | 2.044344 | 0.0501 |
| CointEq(-1) | -0.925752 | 0.110723 | -8.360989 | 0.0000 |

Source: Research results

## 4. Conclusion and Suggestions

The goal of this research was evaluating the effect of export and import of high-tech industries on economic growth of Iran. The results of model estimation in long-term and short-term show that import and export of high-tech industries have positive and significant effects on economic growth of Iran. Therefore, in the first step, technology absorption and learning and in the second step, increasing the diversity and improving the quality of products following with export are the most important methods for economic growth of Iran. In this situation the competition power and export developments, which are based on technological and industrial advancement, would be reached. To reach these goals the following items can be suggested:

- Development of cooperation for exchanging experiences and information with universities, local, regional and international organizations in the field of high-tech and using their research finding to increase the competitiveness of these industries.
- Defining and presenting facilities and business incentives such as: tax and custom exemptions for importing equipment, which is needed in high-tech industries, and export subsidization.
- Granting facilities for improvement of industrial infrastructures like R&D section, training of skilled workers in high-tech industries.
- Preventing time erosion of these industries in customs by facilitating the law and obligations of customs.
- Development of technological level and connecting the engineering and medical sections to improve the export of scientific and medical equipment and medicinal plant products.

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