The Impact Of Knowledge-Based Economics On Total Factors Of Production Productivity Growth

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Abstract: The main of this paper is about the effect of the knowledge – based economy on the total factors of production productivity in selected group of middle - income countries. In this regard, it has been used from World Bank indexes, including indexes of economic and institutional regimes (exports of goods with high technology respect to America dollars), education & human resources (the share of total employment of workers with secondary education), innovation system (number of papers in scientific and technical journals), information and communication technology (number of mobile subscribers per hundred people) for investigating effect for the knowledge-based economy on total factors of production productivity in selected group of middle - income countries are used. Modeling and statistical information in this paper is based on dynamic panel and static panel models and relationship between knowledge-based economy and total factors of production productivity growth rate in selected group of middle - income countries over the period 1998 – 2008 has been done by using generalized moments method ,fixed and random effects. The experimental results from this investigation show that:

- There is a positive and significant between knowledge – based economic indexes such as economic system performance, innovation and education and TFPP growth rate in SGMIC.
- Information communication and technology index has no significant effect on TFPP growth rate in SGMIC.

Key words: knowledge-based economy, total Factor productivity, dynamic panel data and generalized moments method.

INTRODUCTION

Human in all the centuries has faced to problems such as resources and production facilities limitations. This limitation is such that even in the current situation and with increasing development of science, humans are still limited to existing facilities. On the other hand, with regard to the promotion the public's expectations of economic prosperity, the demand for goods and services with almost infinite ascending trend is rising. Considering these two issues, the maximum use of existing facilities may be one of the most important solutions is to reduce the gap between supply and demand. In the current situations, higher productivity and more efficient use of existing facilities have become a choice beyond and converted to a necessity.

Review component of economic growth in developed and developing countries shows that increase share of labor productivity and capital are often dramatic and sometimes share of "increase investment" has surpassed. In western countries economics, technical progress or total factors of production productivity (TFPP) explains the bulk of the country's economic growth. The countries in East Asia are somewhat different issue. In these countries the main source of economic growth is capital stock growth. However, it is noted that the issue of economic growth was not merely a subject of increasing production of small entities but the experience of developed countries show that part of economic growth can be reached from rising levels of TFPP.

Hence, improving the TFPP as one of the major sources of economic growth and increase competitiveness of firms has been considered by economists so that the industrial and developing successful countries have gained a significant portion of its production growth in this way. Due to the nature of the descending output, with continued input growth in the long time, output growth can not be achieved i.e. with using inputs more and more, additional output less than one additional unit of input used can be expected. With continuous growth of output, total factor productivity growth is essential that’s why TFPP growth is synonymous with long-term growth and is reflective growth capacity. However the rate of growth of this index at the macro level show economic situation of country in terms of optimum use of resources and increase in the level of organization can lead to progress in a competitive market, improving the performance of different parts, the more closer to the goals planning, reduce costs, increase revenue, improve quality of production or services and etc. with regards to the role of TFPP growth is required to be known all factors that affect TFPP growth at the macro level are known (J. Prokopenko, 1992).
Today the factors that affect TFPP at the macro level are very different with the factors that were effective a few decades ago. Economic Cooperation Organization Europe want to search of the question of why economic performance of many the European advanced countries in member of this organization are weaker compared to America after 1995? They found their response growth of knowledge-based economy indexes in America such as rising costs information communication technology (ICT), increase research and development costs, training costs, increased innovation and as result increased productivity. Therefore, since the each of the economic indexes impact on TFPP growth in developed and developing countries have investigated but research about the effect of knowledge – based economy growth on TFPP in selected group of middle - income countries (SGMIC) doesn’t have taken place. Hence the main purpose of this paper is the reviews impact of the knowledge - based economy on TFPP in SGMIC by using Cobb-Douglas production function. In this function, the factor of progress technology is considered as endogenous agent and is a function of the indexes of knowledge-based economy and the impact of these indexes on total factor productivity production in SGMIC in the period 1998 - 2008 have studied with using generalized moments method ,fixed and random effects.

In this regard, the main hypothesis of this paper is as follows:

Knowledge – based economic indexes, including economic regime indexes (exports of goods with high technology respect to America dollars), innovation (number of patents), education (total employment of workers with secondary education), information and communication technology (number of mobile subscribers per hundred people), have significant positive effect on total productivity growth in SGMIC.

