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Development impact of higher education across Asian countries

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Abstract

Recent literature has emphasized the importance of education in spiralling economic growth in many countries across the globe. The effect of education on economic growth is estimated via cross-country growth regressions where average annual growth in Gross Domestic Product (GDP) per capita over several decades is expressed as a function of measures of schooling. This paper aims to determine the short-and long-run effects of higher education, measured by education expenditure and gross enrolment rate, on economic development across Asian countries. Using partial adjustment model, it was found that in the short run, education expenditures positively affect GDP in four Southeast Asian and three Middle East countries. Gross enrolment ratio (GER) was found to have short-run positive effect only on carbon dioxide (CO_2) emission and negative effect on adolescent fertility rate in six and four countries, respectively. In the long run, development indicators in all countries were significantly affected by higher education. In most countries, education expenditures and GER positively affect GDP, GDP per capita, and CO_2 emission while adolescent fertility rate was negatively affected in all Middle East and six Southeast Asian countries. These results would rationalize an increased spending on higher education by both public and private institutions further enhancing higher education curricula that will also promote environmental sustainability.

Keywords: Economic Development; Higher Education; Gross Enrolment Ratio; Education Expenditure

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1. Introduction

Education has been recognized as a requisite for economic growth and development. In the past decades, the emphasis was on primary education, since more people especially in the third world countries, can be reached with the same investment. However, since 2000, the importance of higher education has been recognized with a view that it increases skill and knowledge and results in higher income. Higher education is expanding rapidly in the world where millions more men and women are enrolling in the university. The number of students enrolled in tertiary education has increased from 6.1 million in 2000 to 12.2 million in 2013 (UNESCO Institute for Statistics, 2015). The number of those who are completing degrees is expected to increase around the world as advanced skills become more important in both developing and developed economies.

Human capital development, through literacy rate improvement, affects the standard of living of the households, and the society in general, because they can acquire a more decent job and consequently, buy high quality goods and services (Hanushek, 2013). Education is also a major remedy for many problems faced by developing countries due to population pressures caused by high fertility rates. It can affect fertility in the long run since increasing fertility causes poor investment of time and resources in adults (Cleland, n.d.). Decreasing fertility through education will reduce health risks for both women and children, improving their welfare conditions and productivity.

In the literatures, the effect of education on economic growth is estimated via cross-country growth regressions where average annual growth in GDP per capita over several decades is expressed as a function of measures of schooling. Cross-country growth regressions revealed that quantitative measures of schooling positively affect economic growth. Similarly, over the past years, research demonstrates that the quality of education dramatically changes the assessment of contribution of education in economic development (Hanushek and Woessmann, 2007; Hanushek and Woessmann, 2010). The improvements in the quality of higher education play a major role in economic development as the country specializes in industrialization and modernization (Montanini, 2012). Bloom et al. (2005) further emphasized that technological catch-up can help enhance economic development which can be successful through higher education. Furthermore, Matthews and Hu (2007) expressed that development of enhanced technological capacity can be obtained in universities and public research institutes to further improve economic development.

From a macro perspective, economic development is driven by the advancement and application of knowledge which are fundamental to the construction of a knowledge economy and society in all nations (World Bank, 1999). Countries with high literacy rates help the economy grow, bringing more wealth to the individual workers and the economy, thus, resulting in higher standard of living. A more productive workforce will lead to an increased demand for goods and services in the economy which would induce investment growth in the country. A sustained level of education of the workforce, coupled with increased investments and creation of new products will ensure the development of the private and the public sectors, consequently improving the living conditions of the society (Pece et al., 2015).

In many countries across the globe, the importance of higher education has been proven to explain economic growth (Lester, 2005; Bloom et al., 2005; Matthews and Hu, 2007; Sigurdson, 2005; Van Heerden et al., 2007; Yusuf, 2007; Gyimah-Brempong et al., 2006; Aghion et al., 2009; Farrell et al., 2006; Obowna, and

Ssewanyana, 2007). Higher education was measured by average years of education; primary, secondary, and tertiary school enrolments; and education investments. It was revealed that human capital development exhibits significant impact on the nation's output and not much dependent on the natural resources and endowments and the stock of physical capital. Indeed, higher education graduates can contribute to the economy indirectly through tax revenues which can be used to stimulate the economy through social development programs. Other countries, like Saudi Arabia, Singapore, Thailand, Turkey, and Sri Lanka also revealed the same findings that Education expenditures has positive influence on economic growth in the long-run (Cortese, 2003; Amaghionyeodiwe and Osinubi, 2012; Eigbiremolen and Anaduaka, 2014; Mallick et al., 2016). A well-educated workforce causes a significant positive impact on economic growth through factor accumulation and increased labor productivity. A country, therefore, with aggressive human capital development program will be able to achieve a sustainable economic growth.

Asia is a region that can be best described by diversity. From the long history of western colonization, up to the urge to move forward, it has shown their capabilities in the global economy (Danielson, 2009). UNESCO (2015) reported that in Southeast Asia, Singapore has the highest literacy rate of 96.8%, followed by Thailand (96.7%), and Philippines (96.3%). with GDP growth rates of 2%, 2.8%, and 5.9% (World Bank, 2016), respectively in 2015. Singapore has been recognized as one of the developed countries in the region while Thailand and Philippines have been known as emerging economies in Southeast Asia. Conversely, Laos has literacy rate of 79.9% in 2015 but recorded a GDP growth rate of 7.4%. Apparently, these statistics would not entirely prove that high literacy rate would lead to higher economic growth but long run analysis may prove otherwise. The high level of marginal changes of slope coefficients of higher education can be investigated further by looking at its short-run and long-run effects not only on economic growth but also on other potential variables that will measure economic development across countries. This paper, therefore, explores on the impact of higher education, measured by education expenditures and gross enrolment rate, on some economic development indicators such as GDP, GDP per capita, adolescent fertility rate, and CO_2 emission in selected Southeast Asian and Middle East countries. In Europe, it was found that individuals with higher education levels tend to be more environmentally friendly (Meyer, 2015). Hence, an environmental indicator was also considered in the analysis.

