HUMAN CAPITAL, INNOVATION AND ECONOMIC GROWTH IN MALAYSIA, 1980 – 2011

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ABSTRACT

In this paper, we study human capital effects on economic growth of Malaysia from 1980 to 2011. By using Vector autoregression (VAR) and cointegration analyses. These estimates seem confirm that human capital and indigenous innovation efforts are enormously important to process of Malaysia economic growth during period 1980 – 2011. Human capital is the knowledge and skills human carry that makes them valuable to an economy. Becker (1962) regards human capital as a critical input to production as well as innovation. Based on the literature, human capital is one of the determinants of innovation beside an intellectual property rights (IPR’s), geographical concentration, financial structure, market structure, demand and regulation. Human capital can be represented by the level of schooling, skills and competencies that key determinant of economic growth. An educative system in a particular place like school, college and universities are aimed of diffusing base knowledge, giving technical and scientific competencies that enhance research and development activities and finally will promoting innovation. This study used methodology by Barro and Lee (1993) to estimate human capital that based on average time of schooling for population of 25 years old and older starting the period of 1980. Innovation is measure by R&D intensity and growth based on gross domestic product. The finding is consistence with the past empirical studies that there is positive role of human capital in shaping the pace of innovation and economic growth.

Field of Research: Human capital, Innovation, economic growth, Vector Autoregressive (VAR) and Malaysia

1. Introduction

In the 1990’s, Foreign Direct Investment (hereafter referred to as FDI) become the largest source of external finance for developing countries. In 1997, FDI accounted for about half all private capital and 40 percent of total capital flows to developing countries. As a result of substantial inflows FDI, host countries attained a rapid growth in productivity and export, developed a financial sectors, upgraded infrastructure and skills, and speeded up structural reforms. According to Stiglitz (2000), the inflows of FDI not only bring resources, but at the same time bring efficiency gains, new technology, access to
markets, valuable in training and also an improvement in human capital which FDI may support industrialization in developing countries. World Investment Report (1999), points out that FDI is major importance to economic growth, where FDI is capital provided that consist of equity capital, reinvested earnings or intra company loans by foreign investors to an affiliate enterprise in the host countries. It implies that FDI investor exerts significant influence on the management of the enterprise residents in the other economy.

In achieving sustainable economic growth, FDI is widely considered an essential element. United Nation Conference on Trade and Development (UNCTAD), expect FDI to provide a stronger motivation to income growth in host countries than other types of capital inflows. The inflows of FDI result are regarded as vital complements to development efforts. Several countries have been recipients of considerable levels of FDI, which appear to have significantly benefited these economies. The link between FDI and economic growth stems from the fact that higher FDI stimulates high economic growth in the host country and higher economic growth in the host countries attract more FDI. It is theoretically straightforward to argue that inflows of FDI have a potential for increasing the rate of economic growth in the host country.

The inflows of FDI will influence economic growth to host country and provides the important link between technology and economic growth. Multinational corporations (hereafter referred to as MNC) operations in the host country can result in technology spillovers from FDI whereby domestic firms adopt superior MNC technology which enables them to improve their productivity. Technology spillovers thereby generate a positive externality that should allow the host country to enhance its long-run growth rate. Blomstrom et al. (1999) technology is embodied not only in machinery, equipment, patent rights and expatriate managers and technicians, but also in the human capital of the affiliates’ local employees. Mansfield (1980), only FDI can transfer technology embodied in human capital which cannot be transferred by others channel. Human capital is one factor that has been identified as conditioning the “capture” of international knowledge and human capital as a vehicle for international knowledge transfer associated with productivity catch-up among countries.

Although there is broad consensus that technological progress considered in a wide sense, technology is a crucial determinant of growth, access to inventions and new designs is not uniform among countries. In the latter cases, host countries have to benefit from the diffusion of new technology from other countries. In some countries, new technologies are developed when innovation takes place. The role of innovation in economic development or growth is among interested issue by economists. The innovation is based on the results of new technological developments, new combinations of existing technology or utilization of other knowledge acquired by the company. Innovation is a successful exploitation of new ideas and can be a cornerstone of sustained growth and prosperity. Growth through innovation needs to be supported by a healthy level of investment in physical capital, entrepreneurial and human capital.

