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Effects of imported technology on economic growth in Iran

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In this paper, balance relation and long term of five variables: gross domestic product, net capital stock, employment, raw materials and intermediary goods and export and also their influences on each other in Iran for years 1975 to 2008 has been analyzed. For this purpose, vector autoregressive model (VAR) has been used. The first stability of variables by the use of dickey-fuller test has been examined. Next, analysis of Johnson test for considering the convergence among five variables has been used. The results of this research show that the export has a negative effect on gross domestic product. Also net capital stock, employment, raw materials and intermediary goods have a positive relation with gross domestic product.

Key words: Gross domestic product, net capital stock, employment, vector autoregressive model (VAR).

INTRODUCTION

In general discussions of economic, some economists, know technology as an independent factor in production. Some others consider it as a dependant factor of time. Some of them consider it as a dependant factor of investment; finally some know it as expositor factor of residual growth which cannot be created by other factors of product.

Technology is in fact its change. In other words in each product, whether in level of minor or level of national, the present way of product consider as technology. Therefore, use of technology means change of present technology. Of course, change of technology in addition, that may leads to more product, it can leads to quality change of product or even transportations, sometimes it increases quality of product and some other time it leads to making new means of transportation.

The general idea of majority economists is that imported developed technology which is synonym of capital intensive technology does not correspond with economic condition of developing countries. And these countries should use labor intensive technology. The main reason of such theory mentioned as discrepancy in factor production ratio of developing countries-labor ratio in comparison with developed countries.

May be the most important economic issued in years after World War 2 especially in developing countries were technology and economic growth. The goal of growth thesis, is an explanation of factors which determine growth rate in one country and also determine reasons of growth rate's discrepancy per capita incomes among countries and these question that what factors determine economic growth rate and how growth rate affected by various politic were always center of economist's attention of expanding sector. Other factors which had a great effect on economic growth of some developing countries and got the attention of many economists were imported technology and external trade. Imported technology has been used in many articles.

Abdoulaye (2011) in his article titled ‘International technology diffusion and economic growth: Explaining the spillover benefits to developing countries’ explored the extent to which these countries benefit from foreign technology, the diffusion mechanisms involved, and the
factors that shape their absorption capabilities. Results based on a non-stationary panel of 55 developing countries indicate that the benefits are quite substantial: a ten-percent increase in foreign research and development (R and D) stock is translated into more than a two-percent increase in aggregate productivity. Of the diffusion channels considered, imports appear to be more conducive to research and development spillovers. In addition, developing countries that enjoy larger benefits tend to exhibit larger stock of human capital, more openness to trade and foreign activities, and stronger institutions. These north–south research and development spillovers, although larger than previously suggested, appear less strong than north–north spillovers, adding to the general literature on economic divergence between developed and developing countries.

Batra and Lahiri (2002), in their article titled 'Imported technologies, urban unemployment and the north–south dialogue’ extend the Harris-Todaro model with intersectoral capital mobility to include sector specific imported technologies. They found that if the North agrees to reduce the royalty rate on the industrial technology, both the level and the rate of urban unemployment would rise and the income distribution will be changed against the wage earners, whereas such a reduction for the agricultural technology would have just the opposite effects. A decrease in either royalty rate would increase the national income in the south, although the magnitude of the increase in income would be larger with reduced royalty rate for agricultural rather than industrial technology. They suggested that the south should emphasize the import of agricultural technology over the industrial technology.

Rana (2002) in her article titled ‘the impact of imported and domestic technologies on the productivity of firms: panel data evidence from Indian manufacturing firms’ estimated production functions by using panel data on Indian manufacturing firms. The results indicated a statistically significant impact of imported technologies on productivity, especially on account of imports of disembodied technology. New domestic capital goods also impact productivity positively and, in fact, tend to do so in a wider range of industries. However, the productivity enhancing effects of domestic capital goods appear to owe more to the disembodied technologies imported by producers of domestic capital goods than the R and D they conduct.

Katrak (2002) in his article titled ‘imported technologies and research and development in a newly industrialising country: The experience of Indian enterprises’ showed that the imports increased the likelihood that an enterprise would commence research and development. And for enterprises that had already set up research and development unit, the level of research and development expenditures were higher among the importers than the non-importers, and also amongst the importers, the level of research and development expenditures was positively related to the payments for the imported technologies. The impact of the imports on research and development, however, seemed rather limited. The results suggest a number of questions for further research.

