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# Thai education system and its economic impacts

**Saksit Budsayaplakorn*, Thana Sompornserm†**

*Department of Economics, Faculty of Economics, Kasetsart University, Chatuchak, Bangkok 10900, Thailand*

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**Abstract**

This research aimed to analyze Thai education system and its economic impacts during 1990–2018. Bivariate Granger Causality Tests were used to analyze causal relation among variables, then the structural equations were estimated using 2SLS Method. The results indicate that all of the educational variables used in this research do not significantly affect both GDP growth and GDP per capita growth in Thailand; however, the pupil teacher ratio, human development indicator, and average years of schooling can affect the unemployment rate. The policy recommendation from this research focuses on managing the quality of education. In addition, an increase in the average years of schooling from secondary school to university level can reduce the problems related to the shortage of skilled labor.



## Introduction

Education reform is one of the most important national agendas in Thailand. The main objective of this reform was how to cope with rapid economic and social changes. The 21st century education is related to Thailand 4.0 policy for stability, prosperity, and sustainability under the public expectation that Thailand's educational reform would help to improve business performance in the global market. With new information technology, artificial intelligence, robotics and others upcoming innovation, high skilled and productive labor is needed to increase productivity, especially in industrial sector, and to transform Thailand's economic structure. Currently, Thailand's education system has increasingly become public concern in order to create global competitiveness. To be clear, the term education system in this article refers to public schooling, and more commonly to kindergarten through high school programs, and this research aimed to examine and analyze the effects of Thailand's education system on the economy to aid future structural transformation.

## Literature Review

The model used in this research was an extension of endogenous growth model introduced by Romer (1986). Our model was developed by allowing the existence of unemployment rate. Arrow (1962) mentioned that the productivity gains from investment can come from human capital investment. According to the Organization for Economic Co-operation and Development (OECD, 1998), human capital consists of knowledge, skills and

* Corresponding author.
E-mail address: saksitb@yahoo.com (S. Budsayaplakorn).
† Co-first authors.
E-mail address: thana.s@gmail.com (T. Sompornserm).

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other qualifications embodied in individuals related to economic activities. The quality of the labor force can be measured by its educational attainments, so the most frequently employed measurement of individual skill has been the years of schooling attained. Investment in human capital via education might be the origin of technological progress because new knowledge not only creates productivity, but it also builds immunity for external shocks.

The supply side assumptions in this research were as following. Firm maximizes profit. There are spillovers from growth driving mechanism. The production function depends on physical capital ($K$), labor ($L$), and human capital ($H$). Human capital is distinguished from the amount of labor, but it is embodied in the labor. Under constant return to scale, the production function for firm $i$ is shown in Equation (1).

$$Y_i = F(K_i, H_i) = K_i^{\alpha} H_i^{1-\alpha} = K_i^{\alpha} h^{1-\alpha} L_i^{1-\alpha} \quad ,0 \prec \alpha \prec 1, \quad h = \frac{H_i}{L_i} \tag{1}$$

where $L_i$ is the amount of labor in firm $i$ and $h$ is the ratio of human capital per labor. The parameter α is the share of physical capital used in production. The economy consists of $N$ identical firms, and each firm produces $Y_i$ units of output. Equation (2) represents total output generated from productive inputs and investment. Equations (3) and (4) represent physical and human capital accumulation ($\dot{K}$and $\dot{H}$) where $I_K$ and $I_H$ are investment in physical capital and human capital, respectively.

$$\begin{aligned} Y &= NY_i = NF(K_i, H_i) = F(NK_i, NH_i) = F(K, H) = NK_i^{\alpha} H_i^{1-\alpha} = NK_i^{\alpha} h^{1-\alpha} L_i^{1-\alpha} \\ Y &= K^{\alpha} H^{1-\alpha} = C + I_K + I_H \end{aligned} \tag{2}$$

$$\dot{K} = I_K - \delta K \tag{3}$$

$$\dot{H} = I_H - \delta H \tag{4}$$

The model assumes the depreciation rate of both physical capital and human capital equals $\delta$. The aggregate production function has the scale effect, so it is adjusted according to both human capital and physical capital accumulation.