1.1 Problem statement

The development and the level of economic growth of countries will grow when there is more inflow of inputs through increasing physical capital, human capital, level of education and high technologies. However the way of countries ability to absorb and adapt all these factors will demonstrate either country will generate sustainable long run growth or not. Mankiw et al (1992), postulated that there is a significant relationship between investment in human capital and economic growth. In theory, human capital is related to knowledge and qualifications and economic growth depends on the progress of technological and scientific knowledge, so it is reasonable to expect that growth is function of human capital. Many researchers complement economic growth with more innovative activities. Presently, it is common to suppose that new technologies are the driving force of the long run economic growth. Countries can benefit from high degree of innovation activities like research and development (R&D).
From the fact, FDI inflows in developed countries in the past two decades are more than of developing countries. How do the developing countries will do to attract inflows of FDI. The basic attractive investment climate and sound policy environment is by an availability or quality of factors of production at host countries, market size or market access, logistic cost and socio-political environment conducive for doing business with minimal risk. The questions remain here is that, is it enough the inflows of FDI in developing countries especially in Malaysia country in order to improve or contribute in human capital and innovation to enhance economic growth. Our goal is to empirically evaluate the importance of human capital as well as innovation cause Malaysia economic growth since 1980’s till present.

The rest of the paper is structures as follow. In section 2, we provide an overview of related empirical work. In section 3, we describe the data set that we use and methodology to analyze. The empirical analysis of a long run analysis between human capital, productivity and innovation is presented in section 4 and finally in section 5, we conclude for the Malaysia economy during the period 1980 – 2010.

2. Related literature

FDI is seen as a major source for the transfer of technology from the leading countries to the follower countries because MNC tend to be very knowledge intensive firms, (Benhabib and Speigel 1994; Borenstein, De Gregorio and Lee 1998; Slaughter 2002). Slaughter (2002), suggest three channels by which FDI may positively affect the accumulation of human capital, there are technology transfer, spillovers and physical capital investment. Monge Neranjo (2002), hypothesized that FDI speeds up the accumulation of general human capital. Human capital is closely related to the level of schooling rate. According to Blomstrom and Kokko (2003), they show that technology intensive FDI flow essentially toward those economies with high educational levels. Checchi et al (2007) and Suter and Walter (2008), examine the role of human capital of inward FDI by using gross enrollment rate of schools for developing countries and find that there is statistically significant positively correlated with FDI inflow. Country that lack of human capital discourage the inflows of FDI, (Lucas, 1990).

Some of past researchers find that human capital does not statistically significant toward inflows of FDI, (Root and Ahmed 1979; Globerman and Shapiro 2002; Alsan, David and Canning 2005). Schueider and Etey (1985) find that human capital is less significant with FDI. Others like Narula (1996); Checchi and De Simone (2007); Suter and Walter (2008) find that human capital is positively effect on FDI inflow. At the country specific analysis, there is substantial evidence that accumulation of human capital represent a key determinant of economic growth. Barro (1991) concluded that the rate of output growth is strongly related to the initial quantity of human capital. Supported by Levine and Renelt (1992) that the effect of human capital on the rate of output growth is strongly related. Benhabib and Spiegel (1994) analyze growth of total factor productivity as a function of education level and suggest that the role of human capital as a necessary condition for adoption and creation of technology adapted to internal needs is more important than that of being a production factor. Romer (1990) considered that human capital affects growth either directly on influencing the rate of technological innovation of a country or indirectly in influencing the pace of adoption of technologies that come from the outside.