The required information has gathered with using published reports and statistics of external information sources and international Internet sites such as world development indicator (WDI). The structure of the paper is formulated as follows:

After review of theory and research background and estimated and finally the conclusions and policy recommendations are offered.

Theoretical Issues:

From beginning of entering productivity term to the economic literature has pasted more than a century. However, it has added new contents but precise and comprehensive definition of this term is not raised by the knowledge – base economy science and between economists and scholars in sociology and management agreement on the concept of productivity has not been achieved yet. The overall concept of productivity is for achieving a better life in living, the make comfort of its work force, work and the tool and has long history as much as human life on earth. From the perspective of the Asian Productivity Organization, productivity is related to realistic attitude to life that its result is use of the most of the thought, intelligence and resources. International Labor Organization is defined productivity as:

“Goods are produced as a result of four factors: land, capital, labor and organization management which productivity is the conjunction between production yield and one of the factors determining”. Generally, it can be considered the productivity as relationship between goods and services produced and the amount of resources used during the production of goods and services. This relationship is quantitative and measurable and can be expressed as a ratio. Whatever numerator is larger than the denominator, productivity is been higher with same ratio. Productivity has different classification including partial productivity or factors of production productivity (especially labor and capital) and TFPP can be pointed.

In computing productivity in addition labor productivity and capital productivity, multi-factor productivity is also considered which shows a more appropriate measure. in this paper what is desired is the TFPP. TFPP indicate that the average production per unit of total production resources which role of this index in economic growth is impressive. Whatever the rate of TFPP growth is more, the production growth will be higher. Improve the productivity help to increase economic growth from different ways which among them reduce costs and increase competitiveness and export development is followed which is leading to increase economic growth. Most studies of the relationship between productivity and economic growth during the 1970s and 1980s show that the national productivity growth of America has reduced. Robert Solow (1987) stated productivity paradox theory in 1987. This theory and scientific studies of the 1980s was the dominant issue for some time but, With the revival of American productivity growth in the mid-1990s, researchers were looking to answer the question whether information and communication technology, innovation, education, increasing the degree of employees, investment in physical capital, are the factors explaining productivity growth? Research studies have determined that human capital, innovation and inventions, information and communication technology and economic and institutional regimes that are indexes of knowledge-based economy has a major impact on TFPP growth at a macro level. In a knowledge-based economy, most studies show that the knowledge and information as inputs along with other factors of production, improve production processes, capital deepening, technological progress and ultimately economic growth and productivity are increased. These days the knowledge and information are as a valuable resource and asset of any organization and value and validity of the index is even more important than capital or labor indexes. Information and knowledge in economy, affects both on the supply side and demand side. Knowledge and information on the demand side from the utility function affects economic
behavior of consumers and on the supply side is effective on the production function (the producer's behavior). Knowledge economy which is named the digital economy, new economy, virtual economy, and also called network economy, is economics to produce, distribute and apply knowledge, operating and main driver of economic growth, generate wealth and employment in all industries. According to this definition, knowledge-based economy to grow and generate wealth only to a number of industries with high technology dependent, but in this economy all industries use the knowledge to fit the needs (APEC, 2001).

Knowledge base economy is the consequence of two factors of globalization of trade and ICT (M. Pohjola, 2002), indexes of economic and institutional regime, education and human resources, innovation systems, information infrastructure for investigation of the knowledge base economy is used in the various countries by the World Bank. Economic entities including some indexes which show favorable business environment for producing and distributing knowledge and information. Institutional regime including an efficient and reliable state (stability of government policies) and low corruption in this government. In this regime there is also a legal system which protects from fundamental law of trade and material and intellectual property rights. This shaft should be lead resources from inefficient to efficient parts and providing incentives for the use of existing knowledge, gain new knowledge and integrating existing knowledge with new knowledge will be increased productivity and economic growth. Indexes such as exports of goods and services, foreign direct investment and exports with high technology of gross domestic product (GDP) and the export share of total exports of goods with high technology, is used to demonstrate the system economic performance which in this paper from winders high-tech exports as an index of system economic performance are used because of the availability of information and statistics for selected countries.

