The effects of technological changes on economic growth in Iran

Ebrahim Nabiuny, Sohaila Alahverdizadeh
and
Monir Sadat Mirjamali Mehrabadi
Jihad Daneshgahi, Markazi province, Iran

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Abstract
Generally we can suppose production as a function of three elements: the labor force that is used in production process, level of capital that has flowed in that process and finally the combination of these two elements that we identify by the level of technology. In growth models, ordinarily economists are examining the relationship between the growth of production and growth of labor force and capital level. This paper studies the effect of technology on economic growth of Iran during 1965-2011, after a review on the Neo-classical growth models and explaining the principles and defects of these models. Econometric consequences will reveal that the cost of research and development and the import of capital goods had a positive effect on the economic growth. On the other hand, the relationship between employment of specialist labor force and economic growth wouldn't be confirmed. After these steps, we are going to study the share of each index on the economic growth by standardize the variables.

Introduction
Having access to material welfare is one of the most important goals of economists and economy policy makers; achieving such a goal will be manifested more in economic growth hence the economists are to theorize the events pertinent to economic growth and identify the factors influential to that by which they try to expedite the process and help the human come closer to his long wish.

The purpose of compiling this article is to explain the relation between the level of technology and economic growth in Iran's economy. For this purpose at first there is a brief review on different theories given about the growth and factors influencing that, including neoclassic growth patterns and endogenous growth patterns; then by experimental tests the role of technology in economic growth between 1965-2011 has been explored. In this article it is supposed that in Iran's economy the level of technology is a function of costs arising by research and development, the employed specialist work force and the amount of capital goods import. Thus by using so low's residue, we will explore the relationship between that part of economic growth which can't be justified with workforce and capital raise and the factors influencing on the level of technology in Iran. Finally there is the analysis of the relationship between variables by the minimum squares method. The results show that between the three factors, the import of capital goods is more effective on economic growth, while there is no proved relation between employing specialist workforce and economic growth in the pattern.

Theoretical
One of the subjects that nowadays is the unique proof to evaluate different countries' economic revenues, is the economic growth. The important point here is that which factors influence economic growth and by focusing on what factors we can expedite the economic growth.

If we want to review growth models which in fact that act of modeling for factors on economic growth and the way they influence economic growth revenue will do, we face and Dumar model as one of the rudimentary models. In this model the production function is the type of production function with constant coefficients and in fact a certain amount of capital and work is specified as the main factors in production and there is no possibility to replace capital and work.

$$y_t = \min\left[\frac{k}{v}, \frac{1}{\alpha}\right]$$

In this model because both the savings rate in society and the work force growth rate are exogenous, making balance in the model (in a case with neither dormant capital nor unemployed workforce) is almost impossible, for that reason it is called the edge of the blade.

Solow in his famous article 1956 tried to expand reform the Harrad- Dumar model on the basis of neo- classic pattern. In fact what is considered as the downside of Harrad- Dumar model and is usually referred to as the edge of the blade, is in the important supposition based on the condition of production factor constant share or its irreplaceability. As solowsindicates when this supposition is put away the unstable balance on the edge of blade will be disappeared with that. In fact Solow's model accepts all the suppositions of Harrad- Dumar model except the supposition of production factors constant share.

Giving a model

In this article, the authors are to measure the effect of Solow model technology or MEP in Iran's economic growth between 1965 and 2011 therefore they can assess the role of technology in Iran's economic growth, then by making indicators for different factors which are influential in creation of technology (knowledge and human resource) they will understand whether the indicators justify the part of economic growth which can not be justified by capital and work force?

Considering that endogenous growth models or Solows residue amount are generally tested in developed countries, it does not seem realistic to over generalize them to developing countries like Iran due to their economy structure and different mechanism of economic growth, with out any experimental test. Even index human invest factor and knowledge stock according to different economics structures necessarily are not similar. According to mentioned explanation effort to represent model and relation indexes as follows: at the beginning it is supposed that production function of cub-duglus and fixed out put related to measure in this manner: equation $Y = f(L,K) = AL^{\alpha}K^{\beta}\alpha + \beta = 1$ (1)

That

Y: all of annually production in economy (here internal mixed production considered).