In the neoclassical framework, the impact of innovation is treated as part of the Solow residual and hence a key contributing factor to economic progress and long-term convergence (Solow 1957, Fagerberg 1994). The endogenous technological change to explain the growth patterns of world economies had been discussed by Romer (1986), so-called endogenous growth model. According to Romer technological innovation is created in the R&D sectors using human capital and the existing knowledge stocks, then it is used in the production of final goods and leads to permanent increases in the growth rate of output. These models postulate that endogenously determined innovation enables sustainable economic growth, given that there are constant to innovations in terms of human capital.
employed in R&D sectors. Grossman and Helpman (1991), due to the popularity of endogenous growth theories, economists are increasingly of the view that differences in innovation capacity and potential are largely responsible for persistent variations in economic performance and hence wealth among the nations in the world. Investment made by MNC’s through foreign direct investment (FDI) in innovative activity are crucial for economic growth.

According to Cohen and Levinthal (1989) and Goldberg and Kuriakose (2008) R&D which is the key input into innovation is also input into absorption. There are complementarities among innovation and absorptive capacity. Innovation promotes absorptive capacity because the generation of human capital and new ideas, and the associated knowledge spillover effects, help build the absorptive capacity. Conversely, the absorption of cutting edge technology inspires new ideas and innovations. Romer (1986), technological innovation is created in the R&D by using the human capital and the existing of the knowledge of stock. Porter and Stern (2000) find that innovation is positively related to human capital in the R&D sectors and national knowledge stock. Cohen and Levinthal (1989) express the dual role of R&D activities, that means R&D served both for the creation of new knowledge which is innovation and for the ability of firms to absorb and deploy of knowledge that available externally. Firms that invest in R&D not only directly pursue the innovation, but also keep up with the latest research findings and development in the industry and at the same time gaining first mover advantages in the deployment in the new technologies.

To sum up the literature on human capital and innovation on economic growth, human capital and innovation are important determinants of growth. The development of human capital is necessary condition for innovation in adoption and creation of new technology for a country.

2.1. Theoretical Framework

Based on the previous discussion, we propose a conceptual framework that diagrammatically reflect the relationship between the two determinants and intention (see Figure 1)

![Figure 1: The Theoretical Framework.](image-url)
3. Methodology

3.1 The proxies of relevant variables.

In this section we use the annual time series data over the period 1980-2011 in Malaysia that consist 32 observations. Data is collected from Statistical Yearbooks published by Statistics Press, World Intellectual Property Indicator, Malaysia Intellectual Property Indicators and World Bank Indicators. The output growth is constructed by growth rate in total factor productivity, human capital follow Barro and Lee estimation, the proxy of innovation is R&D intensity (gross expenditure on R&D over GDP).

3.2 Specification and estimation of the econometric model

3.2.1 Specification of the econometric model

The purpose of this section is to estimate the long run structural relations between total factor productivity, human capital and innovation for Malaysia economy in the period 1980-2011. These structural relations are based on a log linear specification of the joint evaluation of the total factor productivity as a proxy of growth, innovation and human capital based on average number of years of schooling. The model will be estimates as follows: \( \beta_0 \) is country specific intercept, \( \beta_1 \) is the elasticity of growth rate respect to human capital, \( \beta_2 \) is the elasticity of growth rate respect to innovation and \( u_t \) is the random error term.

\[
TFP_t = \beta_0 + \beta_1 HC_t + \beta_2 INNO_t + u_t
\]

Based on theory, country productivity tends to increase when human capital grows and vice versa. At the same time the larger innovation capability will associated a greater productivity. Therefore, productivity will be positively related to human capital and innovation with the elasticity of these variables are \( \beta_1 > 0 \) and \( \beta_2 > 0 \).

In order to analyze the potential interactions between human capital and innovation on productivity growth by estimating

\[
\begin{align*}
TFP_t &= \beta_0 + \beta_1 HC_t + \beta_2 INNO_t + u_t^2 \\
TFP_t &= \beta_0 + \beta_1 HC_t + \beta_2 INNO_t + \beta_3 HC_t \times INNO_t + u_t^3
\end{align*}
\]

Where \( HC_t \times INNO_t \) is interaction of human capital and innovation for year \( t \). If \( \beta_2 > 0 \) and \( \beta_3 > 0 \), the effect of innovation on productivity tends to be greater when the population is more educated, and the effect of human capital on productivity is directly related to innovation.