The demand side assumptions used in this research are as following. There are many identical households; each household maximizes intertemporal utility subject to budget constraint. Policymaker maximizes social welfare where the utility function takes the form of the constant elasticity of substitution (CES) shown in Equation (5), and the budget constraint is shown in Equation (6).

$$U = \int_0^{\infty} u(c) L e^{-\rho t} dt = \int_0^{\infty} \frac{c^{1-\theta}}{1-\theta} L e^{-\rho t} dt \tag{5}$$

$$Y = C + I_K + I_H = C + (\dot{K} + \delta K) + (\dot{H} + \delta H) \tag{6}$$

where $c$ and $C$ are individual consumption and aggregate consumption, respectively. The dynamic optimization suggested for policy consideration is shown in Equation (7).

$$J = \frac{c^{1-\theta}}{1-\theta} L e^{-\rho t} + \nu(I_K - \delta K) + \mu(I_H - \delta H) + \lambda(K^{\alpha} H^{1-\alpha} - C - I_K - I_H) \tag{7}$$

The first-order conditions are described in Equation (8)–(12);

$$\frac{\partial J}{\partial C} = 0 \quad \Rightarrow \quad c^{-\theta} e^{-\rho t} = \lambda \tag{8}$$

$$\frac{\partial J}{\partial I_K} = 0 \quad \Rightarrow \quad \nu = \lambda \tag{9}$$

$$\frac{\partial J}{\partial I_H} = 0 \quad \Rightarrow \quad \mu = \lambda \tag{10}$$

$$\frac{\partial J}{\partial K} = -\dot{\nu} \quad \Rightarrow \lambda \alpha \left(\frac{K}{H}\right)^{-(1-\alpha)} = -\dot{\nu} + \delta \nu \tag{11}$$

$$\frac{\partial J}{\partial H} = -\dot{\mu} \quad \Rightarrow \lambda(1-\alpha)\left(\frac{K}{H}\right)^{\alpha} = -\dot{\mu} + \delta \mu \tag{12}$$

Transversality conditions for human capital and physical capital are shown in Equation (13)–(14);

$$\lim_{t \to \infty} (\nu_t K_t) = 0 \tag{13}$$

$$\lim_{t \to \infty} (\mu_t H_t) = 0 \tag{14}$$

Solving Equations (1)–(14), we obtain the ratio of physical capital to human capital at the steady stage equilibrium. The solutions of the model are shown in Equations (15) and (16). The ratio of physical capital to human capital is constant at steady stage, and it depends only on the parameter α which is the share of physical capital used in production.

$$\left(\frac{K}{H}\right) = \frac{\alpha}{1-\alpha} \tag{15}$$

$$\frac{\dot{Y}}{Y} = \frac{\dot{C}}{C} = \frac{\dot{K}}{K} = \frac{\dot{H}}{H} = \frac{1}{\theta}\left[\alpha\left(\frac{K}{H}\right)^{1-\alpha} - \delta - \rho\right] = \frac{1}{\theta}\left[\alpha\left(\frac{\alpha}{1-\alpha}\right)^{1-\alpha} - \delta - \rho\right] \tag{16}$$

Growth rates of output and consumption at steady stage are subject to various parameters shown in Equation 16. An increase in the marginal rate of substitution between consumption and labor supply ($\theta$) can lower the long run optimum growth rate. Wilson and Briscoe (2003) stated that the human capital investment has positive effect on economic growth. Our model demonstrated the structural relationship between the ratio of physical capital to human capital and economic growth.