K: total capital stock in economy of country

A: technology index

$\alpha and \beta$ Tension result of relation to invest factors and job power that must estimated, so at first by dividing two sides of mentioned production function to L, function of job power average production (AP_L)

$$y = \frac{Y}{L} = \frac{AK^{\alpha}L^{\beta}}{L} = \frac{AK^{\alpha}}{L^{\alpha}} = AK^{\alpha} \qquad (2)$$

K, shows average invest instead of every job power unit in economy, by normal logarithm from the two sides of equation (2) we reach to following equation:

$$\ln y = Lna + \alpha LnK = C_1 + \alpha LnK \qquad (3)$$

Amount of A in mentioned model of exocrine, normal logarithm as a fix number such as C_1 appear in model, here could estimate amount of tension of production factors by differential of equation 3 following equation appear:

$$y = \alpha k \qquad (4)$$

(Y and k show internal impure production rate and average invest instead of employed job power).

According to expectation, above model couldn't justify all of changes in production so some parts of production that didn't available because of changes in invest fact and job power distinct by MFP. In other hand we have:

$$MFP = \dot{y} - \alpha\dot{k} \qquad (5)$$

On the other hand MFP itself is function of many factors, that according to mentioned subject in previous parts of lecture, the most important one is changing in technology. In endocarp model as explained before, technology index establish from knowledge stock and human invest factors. According to structure of Iran's economy following factors are determine factors of these two variables:

(A): knowledge stock index:

1- Relation of government research budget to total government budget (a): according to in fact that budget of government research normally and without changes include 60% of total expenditure of researches in country; this index transmittable to whole economy.

2- Relation of imports of invest goods to impure internal production (z), according to this fact that our country more import than production of technology and of the ways of technology arrival is to imports of invest goods to country

(B): human invest index:

Relation of expert job power to total employed (b): in this definition means of expert job power is total university under graduation and the people who have certificate of faniva herfie

Model estimation

Mentioned model according to time series datas related to recent years of research represented in table 1. And by least square method and Eviews of t ware estimated that results show in following.

A) MFP estimate by using the product's attraction estimate with regard to production factors:

In order to adjust Iran's economy theories and realities, the virtual variable D58 by zero value for the years before the imposed war and value one for the years after the war, is included in the model. After estimating the equation, the results of regression come as follow:

Estimation Command:

Ls Lny C LnK D58

Estimation Equation:

$$Lny = C(1)C(2)^{*} LnK + C(3)^{*} D58$$

Substituted Coefficients:

$$Lny = -0.130224 + 0.6988328^{*} LnK - 0.181729^{*} D58$$

$$R^2 = 0.8936$$

$$\overline{R}^2 = 0.888$$

More information is offered in the attachment in table 1 and graphs 1, 2.

As it is clear, the patterns used here shows the products attraction with regard to the capital as equal as 0.698328 if we suppose the constant productivity with regard to the scale is the product's attraction comparing to the workforce factor is equal to 0.31672

B) Estimating the relation between MFP and defined indicators

At first by using the definition of compound function, function h is defined as follows:

A: technology factor MFP=f (A) (6)

A= g (a, b, z) (7)

MFP= fog (a, b, z) =h (a, b, z) (8)

Different regressions show that research costs after three years, entering specialist workforce after two years and capital goods import in the first year would affect the production; by adding virtual

variable of the years of oil shock the obtained model by using the data between the year 1965-2011 for Iran's economy and by using the method of minimum squares was estimated, the results are as follows:
Estimation Command:
= = = = = = = = = =
LS (H) TFP () C A (-4) B (-2) Z D53
Estimation Equation:
= = = = = = = = = =
TFP= C (1) + C (2)* A (-4) + C (3)* B (-2) + C (4)* Z + C (5)* D 53
Substituted Coefficients:
= = = = = = = = = =
TFP= 0.01337247133+4.749795248* A (-4) – 0.001596750811* B (-2) + 1.136273751* Z- 0.1176264174* D53