3.2.2 Estimation of the model by cointegration

Cointegration allows estimate equilibrium or long run parameters in a relationship that includes unit root (nonstationary) variables. By using cointegration test to estimate the long run relationship between economic growth, human capital and innovation in Malaysia economy. In the long run cointegration analysis, if the two or more series evolve together, then in a linear combination of them might be stable around a fixed mean, despite of their individuals trends (that cause nonstationarity). Thus, when there is a long run relationship between variables, the regression of all variables (cointegrating variables) has stationarity terms.

3.2.3 Vector Auto Regressive analysis (VAR)
To examine the role of human capital and innovation on economic growth, this study applied Vector Autoregressive Method (VAR). A VAR model describes a system of equations in which each variable is a function of its own lag and the lag of the other variables in the system. By using VAR methods, the unit root test must be conducted to see the variables are integrated at what level either I(0) or I(1) or I(2). The VAR is a special method, whereas when the variables are integrated at I(1) and have the cointegration between variables then analyze can proceed to Vector Error Correction Method (VECM). For the examination of the relationship between economic growth and the other determinants (i.e. human capital, innovation, interaction term (human capital and innovation), the null and alternative hypothesis are as follow:

\[
\begin{align*}
H_0 &: \beta_1 = \beta_2 = \beta_3 \\
H_a &: \beta_1 \neq \beta_2 \neq \beta_3
\end{align*}
\]

Null hypothesis show that all the variables are influence economic growth and alternative hypothesis show that the variables are not significant relationship with economic growth, whereas this hypothesis only show either there exist relationship or not. To estimate which determinants that highly influence economic growth, we need to conduct the other analysis such as granger causality test.

4. Finding and Discussion

4.1 Unit Roots Test

In order to proceed with the empirical analysis, all data series are checked for stationary firstly. If the series are non-stationary, standard economic techniques will lead to misleading estimation. So we have to determine the degree to which they are integrated if the null hypothesis of non-stationary cannot be rejected. By using the method of the augmented Dickey-Fuller (ADF) unit root test, as well as of the Phillips-Perron (PP) test, the unit root tests provide the following results (Table 1). According to the testing results, at level all the variables are not significant. But they are stationary at their first and second differences. Thus, it is reasonable to suppose that all the series in the model are stationary at I(1). Finally, we justify that at levels variables of the model are nonstationary and at first different all the variables are stationary.

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF Test</th>
<th>PP Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level</td>
<td>First Difference</td>
</tr>
<tr>
<td>GROWTH</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No Trend</td>
<td>-1.50</td>
</tr>
<tr>
<td></td>
<td>Trend</td>
<td></td>
</tr>
<tr>
<td>HC</td>
<td></td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td>No Trend</td>
<td></td>
</tr>
<tr>
<td>INNO</td>
<td></td>
<td>-0.96</td>
</tr>
<tr>
<td></td>
<td>No Trend</td>
<td></td>
</tr>
<tr>
<td>HC X INNO</td>
<td></td>
<td>-1.64</td>
</tr>
<tr>
<td></td>
<td>No Trend</td>
<td></td>
</tr>
</tbody>
</table>

Note: The null hypothesis is that the series are non-stationary. The rejection of null hypothesis for ADF and PP test is based on the critical value from MacKinnon (1996). The symbols ***, ** and * indicates the rejection of null hypothesis at 1%, 5% and 10% significance level.
of the series that suggesting stable long run relationship between them.

4.2 Multivariate VAR Framework

The dynamic relationships among the growth, human capital and innovation are examined using vector autoregressive (VAR) analysis. Johansen (1988) and Johansen & Juselius (1992) derived the trace test and maximal eigen-value test to identify the existence and number of distinct cointegrating vectors in the VAR framework. This study used their methods to test the existence and number of cointegration vectors through trace test and maximum eigen-value test. The hypothesis will be as follow and the results are reported in Table 2.

\[ H_0 = 0 \text{ (No cointegration)} \]
\[ H_A \leq 1 \text{ (Have Cointegration)} \]