Katrak (1998) in his article titled ‘Developing countries’ imports of technology, in-house technological capabilities and efforts: an analysis of the Indian experience’ examined whether enterprises’ decisions to import technology are influenced by their in-house technological capabilities and whether the imports subsequently lead to an increase in the research and development intensities. It is argued that in a competitive market situation these decisions could be linked in a sequential relationship, but protectionist regulatory policies may make such a relationship quite unlikely. Empirical tests with data of Indian enterprises in the electrical and electronic industries, circa 1990, found results consistent with the predictions for the protected regulatory situation.

Ziesemer (2003) in his article titled ‘Growth with imported capital goods, limited export demand and foreign debt’ presented the implications of introducing imported inputs and elasticities of export demand into the neoclassical growth model for the analysis of long-run growth. Rates of growth of per capita consumption depend not only on the rates of interest and time preference but also on the terms of trade and will in general not be equalized across countries through international trade and capital movements. Under low interest rates and strong world economic growth per capita income, real wages, capital-labor ratio and the terms of trade grow faster if income elasticities of exports and the growth rate of world income be higher. If creditors debt ratio to the level of the capital stock classical growth results are obtained.

Caselli and Wilson (2003) in their article titled ‘Importing technology’ looked at disaggregated imports of various types of equipment to make inferences on cross-country differences in the composition of equipment investment. They made three contributions. First, they documented strikingly large differences in investment composition. Second, they explained the differences as being based on each equipment type’s degree of complementarity with other factors whose abundance differs across countries. Third, they showed that the composition of capital had the potential to account for some of the large observed differences in total factor productivity (TFP) across countries.

Hoekman et al. (2005) in their article titled ‘Transfer of technology to developing countries: Unilateral and multilateral policy options’ analyzed national and international policy options to encourage the international transfer of technology, distinguishing between four major channels of such transfer: trade in products, trade in knowledge and technology, foreign direct investment, and international movement of people.

A typology of countries and appropriate policy rules of thumb are developed as a guide to both national policymakers and multilateral rule making in the World.
Trade Organization (WTO). They argued that the optimal policy mix varies across countries and that there is a need for differentiation in the design and application of rules in trade agreements as well as for a more explicit focus on evaluation of the impacts of policies.

The rest of the paper is organized as follows: analyses previous studies; description of data and the econometric methodology; discussion of results that emerge from the estimations; conclusions.

DATA AND METHODOLOGY

We use this data from 1979 to 2006 of Iran. We found them in Central Bank of Iran. One vector autoregressive (VAR) model which possess k as exogenous variable. And p as time’s inhibition for each variable, in shape matrix is shown as follow:

\[
Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_p Y_{t-p} + U_t, \quad U_t \sim N(0, \Sigma)
\]

In this relation, \(Y_t\) and it’s lags, \(k \times 1\) vectors are related to models variables, \(A_i, \quad i=1, 2, \ldots, p\) are model’s coefficients for \(k \times k\) matrix. And \(U_t\), \(k \times 1\) vector is related to terms of model’s error. Now for linking short term behavior of \(Y_t\) to long term balance values, we can bring above relation as vector error correction model as following:

\[
\Delta Y_t = \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \ldots + \beta_{p-1} \Delta Y_{t-p-1} + \pi Y_{t-p} + \epsilon_t
\]

Where:

\[
B_t = -(I - A_1 - A_2 - \ldots - A_p) , i=1, 2, \ldots, p-1
\]

\[
\pi = -(I - A_1 - A_2 - \ldots - A_p)
\]

Matrix \(\pi\) contains of information of long term balance variables. We follow the Johansen approach in determining long-run relationships. Patterson (2000) and Doornik and Hendry (2001) provide a full treatment of the issues involved in this method. The first step is to estimate the VAR in levels with an appropriate lag structure. The next stage involves determining the cointegrating rank that is the number of long-run equilibrium relationships or cointegration vectors among the variables. Finally, to allow a reasonable interpretation of the results, cointegration vectors are identified (Abouie, 2001).