2. Theoretical and conceptual frameworks

2.1. Endogenous growth theory

The importance of human capital via education in growth theory was emphasized only in the 1980s and 1990s by endogenous growth models and the expanded neoclassical growth model of Mankiw, Romer, and Weil. This growth model emphasizes that human capital is an added input, hence, countries that have faster education growth rate will have higher transition growth rates and income. The endogenous growth theory asserts that technical progress results from the rate of investment, capital stock, and the stock of human capital. The new

endogenous growth theory has challenged the Solow's tradition, introducing the formation of knowledge, either as part of labor or part of capital (Sena and Fontenele, 2015). The long-run effect of economic growth is acquired using the growth rate of total factor productivity (TFP), which determines the rate of technological progress. The basic formula of the endogenous growth theory is the aggregate production function, $Y = F(K)$ where Y is expressed how much an output can be produced, given the aggregate capital, K.

In endogenous growth models, education can affect economic growth through technical progress developed domestically or through adaptation of foreign technology. Greiner and Semmler, (2002) assert that there are positive externalities in physical capital investment only when education takes effect. Education is also likely to increase the efficiency through improvement in the quantity and quality of inputs which contribute to the increase in total factor productivity.

2.2. Human capital model

Human capital is divided into three categories: out of pocket or direct expenses, foregone earnings, and psychic losses (Ehrenberg and Smith, 2012). An out-of-pocket or direct expense refers to the monetary losses (e.g. tuition and expenditures on food, house rental, books, and other equipment), foregone earnings are the lost earnings because of studying, and psychic losses are the losses incurred because studying is difficult. Under the human capital model of development, education is focused on relevance of the effect towards the growth of the society (Symes et al., 2000).

A person who is entering higher education would think that they would be better-off when finished. Figure 1 shows the alternative learning streams in human capital theory, wherein a person has the capability to choose between entering into higher education (*CC* curve) and the possibility not to continue with higher education (*HH* curve). Precisely, working and attending to school cannot be both performed by a full-time employee. If a person chose to enter a university at the age of 18, the *CC* curve is below *HH*, which includes the out-of-pocket and indirect costs as expenses for not going to work at the particular age. There are foregone earnings while providing higher income in the short run. When the person reaches the age of finishing college, *CC* curve will be above *HH* curve and the gap will continue to increase over time. College graduates will experience higher earnings than their counterparts who did not have a college education.

2.3. Conceptual framework

Tilak (2010) explored on the relationship between education and earnings using the human capital model. Accordingly, education is a contributor of economic growth because it enhances skills and knowledge and generates employment. Education enhances human capital; it is positively related to health; more educated persons have reduced search time in labor markets and have lower fertility rates.

In general, education contributes positively to the social, economic, political, and cultural aspects of the society as people increase their ability to become more adept with the modern technology. This was also proven by Pillay (2002) and Bailey et al. (2011) who found that higher education affects economic development in the long run. Improving higher education would result in technological enhancement which

will lead to higher efficiency of resources and enhanced output growth and reduction in population results in higher GDP per capita. Better education increases the household labor supply especially if substitution effect dominates, hence, affecting the fertility rate of women.

Lastly, the continuing expansion of the manufacturing sector, which is an indication of economic growth, produces much CO_2. Literature says that in some developed economies, those with higher educational literacy are more environmental friendly ((Meyer, 2015), hence, it was hypothesized that CO_2 emissions are reduced in the long-run as the economy is developed. Figure 2 shows that higher education, measured in terms of GER and education expenditures, can have long-term effects on GDP, GDP per capita, adolescent fertility rate, and CO_2 emission.

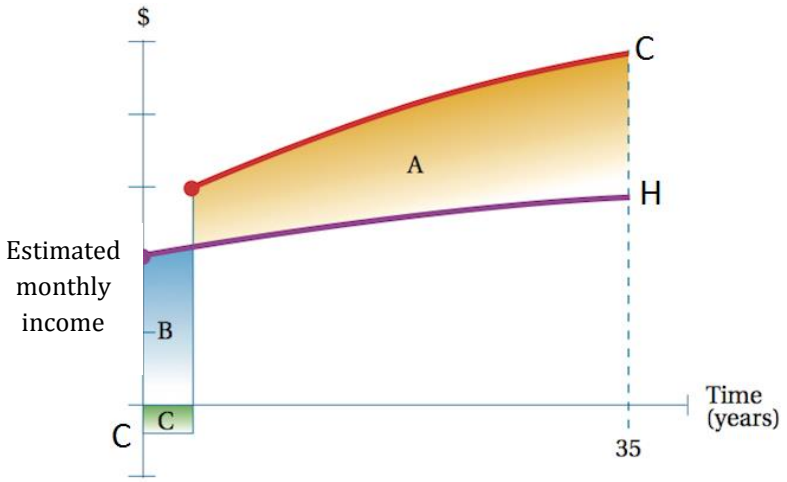

Figure 1. Alternative earning streams on human capital theory

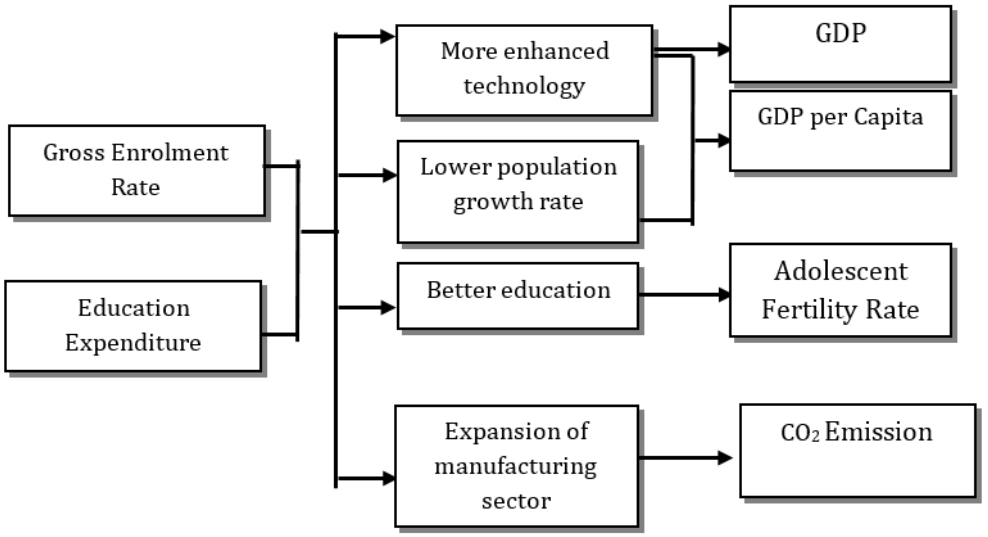

Figure 2. Conceptual framework showing the hypothesized impact of gross enrolment rate on selected economic development variables

3. Data description and analysis

The empirical investigation was carried out in the case of the economies of selected Asian countries with a dataset of the period 1980 to 2014. The latest complete data for all countries considered in the study were only until 2014. East Timor's exclusion was due to lack of data because it had only gained its sovereignty in 2002. The exclusion of Singapore in the study was because of the lack of data points needed to measure the impact. Other countries in the Middle East were also not included due to some data limitations. The study was limited to the data from the World development indicators provided by the World Bank, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), Institute for Statistics, economic planning and development department, Prime Minister's Office, National Statistics Office, CEIC, and Ministry of National Planning and Economic Development. Other indicators used to measure economic development and higher education were outside the scope of the study due to heavy discrepancies on the data, and unavailability of other indicators.