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Trace Statistic</th>
<th>0.05 Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None*</td>
<td>0.6593</td>
<td>125.9451</td>
<td>95.7536</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>At most 1*</td>
<td>0.5069</td>
<td>86.0964</td>
<td>69.8188</td>
<td>0.0015</td>
<td></td>
</tr>
<tr>
<td>At most 2*</td>
<td>0.4582</td>
<td>59.9310</td>
<td>47.8561</td>
<td>0.0025</td>
<td></td>
</tr>
<tr>
<td>At most 3*</td>
<td>0.3692</td>
<td>37.2506</td>
<td>29.7907</td>
<td>0.0058</td>
<td></td>
</tr>
</tbody>
</table>

The trace test of cointegration rank indicates that there exists cointegrating vector in the VAR model set and decides to reject \( H_0 \) and accept \( H_A \). So we can find out that the long-run equilibrium relationship between economic growth, human capital, innovation and interaction between innovation and human capital. Choosing \( r = 1 \), we obtain the following estimates of the cointegrating vectors. The result in Table 3.

**Table 3: Estimate of the long run economic growth elasticities.**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Elasticities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human capital</td>
<td>0.4207</td>
</tr>
<tr>
<td>Innovation</td>
<td>0.3208</td>
</tr>
<tr>
<td>Human capital x Innovation</td>
<td>0.4109</td>
</tr>
</tbody>
</table>

From the table, economic growth is positively related to human capital and innovation. Based on the long run elasticities for interaction between human capital and innovation show positively related to economic growth. Therefore, the estimated cointegration relationships are consistent with the theoretical presumption. Malaysia economic growth has benefited from human capital more than from innovation activity. From the result, 1 percent increase in human capital lead to increase 0.42 percent of economic growth. For innovation only 0.32 percent led to increase in economic growth when 1 percent increases in innovation. In addition, human capital influences economic growth in Malaysia through innovation, whereas the results demonstrate the elasticity of interaction between human capital and innovation shows 0.41 percent.
4.3 Causality Tests

Granger causality test is an econometrics method to test the causal relationship between economic variables. The results of the causality test are summarized in Table 4. The optimal lag length selected is given in estimating the VAR models. According to the table, an increasing in the number of human capital is granger cause of economic growth in the long run. The development of innovation activity at host country has significant effect to economic growth. These results show that the economic growth is supported by human capital.

Table 4: Granger Causality test

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>( \chi^2 ) statistics of lagged first differenced terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>HC</td>
<td>11.5808 (0.0031)***</td>
</tr>
<tr>
<td>INNOVATION</td>
<td>7.7514 (0.0168)**</td>
</tr>
<tr>
<td>HC X INNOVATION</td>
<td>10.1433 (0.0023)**</td>
</tr>
</tbody>
</table>

From the Granger causality test, we can accept \( H_0 \) and reject \( H_a \) because the result show that there is positively relationship between economic growth and it determinants but with different significant level. Based on estimation, human capital is significant at 1%, innovation at 5% and interaction term of human capital and innovation at 5%. This finding has been supported by numerous of study that human capital, innovation and interaction term are the most important indicators to support economic growth. Based on the estimate of variables, we can conclude that human capital is the most important determinant to enhance economic growth follow by interaction of human capital and innovation and innovation for Malaysia economy during 1980 - 2011.

5.0 Conclusion

This main goal of this paper was to study the role of human capital and innovation on economic growth. We estimated long run relationship between economic growth, human capital and innovation and interaction term (composite variable involving human capital and innovation). This estimation was done by using cointegration techniques based on Johansen methodology. The result emphasizes that human capital is more important rather than innovation to explain Malaysia economy growth during 1980 – 2011. The estimate of Malaysia economic growth with respect to human capital is 0.42 percent compare 0.32 percent of innovation. The value of interaction term between human capital and innovation is 0.41 percent, whereas this estimation indicates that there is stable long run relationship between economic growth, human capital and innovation. Human capital is extremely important to Malaysia economic growth either directly through the impact on economic growth or indirectly on the innovation.

References


Checchi, Daniele, De Simone, Gianfranco and Faini, Riccardo, Skilled Migration, FDI and Human Capital Investment (May 2007).