Theoretical principles

The model which is used for investigating the effect of imported technology on economic growth in Iran inspired from the propounded model in Feder (1982)’s paper. This model is defined as follow:

\[
\text{Ln}(\text{GDP})_t = B_0 + B_1 \text{Ln}(K)_t + B_2 \text{Ln}(L)_t + B_3 \text{Ln}(X)_t + B_4 \text{Ln}(MI)_t + B_5 \text{Ln}(MK)_t + \epsilon_t
\]

Where:

\[
\text{Ln}(\text{GDP})_t : \text{Gross domestic product (at basic price)}
\]

\[
\text{Ln}(K)_t : \text{Net capital stock (at constant prices)}
\]

\[
\text{Ln}(L)_t : \text{Employment}
\]

\[
\text{Ln}(X)_t : \text{Export of goods and services}
\]

\[
\text{Ln}(MI)_t : \text{Raw materials and intermediary goods}
\]

\[
\text{Ln}(MK)_t : \text{Capital goods}
\]

FINDINGS AND DISCUSSION

We use the aforementioned formulation to estimate a VAR model containing five variables. The variables are presented in Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{Ln}(\text{GDP})_t)</td>
<td>Gross domestic product (at basic price)</td>
</tr>
<tr>
<td>(\text{Ln}(K)_t)</td>
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</tr>
<tr>
<td>(\text{Ln}(L)_t)</td>
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</tr>
<tr>
<td>(\text{Ln}(X)_t)</td>
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</tr>
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<td>Raw materials and intermediary goods</td>
</tr>
<tr>
<td>(\text{Ln}(MK)_t)</td>
<td>Capital goods</td>
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In order to carry out fitness of VAR pattern first, it is necessary to investigate the persistency of variables. One of the common examinations which are nowadays used for recognition of persistency of one time series process is unit root test; we can do this examination in two ways: Dickey Fuller’s Test and Dickey Fuller’s generalized Test.

The results of the test for variables in levels are presented in Table 2. The results reported in Table 2 show that all the variables are I (0).

After investigation of persistency of variables, one of the important stages in evaluation of vector regression model is choosing rank of pattern (magnitude of lag should be inserted in equations). For choosing optimum rank of pattern, we can use the criterion of Akaike or Schwarz. The most lag which is given to model is 2.

Considering Table 3, the least quantity of Schwarz,
Table 2. ADF tests for unit roots.

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF</th>
<th>Critical value</th>
<th>Lag</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1%</td>
<td>5%</td>
</tr>
<tr>
<td>LGDP</td>
<td>-3.79</td>
<td>-3.58</td>
<td>-2.93</td>
</tr>
<tr>
<td>LL</td>
<td>-6.10</td>
<td>-3.65</td>
<td>-2.95</td>
</tr>
<tr>
<td>LK</td>
<td>-4.69</td>
<td>3.65</td>
<td>-2.95</td>
</tr>
<tr>
<td>LX</td>
<td>-6.90</td>
<td>3.58</td>
<td>-2.93</td>
</tr>
<tr>
<td>LMI</td>
<td>-4.98</td>
<td>3.58</td>
<td>-2.93</td>
</tr>
<tr>
<td>LMK</td>
<td>-5.70</td>
<td>-3.58</td>
<td>-2.93</td>
</tr>
</tbody>
</table>

Table 3. Determination of magnitude of lag of VAR model.

<table>
<thead>
<tr>
<th>Schwarz information</th>
<th>Akaike information</th>
<th>lag</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5.092509</td>
<td>-8.646605</td>
<td>0</td>
</tr>
<tr>
<td>-8.070677*</td>
<td>-9.124001*</td>
<td>1</td>
</tr>
<tr>
<td>-5.760207</td>
<td>-8.063917</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4. Test statistics for Co integrating rank (trace tests).

<table>
<thead>
<tr>
<th>Null</th>
<th>alt</th>
<th>Critical value</th>
<th>λ_{trace}</th>
<th>Probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>r=0</td>
<td>r≥1</td>
<td>95.754</td>
<td>151.88</td>
<td>0.0000</td>
</tr>
<tr>
<td>r≤1</td>
<td>r≥2</td>
<td>69.818</td>
<td>89.985</td>
<td>0.0006</td>
</tr>
<tr>
<td>r≤2</td>
<td>r≥3</td>
<td>47.856</td>
<td>56.719</td>
<td>0.0059</td>
</tr>
<tr>
<td>r≤3</td>
<td>r≥4</td>
<td>29.797</td>
<td>33.308</td>
<td>0.0189</td>
</tr>
<tr>
<td>r≤4</td>
<td>r≥5</td>
<td>15.494</td>
<td>15.638</td>
<td>0.0476</td>
</tr>
<tr>
<td>r≤5</td>
<td>r≥6</td>
<td>3.842</td>
<td>4.915</td>
<td>0.0266</td>
</tr>
</tbody>
</table>

Akaike statistic is prepared in first lag, where we can indicate that the optimum lag of VAR model is equal to 1.