Education and human resources are indexes which show the quantity and quality the people who have access to knowledge and information and in created and distributed more knowledge and information sharing in the economy. Human capitals, including the factors with its direct and indirect effects have abundant application on the quality of labor. Importance of human capital can be investigated from two aspects:

On the other hand, new techniques and new designs can not improve without a trained workforce at all levels of society, economy and can be used effectively. On the other hand, a correct way of thinking based on education and culture, labor productivity, can be a tool in order to accelerate the development and quality of the workforce. Human capital increases the ability of individuals and thereby increases their ability to produce goods and services. These abilities through factors such as savings of scale, economic yield, improve the quality of natural resources and social capital appear to be manifested and can affect the amount and quality of production and provides productivity growth. In this article winders students working with high school education are used as an index of the availability of information and statistics for selected countries.

Innovation system including indexes which shows the quality, quantity and rate of production of knowledge and information. Innovations include a network of institutions, rules and processes that affects on create methods, acquisition, dissemination and use of knowledge. This system can provide an environment that will foster research and development. This work cause to be increased innovation (new products, new production processes and new knowledge) and productivity and economic growth. Indexes such as the share of R&D spending, number of researchers and numerous articles in scientific journals and technical innovation projects for every one million people are used to demonstrate the performance of innovation systems which in this paper, due to the availability of information and statistics from winders such is used as number of patents as indexes of innovation system.

Information infrastructure including indexes which show the yield and effectiveness of information and knowledge distribution in an economy. Information and communication technology infrastructure indicating as information index. Information and communication technology in the 1990s as a new technology enters the market and also expanded rapidly. So that the second half of the twentieth century the world was entering a new era. With enter the computer to market and the continued expansion, information and communication technology ICT revolution occurred therefore, the present era can be called new knowledge- innovation or information age. ICT capital is mutual. ICT like other traditional forms of capital, are used as the production technology (J. Dedrick, et al., 2003).

This means that lower prices of ICT capital lead to substitution ICT capital with other factors and capital deepening; product development and labor productivity are directly affected. On the other hand, a characteristic of ICT is the same of knowledge; because part of ICT capital is to form of digital goods (except the hardware parts). Impact of ICT as one of the new beds is seen in all social aspects including the severe impact of ICT on the economy. It has been used winders such as the number of used mobile phones per 100 people, the number of mobile subscribers per hundred people, number of computers per 100 people and the number of Internet hosts per 10,000 people and the share of the total population of internet users to demonstrate the performance of IT and communication infrastructure is used which in this article due to the availability of fixed statistics, winders telephone lines per hundred people, information and communication technologies are used as indexes.
The Empirical Model and Data:

to calculate the total productivity, production function is needed. To simplify, the Cobb-Douglas function is used as follow:

\[ Y_{ij} = A L^\alpha_{ij} K_{ij} \]  \[ \beta = 1 - \alpha \]  

in this equation, \( j, i \) represents the cross section (country) and period of time respectively and \( K \) is the total capital stock. With castrating \( \alpha + \beta \) yield related to scale is constant.

A or technology is function of ICT infrastructure, education (EDU), innovation (PAT) and the economic system (HITECH). On the other hand,

\[ A = f(\text{HITECH, EDU, PAT, ICT}) \]  

by dividing equation (1) on \( L \) equation is defined as the capita production and investment as followed:

\[ Y_{ij} = A k_{ij} \]  

taking the logarithm of equation (3) and rewrite it again, the estimated production function is obtained using the following equation[11]:

\[ Ly_{ij} = LA + \alpha Lk_{ij} \]  

After estimating equation (3), total productivity is obtained by using the following equation:

\[ LTFP = LA = Ly_{ij} - \alpha Lk_{ij} \]  

With respect to equation (2) it can be written:

\[ LA = \beta_0 + \beta_1 \text{HITECH} + \beta_2 \text{LEDU} + \beta_3 \text{LPAT} + \beta_4 \text{LICT} \]  