$R^2 = 0.6425$

$\overline{R}^2 = 0.5727$

More information is offered in attachment in table 2 and graph 3.
a) the coefficient of the variable A,Z have a significant relation with the variable MFP , but variable B as an indicator for human resource does not have any significant relation with MFP. We will deal with the reason of this lack of significance later.
a) The signs of variables A, Z coordinate with theoretical discussions.
b) By exploring the estimate criterion and balanced estimate criterion we can conclude that there is the possibly that other variables are effective in forming MFP which is in accordance with the matters reviewed in the theoretical section.
The main reasons for the insignificance of the human resource variable coefficient come as follows:
1- Lack of accordance with the types of education and expertise with the needs of the job market.
2- Lack of employing specialist work force in jobs related to their expertise.
3- The low quality of education and lack of specialist workforce efficiency in activities related to their major.

C) Estimating the relation between MFP with the two variables that show knowledge assets

By omitting variable B from the model being tested and with the supposition that the research cost after 4 years and capital goods import in the same year affect the production and by considering the same virtual variable for the years after the oil shock, the new model is assessed as follows:
Estimation Command:
= = = = = = = = = =

$LS(H)TFP(\ )CA(-4)Z(\ )D53$

Estimation Equation:
= = = = = = = = = =

$TFP = C(1) + C(2)^* A(-4) + C(3)^* Z + C(4)^* D53$

Substituted Coefficients:
= = = = = = = = = =

$TFP = -0.01654439907 + 4.607376948^* A(-4) + 1.147564691^* Z - 0.1441140808^* D53$

$R^2 = 0.6105$

$\overline{R}^2 = 0.5716$

The observed dissimilarity variation was removed with white method.
The results come as follows:
a) all the pattern variables coefficient are meaningful
b) the signs of variables coordinates with theoretical discussions

c) Exploring estimate criterion and adjustment estimate criterion shows that at least 57% of changes in MEP is due to the change in the variables A, Z. in order to clarify the importance of each variable A,Z changes of MEP, the variables become standardized. After standardizing them, we observed that the effect of capital goods import to the country is more than the effect of costs arising by research and development on the economic growth. Among the reasons we can refer to lack of relationship between the researches and the need in different economical sectors, not using the researches achievements in production process and the formal aspects of these researches in many institutes. Of course such a result comes from the fact that domestic production more is capital intensive in comparison with importing goods.

Summation and conclusion

On the basis of theoretical discussions and according to the suppositions dominant on endogenous growth patterns, knowledge and human resource are the two factors that specify the level of technology, and technology is one of the effective factors in economic growth.

The study shows that in Iran's economy, despite the oil income and the important effects which these incomes have on economic growth, the level of technology can be taken into consideration as one of the effective factors. The study also shows that the cost of research and development along with the capital goods important which are taken as indicators to increase the level of knowledge in Iran's economic activities, can justify the important part of economic growth which is not justifiable by workforce and capital. But the authors of the article did not observe any significant relationship between the ratio of specialist workforce to the whole employed workforce as an indicator of human resource and this part of economic growth. Non-adjustment between the type of education and expertise to the need of job market, lack of specialist workforce employment in jobs related to their expertise, low quality of education and lack of efficiency in specialist workforce for activities related to their field of studies are among the important reasons for this insignificance between the two factors of research and development costs and capital goods import, the latter is more effective on Iran's economic growth; the reasons are lack of relationship between the researches and the need in different economical sectors, not using the research achievements in production process, the formality aspects of these researches in many institutes and also the fact that domestic production is more capital intensive comparing to importing goods. Such results clarify the need to step toward the knowledge based development more than before.

It is hoped that by creating efficient relationship between universities, research centers and economic institutions we could take a positive step toward the knowledge based economic growth in Iran.

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