Data on gross enrolment rate were obtained from UNESCO while GDP and GDP per capita were sourced out from Economic planning and development department, Prime Minister's Office in Brunei; National Statistics Office in Cambodia, Laos, Malaysia, and Vietnam; CEIC in Indonesia, Philippines, and Thailand; Ministry of National Planning and Economic Development in Myanmar, World Bank and OECD National Accounts for Egypt, Israel, Saudi Arabia, and Turkey. Adolescent fertility rate and CO_2 emission were gathered from the World Bank.

The dependent variable, higher education, was proxied by GER and education expenditures while economic growth was measured by GDP and GDP per capita. Other development indicators considered were adolescent fertility rates and CO_2 emission. GER is the proportion of students enrolled in tertiary education divided by the age group 15 to 24 years, covering all the students studying tertiary education in a particular country. The length of school year and the quality of education are assumed to be the same across countries. Moreover, the indicator does not apply the effects of repetition and the enrolment data do not account for many types of trainings. As GER can exceed 100 because of the inclusion of below and above the typical group age, interpretations of this indicator require additional information to evaluate the effects of repetition and late and early entrants. Education expenditure did not include capital investments in school buildings, academic facilities, and equipment but focused only on the current operating expenditures in education, including wages and salaries. GDP measures how the economy performs in a given period of time which gives the total market value of final goods and services produced domestically. GDP per capita is the average income received by a single person in a particular country. Being one of the indicators for fertility, adolescent fertility rate provides the estimated average number of births per 1,000 women aged 15 to 19 years. Lastly, CO_2 emission measures the amount of CO_2 being discharged caused by human activities.

The general model used in the study considered all the variables to determine the significant impact with the development indicators expressed as:

$$GDP_{a\text{-}m} = f\,[GER_{a\text{-}i}, EX_{a\text{-}i}] \quad (1)$$

$$GDPC_{a\text{-}m} = f\,[GER_{a\text{-}i}, EX_{a\text{-}i}] \quad (2)$$

$$FR_{a\text{-}m} = f\,[GER_{a\text{-}i}, EX_{a\text{-}i}] \quad (3)$$

$$CO2_{a\text{-}m} = f\,[GER_{a\text{-}i}, EX_{a\text{-}i}] \quad (4)$$

Where:

GDP = Gross domestic product (in billion USD)

GDPC = Gross domestic product per capita (in USD)

FR = Adolescent fertility rate (per 1,000 women)

CO2 = Carbon dioxide emission (in kt)

a-m = countries in Southeast Asia and Middle East

a = Brunei

b = Cambodia

c = Indonesia

d = Laos

e = Malaysia

f = Myanmar

g = Philippines

h = Thailand

i = Vietnam

j = Egypt

k = Israel

l = Saudi Arabia

m = Turkey

GER = Gross enrolment rate in tertiary education (in %)

EX = Education expenditure (in billion USD)

The Koyck transformation proves that the lags of the independent variable could be treated as a partial adjustment mechanism as follows:

$$Y_t = \alpha + \beta_0 X_t + \lambda y_{t-1} + \varepsilon_t \quad (5)$$

where:

Y_t = Dependent variable

X_t = Independent variable

y_{t-1} = Dependent variable, lagged one period

α = Constant

β_0 = Short-run coefficient

λ = Long-run coefficient

ε_t = Error term

Using the Koyck transformation, long-run multipliers can be determined by the following formulas written as:

β_0 = Short-run multiplier

$\frac{\beta_0}{(1-\lambda)}$ = Long-run multiplier

λ /(1 - λ) = Mean lag (speed of adjustment)

Gujarati (2004) describes the distributed lag model as follows:

$$Y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \beta_k X_{t-k} + u_t \quad (6)$$

Equation (7) is the distributed lag model with a finite lag of k time periods. With the short-run effect multiplier β_0, the change in the mean value of Y will change following a unit change on X in the same period. If the change in Y has been maintained at the same level thereafter, then $(\beta_0 + \beta_1)$ gives the change on Y in the next period, $(\beta_0 + \beta_1 + \beta_2)$ in the following period, and so on. The partial sums of β are called interim or immediate multipliers. Finally, after k periods, the long-run or distributed lag multiplier is obtained as follows (Gujarati, 2004):

$$\beta_1 = \beta_0 + \beta_1 + \beta_2 + \cdots + \beta_k = \beta \quad (7)$$

4. Empirical results and analysis

4.1. Growth and development trends across Asian countries

4.1.1. GDP and GDP per capita

Figures 3 and 4 show generally increasing trends in GDP and GDP per capita, although there were noticeable slumps in some periods. A stronger growth in GDP was observed, especially in big economies like Indonesia, Saudi Arabia, and Turkey. In Southeast Asia, Indonesia recorded the highest mean GDP of US$284.83 billion from 1980 to 2014 but Malaysia has the highest mean GDP per capita of US$4,634.80. Indonesia ramps up investment in infrastructure and implements policy reform that spurs private investment. The increase in per capita income in Indonesia made the transition from being classified as one of the “low-income” countries to “low-middle income” country in 1994 (World Bank, 1996).

In Middle East, Turkey has the highest mean GDP of US$311.344 billion for 35-year period but Israel got the highest mean GDP per capita of US$17,811.55, the highest among all countries under study. Thailand was also aggressive, recovering faster from the Asian Financial Crisis increasing trend in The key to future poverty reductions is to have a sustained economic growth (Hillebrand, 2008). In 1996, Indonesia, Malaysia, Thailand, Philippines, and Vietnam grew 6% to 7%, the first time recorded in history where there has been a rapid synchronized growth in a region (Hill, 1997). However, mismatches in currency and maturities caused an external shock in the 1997 Asian financial crisis (Bhaskaran, 2010). Learning from the 1997 crisis, Southeast Asia avoided high-risk lending and derivative investments, building a region with more sustainable economic growth (Perkins, 2009).