We can write  \( b \) using the equations (5) and (6)

\[ LTFP = \alpha_0 + \alpha_1 \text{HITECH} + \alpha_2 \text{LEDU} + \alpha_3 \text{LPAT} + \alpha_4 \text{LICT} \]  

if both sides of equation (7) have been taken differential, equation is obtained as follows

\[ dLTFP = \alpha_0 + \alpha_1 d\text{HITECH}_{ij} + \alpha_2 d\text{LEDU}_{ij} + \alpha_3 d\text{LPAT}_{ij} + \alpha_4 d\text{LICT}_{ij} \]  

and finally, an equation that is estimated by this model is as follows:

\[ dLTFP_{ij} = \alpha_0 + \alpha_1 d\text{HITECH}_{ij} + \alpha_2 d\text{LEDU}_{ij} + \alpha_3 d\text{LPAT}_{ij} + \alpha_4 d\text{LICT}_{ij} + \epsilon_{it} \]  

in this equation \( d\text{(TFP)}, d\text{(HITECH, LPAT, LEDU, ICT)} \) is total productivity growth, high-tech exports growth to the America dollars as an index of the economic system, number of patents growth (innovative design) as an index of innovation, share of total employment growth as employees with secondary education, training of human resources growth and the number of mobile subscribers per hundred people growth as an index of ICT infrastructure, respectively. Symbols of \( L, d, i, j, \epsilon \) respectively, represent the logarithm, differential, period, country and disturbing component. Information and statistics used in this article is extracted from the latest data released by the WDI 2010. With regards to given the knowledge economies, the period 2008 - 1998 is considered. Short period of time is due to the lack of statistics and information about the variables of knowledge-based economy in particular, innovation and education indexes in SGMIC.

Econometric Techniques:

In order to estimate the parameters we have used the panel data method that follows is presented:

\[ Y_{it} = \delta_i + \Gamma_t + (X_{it}) \tau + \omega_{it} \]  

Where:

\( Y_{it} \) : TFPP in i country in t year

\( X_{it} \) : Vector of explanatory variables (exports of goods with high technology, human capital, innovation ICT for countries \( i = 1, \ldots, m \).

\( \tau \) : a vector-scalar (single-element matrix) of the parameters \( \beta_1, \ldots, \beta_5 \)

\( \omega_{it} \) : Is a random disturbance component

\( \Gamma_t \) and \( \delta_i \) : show special effects of time and sections, respectively.
With based on special effects of time and section \( (\Gamma_t, \delta_i) \) the different hypnoses of estimation of model are investigated and each of which gave better results, are selected for interpretation. In most models, the explanatory model variables, have strong creation properties or value dependent variable model in previous period have impact on it or both are present in the model (J. Eugenio-Martin, et al., 2004). To overcome these problems and estimate these models Arellano-Band (1991) have provided a dynamic method that is as follows:

\[
X_{it-1} + \gamma^iZ_{it} + V_i + \varepsilon_{it} + \Delta Y_{it-1} + \beta^i\Delta Y_{it-1} = \alpha^i\Delta
\]

in which:
- \( \Delta Y_{it} \): The first difference total factors productivity in I country in period t
- \( \Delta \): Deference of Dependent variable with time delay \( \Delta Y_{it-1} \)
- \( \Delta \): delay vector variables and endogenous variable differential \( X_{it-1} \)
- \( Z_{it} \): Vector of endogenous amounted and \( \gamma, \beta \) and \( \alpha \) represent the estimated parameters
- \( \varepsilon_{it} \) and \( V_i \): be assumed that in all time in I country are independent. \( V_i \)

Expression has pointed to special effect of section I which independently and equally distributed in all countries. While \( \varepsilon_{it} \) is random disturbance component and be assumed distributed independently, in this study the potential for bias control and the creation of variables we use from GMM in order to investigation of the effect of knowledge-based economy and other explanatory variables on TFPP in SGMIC.

To evaluate the relationship between knowledge-based economy and total factors productivity growth, we use from panel data and GMM methods. Accordingly, it is necessary to check the stativity of data. Results of stativity variables show, which have been done by using IPS unit root tests in panel data format, have been investigated below.

Table 1: investigation of static and non static variables in SGMIC.

<table>
<thead>
<tr>
<th>Regression type</th>
<th>FDI</th>
<th>DL(ICT)</th>
<th>DL(PAT)</th>
<th>DL(EDU)</th>
<th>DL(HITECH)</th>
<th>DL(TFP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( (P - \text{value}) )</td>
<td>0.0039</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0132</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>IPS statistic result</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

as Table 1 shows with regards to IPS statistic unit root null hypothesis is rejected. as result, Stability of the data used in this study confirmed before the estimation of models was done. Results of convergence tests in Table 2 also show that there is a long term relationship between the variables used in the model.