Mahmoudi and Pingle (2016) introduced New-Keynesian economics concept by allowing for unemployment in the endogenous growth model. The modified model indicates that both employment and unemployment rates significantly affect investment and capital accumulation. Kaldor (1957) explained that technological progress and innovation are endogenously determined in the system depending on the rate of capital accumulation. Hicks (1932) stated that labor market condition has been influenced by technology and innovation. When facing either labor shortage or low unemployment rate, business usually has an incentive to develop new technology and innovation. Let $U$ is the unemployment rate and $U = 1 - \frac{L}{N}$ where $L$ is employed labor and $N$ is the total labor force. $g_N$ is the growth rate of unemployment; $g_N$ is the growth rate of labor force, and $g_L$ is the growth rate of employed labor. $g_U = g_L - g_N$ and $g_L = g_{LS} + g_A$ where $g_{LS}$ is the growth rate of labor supply; $g_A$ is the growth rate of laborers who learn new technology. $g_A = \alpha_0 + \alpha_1 g_G - \alpha_{2U}$, where $g_K$ is the long run capital accumulation rate. The long run unemployment rate is shown in Equation (17).

$$U^* = \{g_N + \alpha_0 + (1 - \alpha_1)g_K\}/\alpha_2 \quad (17)$$

Besides the theoretical model mentioned above, Schultz (1961, 1963) pointed out that productivity and economic growth depend on people, where the value of people to an economy is defined as human capital. Mincer (1970); Barney (1991); Mathur (1999); Barro (1998, 2001), and Psacharopoulos and Patrinos (2004) stated that the level of school attainment is just a rough measure of individual skills, but it is positively correlated with economic growth.

Koc (2013) mentioned that after the second world war, the reliance on physical capital and natural resources was replaced by knowledge and human capital along with the transition to information society. Wheeler (1980) provided evidence using simultaneous equations model that education indicators such as literacy rate and other human resource development indicators affect economic development. Easterlin (1981); Marris (1982); Lucas (1988); Becker, Murphy, and Tamura (1990); Whalley and Zhao (2013) and Chu et al. (2016) supported that human capital accumulation is an endogenous driver of economic performance and education is the key element in human capital accumulation that makes both a direct and an indirect causal relationship to sustainable economic growth. Human capital intensity accounts for an increase in productivity growth and technological progress via research, development, and innovations. Miller and Upadhyay (2000); Noorbakhsh, Paloni, and Youssef (2001); Wu (2013) and Chu et al. (2016) investigated the relationship between human capital and the flow of FDI in developing countries. The evidence indicated that human capital investment is one of the most important determinants of FDI inflow and knowledge spillovers toward capital intensive sectors and higher value-added industries which can induce economic growth. Castelló and Doménech (2002), De la Fuente and Doménech (2006), Baldacci, Clements, Gupta, and Cui (2008) and Fleisher, Li, and Zhao (2010) showed that education inequality is not only lower income growth, but it also affects regional inequality. Education spending in basic skill development and school quality has a significant positive long-term impact on wage, job stability, output growth, and poverty reduction. The contribution of investment in education to productivity growth is sizable and more pronounced in low-income countries compared to that in the middle-income countries. As a result, The UN Human Capital Project supports the idea that the government should play a vital role in building human capital by providing, financing, and regulating education quality for the children to be future productive adults.

Baldacci et al. (2008); Monteils (2004) and Acaroğlu and Ada (2014) results showed no causal relation between human capital and economic growth in France, Germany, 15 Middle East and North Africa countries. They mention that it is difficult to measure the improvement of human capital via education because there are time lags between the effects of education spending and social indicators and growth for 10–15 years. Hanushek and Kimko (2000) found that there is a solid link between the differences in school quality and the differences in economic growth with a dramatic impact on productivity and national growth rates, so attempting to measure human capital in terms of education using only school attainment may not be proper. Nevertheless, Karhan (2018) used the education index to represent human capital variable, and the education index is an index composed of the average of mean years of schooling (of adults) and expected years of schooling (of children). Hanushek and Raymond (2002) suggested indicators that highly and moderately reflect education quality and correlated with test scores are repetition rate, suspension rate, dropout rate, teacher and student absence rates, and length of school year.