In this article, we followed vectors and accumulated vectors among variables of gross domestic product, net capital stock, employment, raw materials and intermediary goods and export by the use of Johansson's method. Considering stationary test, variables which are under consideration are I (0). In Johnson's method after doing necessary calculations for studying the existence of convergence we use two criterions which consist of λ_{max} and λ_{trace}. If existence of convergence among the variables is verified, we can say that balance and long term relation among the variables is established.

Results which are concluded from the effect of the examination of maximum specific values for determination of accumulated vectors among model's variables are presented in following tables. Results of maximum of specific values for determination magnitude of accumulated vector are reported in Table 4.

The magnitudes of vectors which are prepared statistic of examination effect matrix are equal to 6 vector and magnitudes of vectors which are prepared statistic of maximum specific values are equal to 1. Considering that examination of maximum specific values is stronger than examination of effect matrix, therefore, for determination of magnitude of accumulated vector, examination of maximum specific values is used. Considering the results of Table 5 in level of probability of 90% magnitude of long term relations among variables, compatible pattern with economic theory is equal to (r=1) 1 is determined.

In Table 6, number inside parentheses are statistic of accounting t. estimated coefficients of all variables in a meaning full level, 5% are significant from statistical aspect. Considering prepared results within investigated period, variables of gross domestic product, net capital stock, employment and raw materials and intermediary goods had positive effect on growth rate and variable of export of goods and services has a negative effect on growth rate.

According to results, with an augmentation of one percent in gross domestic product, net capital stock, employment and raw materials and intermediary goods in order growth rate will be increase 0.36, 3.67, 0.10,
the exporting goods are benefits to developing countries.

Increasing product activities and as a result increasing activities through it. Therefore importing here leads to government sector use modern technology and expand and intermediate goods made the private and positive effect on economic growth. Economic growth of country, and through this, it had a plays domestic product.

Intermediate goods have a positive relation with gross domestic product. Also net capital stock, employment, raw materials and intermediary goods have a positive relation with gross domestic product.

Considering that mail part of imports is used for entering capital and goods like factories equipment, so it plays an effective role in product of country and reinforce economic growth of country, and through this, it had a positive effect on economic growth. Importing of capital and intermediate goods we need investment. So investment in importing capital goods is effective and reinforces importing of capital goods and in this way it can reinforce economic growth. Export has negative relation with economic growth, that is so because the exporting goods are scarce or strategic in internal markets and in order to continuing internal industrial activities, it is really needs. So the exporting of these goods decrease the internal product activity in country and it as a negative on economic growth we suggest some limitation should be created for exporting raw materials of this type of industry, In order to continuing activities of product industries.

Concl

0.07% and with an augmentation of one percent in export of goods and services in order growth rate will be decreased 0.05%.

Conclusion

Generally, in this article relation between imported technologies on growth rate in Iran was investigated. First we presented a model and estimated this model, in order to fitness of VAR pattern we used unit root test, then the magnitude of inhibition of VAR model was determined after that by using of Johansson’s and existence of accumulated vectors showed long term relations among variables. After certainty about existence of long term relation, we estimated this relation and then interpreted these coefficients.

The results of this research show that the export has a negative effect on gross domestic product. Also net capital stock, employment, raw materials and intermediary goods have a positive relation with gross domestic product.

Table 6. Co integrating vectors.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Vector 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGDP(-1)</td>
<td>1.00</td>
</tr>
<tr>
<td>LK(-1)</td>
<td>-0.36(-4.47) (-14.3)</td>
</tr>
<tr>
<td>LL(-1)</td>
<td>-3.67(-5.70) (2.33)</td>
</tr>
<tr>
<td>LMI(-1)</td>
<td>-0.10(-3.12) (-4.1)</td>
</tr>
<tr>
<td>LMK(-1)</td>
<td>-0.07(3.06) (2.03)</td>
</tr>
<tr>
<td>LX(-1)</td>
<td>0.05(2.06)</td>
</tr>
<tr>
<td>C</td>
<td>0.14</td>
</tr>
</tbody>
</table>

REFERENCES


Katruk H (2002). Imported technologies and R and D in a newly industrialising country: The experience of Indian enterprises.