Table 2: Convergence test results of SGMIC.

<table>
<thead>
<tr>
<th>Kao Residual Co integration Test</th>
<th>Series: DL(PAT) DL(HITECH) DL(ICT) DL(EDU) DL(TFP) FDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date: 05/31/12  Time: 19:53</td>
<td>Sample: 1998-2008</td>
</tr>
<tr>
<td>Included observations: 253</td>
<td>Null Hypothesis: No co integration</td>
</tr>
<tr>
<td>Trend assumption: No deterministic trend</td>
<td>Lag selection: fixed at 1</td>
</tr>
<tr>
<td>Newey-West bandwidth selection using Bartlett kernel</td>
<td>ADF t-Statistic Prob.</td>
</tr>
<tr>
<td>-3.37812</td>
<td>0.0004</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

To better specify the model and consider the features of these countries and emphasized the empirical studies, we have estimated Equation (9) with respect to control variables of foreign direct investment. The final model after adding a control variable to the equation (9) is estimated as follows:

\[
dLTFP_a = C + \lambda_d dLTFP(-1)_a + \lambda_d dHITECH_a + \lambda_d dLEDU_a + \\
\lambda_d dLAT_a + \lambda_d dLICT_a + \lambda_d dFDI + U_a
\]

(12)
Which in above equation: FDI represents foreign direct investment of GDP. Since there was no the statistics related to the indexes of human capital and innovation as a series regular for all years from 1996 to 2000, in regression (12) Estimation of model was performed using a dynamic panel for years 2000 to 2008. The results of estimating equation (12) after conducting various tests to ensure the accuracy of the results are shown in Table 3.


<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>DL(HITECH)</th>
<th>DL(EDU)</th>
<th>DL(PAT)</th>
<th>DL(ICT)</th>
<th>DL(FDI)</th>
<th>DLTFP(-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDP</td>
<td>0.023*</td>
<td>0.014**</td>
<td>0.042*</td>
<td>0.119*</td>
<td>0.013*</td>
<td>0.032*</td>
</tr>
<tr>
<td>J-statistic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.56</td>
</tr>
<tr>
<td>Number of observations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>117</td>
</tr>
</tbody>
</table>

1) * ,** are statistically significant at 1% and 5% level respectively
2) depended variable :dlog (TFP)
3) t-statistic are in the parenthesis

as can be seen all the variables used in both models are statistically significant at a high level and the coefficient signs are consistent with economic theories. The J-statistic which has $\chi^2$ distribution with degrees of freedom equal to the maximum number of specified limitations rejected null hypothesis based on the waste convergence associated with instrumental variables. With regards to the results of this test instrumental variables used in estimation of model have sufficient validity. Therefore the validity of the results for interpretation are confirmed.

The results of this model are also obvious that the variable delay (dLTFP(-1)) has positive and significant effect on TFPP in SGMIC. Also, according to the results the coefficient index of variables of exports with high technology, human capital, innovation and ICT and foreign direct investment impact on TFPP growth in SGMIC are positive and significant statistically at high level which indicate that development components of knowledge-based economy and foreign investment on TFPP growth are effective in selected group countries in considered period.

In dynamic panel models, From stability point for more reliable results, number of observations must be large enough and observation for all the years have been seen, because in this method when the number of observations is small Interpretation of results is difficult due to the high bias. To ensure results, these estimates with the low number of observations during the period 1998-2008 and 2000-2008 were conducted by the static panel.

For investigation impact of knowledge – based economic on TFPP in selected group middle – income countries by static panel method, we have used from equation (13) and (14):

$$dLTFP_{ij} = \alpha_0 + \alpha_1dLHitech_{ij} + \alpha_2dLedu_{ij} + \alpha_3dLPat_{ij} + \alpha_4dLict_{ij} + \varepsilon_{it}$$

$$dLTFP_{ij} = \alpha_0 + \alpha_1dLHitech_{ij} + \alpha_2dLedu_{ij} + \alpha_3dLPat_{ij} + \alpha_4dLict_{ij} + \alpha_5FDI + \varepsilon_{it}$$

With regards to regression (13) in order to estimate the model using the static panel methods it is necessary to determine type of estimation for a specific cross section – combined data. First, to determine the presence (or absence) intercept, the F statistics were used separately for each of the countries. Evidence indicates on rejecting the null hypothesis (i.e., ordinary least squares). Then, to test the estimation model by using the fixed effects or random effects method, Hausman test should be used. $\chi^2$ Statistics of table is larger than obtained $\chi^2$ Statistics from calculation for this regression, therefore this hypothesis is based on using random effects with 85 percent probability has been approved. Hence, the random effects model to estimate is confirmed.