4.1.2. Adolescent fertility rate

Reducing adolescent fertility rates is one of the main concerns of developing economies. Asia declined in the late 1960s and continued in the 1970s and 1990s (Hirschman, 2001). Over time, the trend has certainly been downward, but there are very sharp differences in levels and trends across regions (Fig 5). There was a tremendous decrease in fertility in Middle East countries compared to Southeast Asia. Given the annual fertility ratio per 1,000 women aged 15 to 19 years, the most improved country was Saudi Arabia in the Middle East and Myanmar in Southeast Asia. Saudi Arabia has reduced its fertility rate by 92.4% from 1980 to 2014 followed by Israel (71.2%). Myanmar has also succeeded its effort in reducing its fertility, achieving a record of 76.3%. While the adolescent fertility rate in Asia has been gradually decreasing over time, Vietnam is an exception, recording an increase by 88.1% growth between 1980 and 2014. The Philippines has an almost constant trend but has started to increase from 2010 to 2014 having a positive growth rate from 1980 to 2014. The highest fertility rate in 2014 was in Laos, followed by Philippines, Egypt, Cambodia, and Indonesia. There are two reasons for the decline in fertility rates in Asia: the effectiveness of family planning programs and the improvement in the socioeconomic status in the region. Fertility trends in Indonesia, Vietnam, and Malaysia supported the argument that strong income per capita affects fertility rates to reach replacement level (Jones 2011).

4.1.3. Carbon dioxide emission

The increase in CO_2 emission from fossil fuel and other sources is the main cause of global warming (PBL Netherlands Environmental Assessment Agency 2013). Figure 6 shows that the trend is increasing with Saudi Arabia, Indonesia, Turkey, Thailand, and Malaysia comprising 77% of the total emission in all countries considered in this study while Brunei, Cambodia, Laos, Myanmar, Philippines, and Israel have not exceeded 100 megatons. In general, all countries have positive annual growth rate with Cambodia having the highest growth of 9%, followed by Laos (7.43%), Vietnam (6.68%), and Malaysia (6.47%). Those with low annual growth rates are Brunei (0.37%), Myanmar (2.5%), Philippines (2.96%), and Saudi Arabia. With the expansion of sectors, combustion of fossil fuels and factories become one of the key contributors of increasing carbon dioxide emission.

4.1.4. Gross enrolment rate

As expected, GER in Asia has been increasing from 1980 to 2014 with Middle East countries having higher GER, led by Turkey, Israel, and Saudi Arabia (Figure 7). In Southeast Asia, the proportion of students entering university-level education increased by as much as 15.22% in Cambodia, followed by Brunei (11.67% while the lowest was in Myanmar registering an annual average of only 0.33% from 1980 to 2014. In 2014, however, Thailand has the highest GER, followed by Malaysia, and Philippines, but Malaysia's GER has dropped by as much as 27% in 2014. From 1997 to 2014, GER in Thailand has been continuously increasing as the number of universities rose because of the initiatives of the Thaksin government to improve most of their public institutes to universities, attracting students to pursue higher education. After the implementation of the Education Act in 1996, GER in Thailand spiked from 11.15% in 1995 to 22.90% in 1997 and was still increasing until 2010 by 42.28%. Cambodia, Brunei, and Laos had the highest annual growth rates of 15.22%, 11.67%, and 11.23%, respectively while Myanmar, Philippines, Turkey, and Egypt had the lowest annual growth rates.

4.1.5. Education expenditures

Figure 8 shows the increasing trend of education expenditures in Asian countries, though the effect of financial crisis in 2009 was too apparent, taking its toll in investment in education. Saudi Arabia has been too aggressive, with education spending of as much as $55.36B in 2014 with an annual growth rate of 7.41%. This was followed by Indonesia and Turkey with education expenditures of US$25.93 billion and S$20.87 billion and growth rates of10.54% and 8.26%, respectively. Human capital investment in Southeast Asia started late and some enrolments in secondary and tertiary education were stagnant or declining, with periods matching the growth of GDP (Phan and Coxhead, 2013). In Southeast Asia, Malaysia was next to Indonesia followed by Thailand and Philippines. Laos, Cambodia, and Brunei were in the tail end with spending of only US$0.117 B, US$0.26, and US$0.3467, respectively in 2014. They also recorded the lowest annual growth rates in education expenditures for 35-year period. The spending on education was attributed to private spending (31%), government expenditure (10%), fund operational (6%), and the biggest district expenditure (53%) (World Bank, 2008). Philippines spent only about US$6.34 in 2014 with annual mean spending of US$2.64 and annual growth rate of 6.72%. This can be attributed to the low priority of the national government to education and the continuing increase of tuition in higher education, especially in private institutions which dominate tertiary education in the Philippines.

4.2. Impact of higher education on economic development across Asian countries

4.2.1. Brunei

Table 1 shows that GER in Brunei has short-run effect on adolescent fertility rate. The result implies that an increase in GER by 1% will decrease adolescent fertility rate by 0.34% in the short run but a bigger impact was noted in the long run with 0.44% decrease in fertility rate. Indeed, it can be deduced that building more educated and skilled workforce will lead to lower population growth rate in the long run. Also, CO_2 emission would have the tendency to decrease in the long run as GER and education expenditures increase. It can be

opined that as the population becomes more educated, they will become more sensitive to the aggravating effect of CO_2 emissions on the economy.

Higher education variables are significant on GDP in both the short and long run. An increase in education expenditure by 1% will increase GDP by 0.35% and 0.9% in the short run and long run, respectively. The rest of economic development variables are highly significant in the long run. It seems plausible that since the discovery of oil in 1929, Brunei has been having one of the highest GDP per capita among ASEAN member countries. Therefore, it has the ability to provide holistic and quality education to Brunei population to achieve its full potential. The results affirm the study of Ranis (2004) where education can contribute to the growth of income per capita. Moreover, being characterized as the country where severe economic problems are easily resolved (Thambipillai 2010), Brunei was one of the stable countries in terms of economic stability.