With regards to regression (14) obtained F Statistics from calculation is larger than F statistics of table, so the 99 percent confidence level the null hypothesis test based on ordinary least squares method can be rejected and the different intercept (fixed or random effects method) in the model should be considered. Then, to test for that the model with utilized the fixed effects or random effects method has been estimated, it has been used from Hausman test. Obtained $\chi^2$ Statistics from calculation is larger than $\chi^2$ Statistics of table for this Regression, therefore hypothesis based on the using random effects method can be rejected with 99 percent probability.
Hence, fixed effects to estimation of model are confirmed. The results of the effect of knowledge-based economy on TFPP growth in two separate regressions is shown in the table below:

Table 4: Estimation results of the indexes of knowledge-based economy on the TFPP growth by using data fusion method in 2000 – 2008 periods.

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>DL(HITECH)</th>
<th>DL(EDU)</th>
<th>DL(PAT)</th>
<th>DL(ICT)</th>
<th>DL(FDI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>0.033</td>
<td>0.054</td>
<td>0.043</td>
<td>0.043</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.88)</td>
<td>(0.86)</td>
<td>(0.99)</td>
<td>(1.04)</td>
<td></td>
</tr>
<tr>
<td>Adjusted R squared</td>
<td>0.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F test</td>
<td>11.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hausman test</td>
<td>1.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
<td>146</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 0.028** (2.38)   0.07 (1.40)  0.054* (5.93)  0.013 (0.53)  0.009** (3.56)
- Adjusted R squared 0.78
- F test 8.26
- Hausman test 17.66
- Number of observations 135

1) * ,** are statistically significant at 1% and 5% level respectively
2) depended variable ;dlog (TFP)
3) t-statistic are in the parenthesis

it can be seen from Table (4) results:
Regardless of the control variables, relation between the components of knowledge-based economy and TFPP growth will be studied and from obtained results this relationship in selected has not been confirmed in considered period. All obtained coefficient from this estimation are insignificant at low level.

After adding control variable, impact of knowledge – based economy on TFPP growth in selected group countries have studied. With regards to obtained results, impact of ICT and human capital variables on TFPP growth are positive but are insignificant statistically. But impact of other variables on TFPP growth in selected group countries are positive are significant.

Table 5: Estimation results of the indexes of knowledge-based economy on the TFPP growth by using data fusion method in 1998 – 2008 periods.

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>DL(HITECH)</th>
<th>DL(EDU)</th>
<th>DL(PAT)</th>
<th>DL(ICT)</th>
<th>DL(FDI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3)</td>
<td>0.031*</td>
<td>0.054**</td>
<td>0.058*</td>
<td>0.023</td>
<td>0.008*</td>
</tr>
<tr>
<td></td>
<td>(3.26)</td>
<td>(2.00)</td>
<td>(5.93)</td>
<td>(1.32)</td>
<td>(3.45)</td>
</tr>
<tr>
<td>Adjusted R squared</td>
<td>0.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F test</td>
<td>9.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hausman test</td>
<td>15.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
<td>146</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) * ,** are statistically significant at 1% and 5% level respectively
2) depended variable ;dlog (TFP)
3) t-statistic are in the parenthesis

We can conclude from estimation of model (14):
- foreign direct investment of GDP has a positive and significant effect on total factor productivity growth rate of production in selected developing countries So that a percent change (increase, decrease) in the leading index are produced to 0.009 percent change (increase, decrease) in total factor productivity growth rates, because foreign investment Through technology transfer and thus increase production can produce a positive impact on overall productivity growth.
- The growth rate of exports with high technology has a positive and significant effect on TFPP growth rate of the selected group of developing countries so that a percent change (increase, decrease) in the leading index to 0.022 percent change (increase, decrease) in total factor productivity growth rates are produced. In fact,
the high share of exports in GDP, which mainly exports industrial goods and services, corresponding high level of competitiveness and technology which can lead to an increase in total factor productivity growth.