Table 1. PAM results in Brunei to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	-0.0368	-0.8641	0.3469	0.9009
	(.4745)	(.0000)	(.0024)	(.0000)
GDP per capita	0.0448	0.6424	0.1579	0.5120
	(.2846)	(.0000)	(.0867)	(.0000)
Adolescent fertility rate	-0.0343	-0.4375	0.5906	38.6747
	(.0399)	(.0000)	(.7296)	(.0000)
CO_2 emission	-0.1077	-0.5906	0.0327	-0.9722
	(.4189)	(.0000)	(.0566)	(.0002)

Note: Figures in parentheses are probability values

4.2.2. Cambodia

The short-run effect of gross enrolment rate on all economic development variables was not significant ($p > .05$) while the long-run effect was highly significant ($p < .01$) (Table 2). In the 1970s, Cambodia did not experience an increase in the number of students in higher education because of the advent of the Khmer Rouge which killed nearly 500,000 people and destroyed facilities, however, it slowly regained in the 1980s (Chet 2006). The results imply that if gross enrolment rate and education expenditure will increase by 1%, GDP will increase by 1.76% and 0.72%, respectively. GDP per capita and CO_2 emission are also positively responsive to higher education variables in the long run. As expected, GER and education expenditure will negatively affect the fertility rate. With the agriculture sector as the main source of economic growth in the country, amounting to almost 30% of GDP in 2012 (ADB, 2012), government initiatives to enhance economic growth can also be possible through additional professional manpower. Hence, the result supports the study of Nizam (2006) wherein education can contribute to strengthen economic growth. As the government invests more on education, economic growth can prosper.

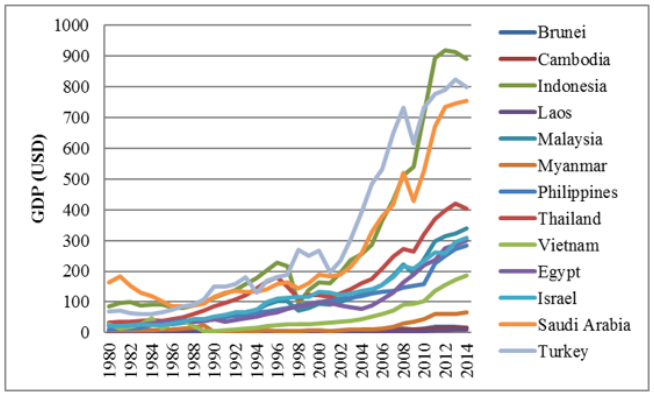

Figure 3. GDP trends in selected Asian countries

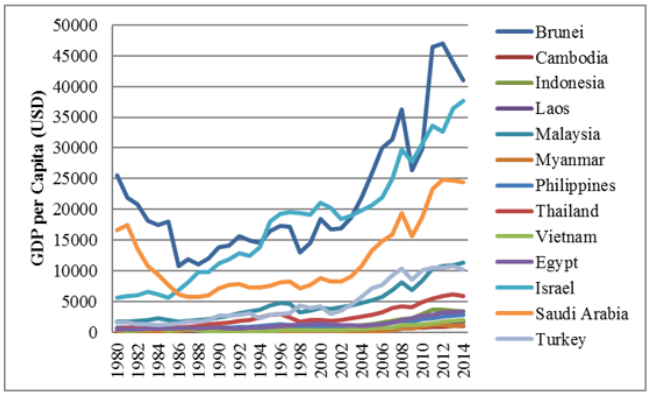

Figure 4. GDP per capita trends in selected Asian Countries

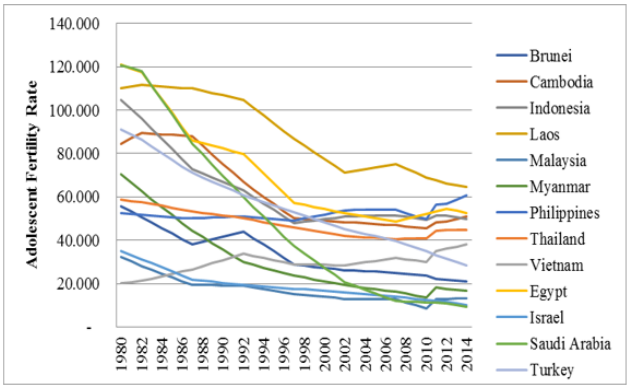

Figure 5. Adolescent fertility rate trends in selected Asian countries

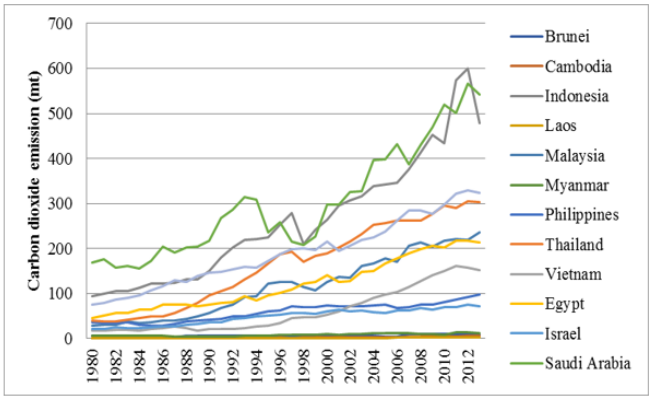

Figure 6. CO_2 emission trends in selected Asian countries

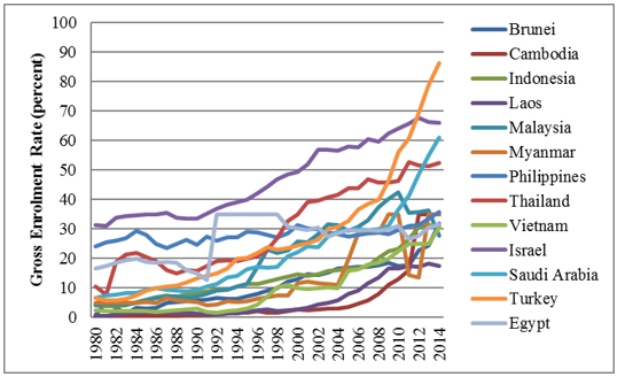

Figure 7. Gross enrolment rate trends in selected Asian countries

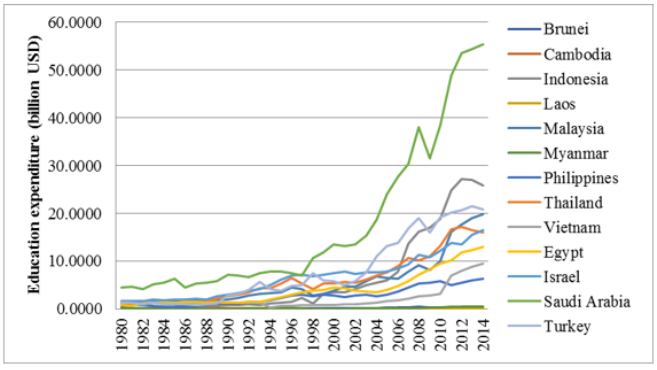

Figure 8. Education expenditure trends in selected Asian countries

Table 2. PAM results in Cambodia to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	0.1549	1.7653	-0.0368	0.7272
	(.2169)	(.0000)	(.7318)	(.0000)
GDP per capita	0.1587	1.2681	-0.0298	0.7179
	(.1606)	(.0000)	(.7857)	(.0000)
Adolescent fertility rate	-0.0038	-0.0655	-0.0040	-0.0953
	(.7860)	(.0000)	(.9117)	(.0000)
CO_2 emission	0.0506	0.5042	-0.0213	1.0433
	(.4353)	(.0000)	(.7871)	(.0000)

4.2.3. Indonesia

The partial adjustment model (PAM) results show that gross enrolment rate and education expenditure have a long-run positive impact on GDP, GDP per capita, and CO_2 emission and a negative impact on adolescent fertility rate ($p < .01$) as shown in Table 3. An increase in GER and education expenditure by 1% will reduce fertility rate by -2,23% and -0.46%, respectively. Therefore, increasing GER and education expenditure will help lessen fertility rate. It is also worth noting that as GER increases by 1%, CO_2 emission increases by 0.94% and by 0.44% if education expenditure will increase by 1%. The increase in the number of students in higher education increases the amount of CO_2 being emitted because of industrialization and expansion of the manufacturing sector.

The short-run effects of higher education can be felt in GDP, GDP per capita, and CO_2 emission. The significant impact on GDP may be due to the high student enrolment in higher education. Moreover, aside from manufacturing, the country also specializes in agriculture and trade harnessing the skills and knowledge of young graduates. With four types of higher education institution (Academy, Polytechnics, School of higher learning, and University), Indonesia continued to be one of the most progressive countries in Southeast Asia in terms of higher education (Yaakub, 2012).

Table 3. PAM results in Indonesia to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	0.1348	0.8719	0.1895	0.5258
	(.2637)	(.0000)	(.0075)	(.0000)
GDP per capita	0.0927	0.5979	0.1538	0.4161
	(.3650)	(.0000)	(.0144)	(.0000)
Adolescent fertility rate	-0.0298	-2.2278	-0.0098	-0.4597
	(.2072)	(.0000)	(.0851)	(.0000)
CO_2	(0.3446)	0.9367	(0.0754)	0.4418
	(.0068)	(.0000)	(.0309)	(.0000)

4.2.4. Laos

Table 4 shows that only GDP per capita was found to have positively affected by education expenditure. Moreover, higher education has a positive impact on GDP, GDP per capita, and CO_2 emission in the long run. Indeed, as the country progresses, more CO_2 are emitted. Moreover, the negative sign of adolescent fertility rate indicates a negative long-run effect of gross enrolment rate and education expenditure. This conforms with the result of Shirahase (2000) who found that women receiving higher education tend to have decreasing fertility rate in Japan. Tilak (2006) also explains that higher education contributes to economic development and makes a significant contribution to reduce absolute and relative poverty, and reflects other areas of poverty, such as infant mortality and increases life expectancy. Several decrees made by the Prime Minister in Laos since 1995 were the highlights of higher education reforms, which had contributed to economic growth and development (Phou, 2006).

Table 4. PAM results in Laos to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	0.1328	0.5080	0.1622	1.0190
	(.1809)	(.0000)	(.1483)	(.0000)
GDP per capita	0.0630	0.2775	0.2387	0.9129
	(.3947)	(.0000)	(.0490)	(.0000)
Adolescent fertility rate	-0.0070	-0.0981	-0.0083	-0.3197
	(.6796)	(.0000)	(.2480)	(.0000)
CO_2 emission	0.0723	0.7478	0.0365	1.8493
	(.1631)	(.0000)	(.4941)	(.0000)

4.2.5. Malaysia

It was found that GER has no short-run effect on GDP and GDP per capita (Table 5). This may be because Malaysia is already considered as a newly industrialized economy and has already achieved much in terms of improving its economy. The short-run effect of GER on adolescent fertility rate and CO_2 emission, as well as education expenditure on GDP, GDP per capita and CO_2 emission were significant ($p < .05$). Moreover, impact was positive on GDP, GDP per capita, and carbon dioxide emission and was negative on adolescent fertility rate. This can possibly be attributed to the fact that the government of Malaysia has recognized the importance of private higher education where access to it heavily relied on the monetary contribution of the government and the status of living of the students (Hassan 2002). Also, Malaysia stands today as one of the successful tiger economies and is classified as an upper-middle income country by the World Bank (2015). The impact of education on economic growth was also proven by Mallick, Das, and Pradhan (2016) who found that expenditure on education has a long-run positive impact on economic growth in 14 Asian countries which include Malaysia, Philippines, Thailand, Saudi Arabia, and Turkey. The vector error correction showed unidirectional Granger causality running from economic growth to expenditure on education both in the short- as well as in the long-run, but expenditure on education only Granger causes economic growth in the long-run.

4.2.6. Myanmar

Myanmar is still one of the ASEAN members with the result of the PAM in Myanmar showed a positive short-run effect on CO_2, as shown in Table 6. The long-run effects of higher education were significant ($p < .05$) on GDP, GDP per capita, adolescent fertility rate, and CO_2 emission. It is worth noting that GER and education expenditure have positive long-term effect on adolescent fertility rate unlike in other countries. In the long run, a 1% increase in GER and education expenditure will increase adolescent fertility rate by 0.31% and 0.81%, respectively. Myanmar has been generating techniques to enhance quality education to create a system that copes up with the knowledge age (Yaakub, 2012).