- growth rate and a significant number of patents have a positive effect on the dignity of total factor productivity growth rate of production is a developing group of selected countries so that a percent change (increase, decrease) in the leading index to 0.055 percent change (increase, decrease) in total factor productivity growth rates are produced.

- the growth rate of total employment share of workers with secondary education has a positive and significant effect on TFPP growth rate of production is a developing group of selected countries so that a percent change (increase, decrease) in the leading index to 0.059 percent change (increase, decrease) in total factor productivity growth rates are produce. The human capital that is highly educated, experienced and professional and their new ideas and this kind of labor-based jobs, primarily in knowledge-based jobs, and their effectiveness are increased productivity. This kind of labor-based jobs, primarily in knowledge-based jobs, and their effectiveness are increased productivity.

- growth rate of the number of mobile subscribe per hundred people doesn’t have a significant effect on the growth rate of total factor productivity in SGMIC. Dewan and Kraemer (2000) and Pahjola (2000) impact of poor ICT index in developing countries (in 1980) related to the lack of complementary assets and the necessary infrastructure such as structure of base of knowledge to support the use of ICT products.

Conclusions:
The recent years have universality of concepts such as knowledge-based economy or new economy. Given that the knowledge-based economy knowledge has basic role in growth and value creation according to local knowledge is required in order to develop knowledge-based economy. On the other hand, review and understand the fluctuations of the TFPP and components as the most important factors of economic growth are vital.

overall, the results of the estimation of model TFPP growth by using panel data show that indexes of knowledge-based economy, including high-tech exports to the dollar as an index of the economic system, number of patents as innovation indexes, the share of employees with high school education as an index, have positive and significant effect on total factor productivity growth in SGMIC and the number of mobile subscribe per hundred people the number of fixed telephone lines per hundred people, as an index of ICT infrastructure have no significant on TFPP growth.. Therefore, the results of this study will provide suggestions below:

- to improve overall productivity, increase exports, especially exports of goods and services and imports of capital goods industry with new technology should be considered.

- Foreign direct investment, external factors affecting the TFPP. It is recommended that the results providing policy makers with the necessary platform for the development of foreign direct investment, cause of foreign technology and knowledge transfer and consequently improve the yield of production factors provide.

- Increase the share of educated workforce and improve its quality workforce and the per capita production and ultimately increase overall productivity. since the commercialization of knowledge in knowledge-based economy is the main importance it should be efforts to educate high school and university-based and focused on the commercialization of knowledge, so that all schools and university graduates become familiar with computers and with relevant skills and also brokers is been attended during work in specialized training courses and related activities to enhance their skills and familiarity with new technologies.

- Improve the incentive system by establishing a system of strong property rights and changes in the reward system, innovators, inventors and inventions may be due to low numbers.

- For the institutionalization of the innovation and invention in various economic activities in all educational levels is better funding to encourage and develop valuable inventions and their commercialization to be allocated.

- To develop information and communication technologies in the production of technical and communication infrastructure and communication as electronic communications infrastructure will provide the economy.

Appendix:
TFPP is the Solow residual which by using the Cobb-Douglas function is defined as following equation:

\[ Y = AL^\beta K^\alpha \quad \beta = 1 - \alpha \]

Where:
Y, K, L and A are GDP, reversing the entire capital, workforce and total factors productivity respectively and \( 0 < \alpha < 1, \quad 0 < \beta < 1 \) show the production elasticity of capital and the production elasticity of workforce respectively.

With the GDP data from the reversing capital and labor productivity, total factor productivity can be calculated. also \( \alpha \) can be obtained by a growth accounting methodology, with the assumptions of competitive
product and factor markets and profit maximization, with Equal $\alpha, \beta$ (elasticity factors) to the share of income. many studies have been carried out in the country researchers often consider $\alpha$ (the share of capital income) equal to 0.3 and $\beta$ (share of labor income) equal to 0.7 and considered the same for all countries[16]. in this study, $\alpha$ and $\beta$ equal to 0.3 and 0.7 are considered respectively and total factor productivity is calculated by relationship that is shown above.

**REFERENCES**

APEC Economic Committee, 2001. Toward Knowledge-Based Economies in APEC.