Table 5. PAM results in Malaysia to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	0.1197	0.8829	0.3835	1.0219
	(.0639)	(.0000)	(.0002)	(.0000)
GDP per capita	0.0886	0.5665	0.3851	0.7171
	(.0921)	(.0000)	(.0000)	(.0001)
Adolescent fertility rate	-0.1688	-0.4139	-0.0683	-0.6092
	(.0020)	(.0002)	(.0568)	(.0000)
CO_2 emission	0.1865	0.9333	0.1283	1.1396
	(.0052)	(.0000)	(.0350)	(.0000)

Table 6. *PAM* results in Myanmar to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	0.0391	0.1841	0.1464	0.5801
	(.8082)	(.0000)	(.3070)	(.0000)
GDP per capita	-0.0202	-0.1045	0.1508	0.5617
	(.8913)	(.0000)	(.3010)	(.0000)
Adolescent fertility rate	-0.0050	0.3080	-0.0246	0.8083
	(.7457)	(.0000)	(.0867)	(.0000)
CO_2 emission	0.1535	0.6438	0.0212	0.1880
	(.0122)	(.0000)	(.6141)	(.0000)

4.2.7. Philippines

Table 7 shows that the short-run effect of GER in the Philippines is positive on GDP per capita and CO_2 emission. Long-run effects are also significant on GDP, GDP per capita, adolescent fertility rate, and CO_2 emission. The positive impact of GER on adolescent fertility rate may be attributed to the fact that the new curriculum on sex education in high school has not yet been approved during the years 1980 to 2014. On the other hand, the long-

run effect of GER on GDP was significant and negative, generating a long-run multiplier of 3.06%. The negative impact illustrates that investing in education does not give effective outcome in the country's economic growth as public health and job opportunities needed more funding than education.

4.2.8. Thailand

Higher education in Thailand had been improving because of the major reforms set by the government, especially in the late 1990s (Bovornsiri 2006). Short-run effects of GER, as shown in Table 8 were not significant ($p > .05$) on adolescent fertility rate while education expenditure is significant on GDP, GDP per capita, adolescent fertility rate, and CO_2 emission in the short-term. Long-term results indicate positive impact of higher education on GDP, GDP per capita, and adolescent fertility rate.

4.2.9. Vietnam

Enhancing higher education policies over time, the quality of teaching in Vietnam has evolved. Table 9 shows the results of the partial adjustment model in Vietnam. Based on the results, the short-run effects of education expenditure on CO_2 emission is positive and significant. Long-run effects were, likewise, significant ($p < .05$) and positive on GDP, GDP per capita, and CO_2 emission.

Table 7. PAM results in the Philippines to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	-0.1481	3.0636	0.0130	-1.2747
	(.5014)	(.0000)	(.8010)	(.0000)
GDP per capita	0.7042	4.2972	0.0844	0.3886
	(.0077)	(.0000)	(.0708)	(.0000)
Adolescent fertility rate	0.0206	0.0739	-0.0010	-0.0038
	(.6893)	(.0000)	(.8676)	(.0000)
CO_2 emission	0.4440	4.5354	0.2147	0.4102
	(.0465)	(.0000)	(.0247)	(.0217)

Table 8. PAM results in Thailand to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	0.0356	1.5283	0.4399	0.8540
	(.5855)	(.0000)	(.0000)	(.0000)
GDP per capita	0.0335	0.9980	0.3471	0.7410
	(.5964)	(.0000)	(.0000)	(.0000)
Adolescent fertility rate	-0.0249	-0.4561	-0.0186	-0.2144
	(.0240)	(.0000)	(.0063)	(.0000)
CO_2 emission	0.0015	-0.2528	0.1732	0.8246
	(.9809)	(.0000)	(.0402)	(.0000)

Table 9. PAM results in Vietnam to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	0.0356	1.5283	0.2010	0.7977
	(.5855)	(.0000)	(.1220)	(.0000)
GDP per capita	0.1290	0.4396	0.2085	0.7261
	(.2268)	(.0000)	(.1100)	(.0000)
Adolescent fertility rate	0.0023	0.0565	-0.0246	0.4023
	(.8925)	(.0000)	(.0172)	(.0000)
CO_2 emission	0.1976	0.7497	0.0851	1.5651
	(.1004)	(.0000)	(.0079)	(.0000)

4.2.10. Egypt

Egypt's education expenditure has shown positive and significant short-term effect on GDP, GDP per capita and CO_2 emission while adolescent fertility rate was found not significant. Moreover, all economic development indicators were significantly affected by GER and education expenditure, with fertility rate expecting to decline in the long run as human capital improves in Egypt (Table 10). The results further show that the CO_2 emission will still continue to rise amidst increases in GER and education expenditure. In general, it seems plausible that the economic shocks faced by Egypt such as rising inflation, an appreciating currency, and high unemployment rates, especially among women, seemed manageable. The global crisis that hit Egypt in mid-2008 did not also manifest an adverse effect on the country's growth prospects in the succeeding years. This result supports the finding of Ghorab (2016) that there is a strong connection between physical and human capital and that sustainable economic growth can only be achieved by investing in both stocks of capital.

4.2.11. Israel

Long-run effects of higher education on economic development have been significant and positive on GDP, GDP per capita, and CO_2 emission (Table 11). Mean lags of higher education on GDP per capita has shorter period, which implies that waiting for a student to graduate is not a pre-requisite for the impact to be fully felt.

4.2.12. Saudi Arabia

From being a developing country, the discovery of oil in the 1930s positively contributed to the success of Saudi Arabia. As the country continues to generate income from oil, initiatives to promote higher education have also been established. The impact of higher education on GDP, GDP per capita, and CO_2 emission as shown in Table 12 is positive and significant.

Table 10. PAM results in Egypt to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	0.0356	0.8199	0.5029	0.8947
	(.7765)	(.0000)	(.0000)	(.0001)
GDP per capita	0.0431	0.6208	0.3798	0.6482
	(.7189)	(.0000)	(.0000)	(.0010)
Adolescent fertility rate	0.0089	-0.2397	-0.0156	-0.7477
	(.9393)	(.0000)	(.5629)	(.0000)
CO_2 emission	-0.1101	1.7284	0.1238	0.6551
	(.1740)	(.0000)	(.0290)	(.0000)

Table 11. PAM results in Israel to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	0.2795	3.1333	0.4842	1.1339
	(.0870)	(.0000)	(.0000)	(.0000)
GDP per capita	0.2111	0.1110	0.3842	0.8082
	(.1332)	(.0000)	(.0000)	(.0000)
Adolescent fertility rate	-0.0061	-0.3470	0.9315	-0.4165
	(.9720)	(.0000)	(.6122)	(.0000)
CO_2 emission	0.2121	2.3333	0.1423	0.6513
	(.0038)	(.0000)	(.0052)	(.0000)

Table 12. PAM results in Saudi Arabia to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	-0.0548	-1.6352	0.0009	0.1113
	(.4758)	(.0000)	(.9155)	(.0000)
GDP per capita	-0.1108	7.3099	-0.0889	1.8614
	(.0274)	(.0000)	(.0540)	(.0000)
Adolescent fertility rate	0.0894	-1.7717	-0.0499	-0.8849
	(.4662)	(.0000)	(.2286)	(.0000)
CO_2 emission	0.1620	0.5794	0.1089	0.4125
	(.0468)	(.0000)	(.1399)	(.0000)

4.2.13. Turkey

The Turkish Republic has been funding public higher education institutions to make it more accessible to those who seek further learning. In Table 13, long-term effects of higher education have seen to have positive impact on GDP, GDP per capita and CO_2 emission, and negative impact on adolescent fertility rate. This is consistent with the finding of Beskaya, Sabas, and Samiloglu (2010) that there is an evidence of long-run cointegrating

relationships between school enrolments and real income and concluded that education and economic growth made important mutual contributions.

The "Asian Miracle" in the early 1990s provided a set of explanations that can prove their success but almost all countries agreed that education had contributed a portion of their GDP (Nelson and Pack, 1999). Hence, comparing the impacts will assess which country has a high impact on economic development. A summary of the long-term effects are shown in Tables 14 and 15.

Table 13. PAM results in Turkey to determine short-run and long-run effects of higher education

Variable	Gross enrolment rate		Education expenditure	
	Short-run	Long-run	Short-run	Long-run
GDP	0.1380	1.0238	0.3241	0.7867
	(.3925)	(.0000)	(.0000)	(.0000)
GDP per capita	0.1103	0.7941	0.3037	0.6424
	(.4293)	(.0000)	(.0000)	(.0000)
Adolescent fertility rate	0.0206	-0.1321	-0.0012	-0.0828
	(.6893)	(.0000)	(.8260)	(.0000)
CO_2 emission	0.1321	0.6409	0.0313	0.5791
	(.0638)	(.0000)	(.1621)	(.0000)

Table 14. Comparison of the long-run effects of GER on economic development indicators across Asia

Country	GDP	GDP per capita	Adolescent fertility rate	CO_2 emission
Brunei	-0.8641	-0.6424	-0.4375	-0.9722
Cambodia	1.7653	1.2681	-0.0655	0.0542
Indonesia	0.8719	0.5979	-2.2278	0.9367
Laos	0.5080	0.2775	-0.0981	0.7478
Malaysia	0.8829	0.5665	-0.4139	0.9333
Myanmar	0.1841	-0.1045	0.3080	0.6438
Philippines	3.0636	4.2972	0.0739	4.5354
Thailand	1.5283	0.9980	-0.4561	-0.2528
Vietnam	0.5961	0.4396	0.0565	0.7497
Egypt	0.8199	0.6208	-0.2397	1.7284
Israel	3.1333	0.1110	-0.3470	2.3333
Saudi Arabia	-1.6352	7.3099	-1.7717	0.5794
Turkey	1.0238	0.7941	-0.1321	0.6409

Table 15. Summary of the long-run effects of education expenditure on economic development indicators across Southeast Asia

Country	GDP	GDP per capita	Adolescent fertility rate	CO_2 emission
Brunei	0.9009	0.5120	-0.5906	0.5741
Cambodia	0.7272	0.7179	-0.0953	-1.0433
Indonesia	0.5258	0.4161	0.4597	0.4418
Laos	1.0190	0.9129	-0.3197	1.8493

Malaysia	1.0219	0.7171	-0.6092	1.1396
Myanmar	0.5801	0.5617	0.8083	0.1880
Philippines	-1.2747	0.3886	-0.0038	0.4102
Thailand	0.8540	0.7410	-0.2144	0.8246
Vietnam	0.7977	0.7261	0.4023	1.5651
Egypt	0.8947	0.6482	-0.7477	0.6551
Israel	1.1339	0.8082	-0.4165	0.6513
Saudi Arabia	0.1113	1.8614	-0.8849	0.4125
Turkey	0.7867	0.6424	-0.0828	0.5791

5. Policy implications and conclusions

The study has made an attempt to uncover the impact of higher education on some development indicators in 13 countries in Asia spanning from 1980 to 2014. Using partial adjustment model, the study finds that higher education was found to have an impact on GDP, GDP per capita, and adolescent fertility rate in the most of the Asian countries under study. Indeed, investments in higher education in respective countries would prove useful in generating more skilled workforce, increasing long-run productivity and consequently, enhance development of the economy. Therefore, the public sector should find ways to increase spending on education to help publicize tertiary education, not only in state institutions but also to encourage the youth to enrol in private universities. Moreover, high quality education should be promoted in both state and private universities and should be made affordable for all by subsidizing education. In this manner, the cost of education will decrease, increasing the demand for education and consequently improving the nation's human capital stock.

When a student enters a university, economic growth is strengthened through spending. The positive effect on CO_2 emission explains that environmental sustainability programs in the university have little or no effect in reducing carbon dioxide. An increase in gross enrolment rate by one percent will affect GDP, GDP per capita, and carbon dioxide emission positively in the long-run. Mean lags of gross enrolment rate on GDP, GDP per capita, and adolescent fertility rate are mostly higher than four years, indicating that the increase in economic development can be felt fully in the long-run when the students finish a degree program. On the other hand, higher education proves to have a negative effect on adolescent fertility rate.

The key to improve the country's performance is to develop new methods and technologies through research and development. To achieve this goal, government agencies can allocate a portion of their funds to inspire students to conduct insightful researches. Public e-learning websites can be developed where students can freely acquire knowledge through researches made by professionals. This will also enhance the output of the students, contributing quality researches and new techniques in the research community.

It is worth noting that in spite of improved higher education programs in Asian countries, increased carbon dioxide emission has been a challenge. This proves that there is really difficulty in reconciling environmental degradation and economic growth and development. Literacy improvement through curriculum enhancement by adding more subjects that promote environmental sustainability, can be done. These are the subjects that involve application of environmentally sustainable programs in their specific fields, hence, reducing negative impact on the environment amidst nation's development. Lastly, some of the countries in Asia have yet to

establish higher education sectors, separate from the Ministry of Education. A separate sector in higher education can be created to give more emphasis on addressing the problems and to further improve the quality and quantity of learning.

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