Morris (1996), and Collins and Bosworth (1996) examined the education patterns in Asian Tigers and found the sequential nature of education expansion in these countries. In the early stage of industrialization, these countries put priority in the expansion of primary education. As the economies grew, they rapidly expand secondary education. The success for East Asia and for Thailand, relative to other developing countries, resulted from rapid physical and human capital accumulations causing productivity growth, which in turn creates employment opportunities, but these opportunities can only be utilized productively when the labor force has some minimum standard of human capital. Cummings (1997), Ashton, Green, James, and Sung (1999), Tirak (2001), and Khanittha (2017) pointed out that schools in these countries effectively provide the Eastern moral foundation for a good society as a core of their curriculum, and their education systems aim to build solid foundation in mathematics and science during primary education, then enhancing these knowledges in higher education. In other words, primary schools are considered the foundation for a sequential successful education, with special attention to sciences and mathematical subjects; that eventually contributes to economic development. Good education system is viewed as a prime national investment, and it is considered as a vital instrument of industrialization and economic development.

Sussangkarn (1993), and Khoman (1993) described that the expansion of primary education in Thailand started in the1960s, and by the 1980s primary education was almost universal, but secondary education participation rates were far below regional averages. Secondary education and vocational education are essential for the development of modern sectors. In short, Thailand has experienced under-developed secondary education because it is costly to provide secondary education for a large share of the population that lives in rural areas. Since 1991, the Thai government has launched programs to increase secondary schooling and university education. The enrollment ratio at secondary level has increased due to free public schools and student loans are available.

The current Thai education system stems from the reforms set by the 1999 National Education Act. The decentralization measures have not yielded tangible improvement in school accountability. Expansions in school enrollment for both basic and higher education have contributed to a persisting decline in quality. Somkiat and Supanutt (2012) pointed out that Thai quality assessment system does not reflect student performance. These assessments are not only ineffective in improving student performance, but also created a burden on both schools and teachers. Hanushek (2013) used the cognitive skill to measure the effect of education on performance. Tinakorn and Sussangkarn (1994), Young (1994), Warr and Nidhiprabha (1996), Campos and Root (1996), Collins and Bosworth (1996), Sarel (1997), Barker and Goto (1998), Dixon (1999), and Somchai (2012) concluded that the sources of economic growth in Thailand are capital accumulation, the increased quality of the labor input, and the growth in total factor productivity (TFP). The Thai government has long been reluctant to engage in research and development activities. R&D expenditure, as a percentage of GDP, is among the lowest in the Pacific region. Thai industries have experienced the problems of high labor costs, especially in labor intensive industries, and low skill levels in skill-intensive industries. About half of all unskilled workers adhere to the minimum wage because Thailand's education system is unable to prepare graduates suitable for the labor market. Relevant skills required in global competition are lacking. According to the International Labor Organization (2008), these skills are foundation skills, core working skills, technical skills, and entrepreneurial and management skills. The demand for skilled labor could not be satisfied, leading to high wages for skilled workers and a wide gap between wages for skilled and unskilled workers. Contrary to the conventional wisdom, the evolutionary idea emerges in the next phase of economic development in which investment in basic education may not be sufficient for future economic development. Therefore, the secondary and tertiary levels of education as well as higher education are required and need to be tailored in order to build the intellectual capital in response to economic and social demands for sustainable development. As a result, the Thai government heavily subsidizes some areas of higher education such as science, engineering, and medicine in order to attract good students. Yuvares (2016) pointed out that there is corruption in Thailand's education system, which causes misallocation of resources and lower education quality.

## Methodology

The first step of structural analysis started by examining causal relation between education and economic variables. Annual data of Thai economy used in this research were from 1990 to 2018. Several education and economic variables were used to capture the characteristics of structural relationships explained in both theoretical model and literature reviews. These variables included the growth rate of GDP (GGDP), the growth rate of GDP per capita (GGDPP), and unemployment rate (UR). The variable used to represent human capital was human development indicator (HDI). Several variables used to describe education characteristics were education index (EDU), average years of schooling (YOS), school enrollment rate (POPSE) and pupil–teacher ratio (PTR). The control variables used to capture other important factors described in theoretical model were foreign direct investment (FDI), fertility rate (FER), and government spending on education (GEXP).

Secondary data were obtained from Ministry of Education, Office of the Education Council, Bank of Thailand, Ministry of Finance, Office of the National Economic and Social Development Board, United Nations Development Program (UNDP), World Development Indicators from the World Bank and International Financial Statistics from the IMF. Missing values were treated using interpolation and extrapolation techniques characterized by the data pattern in each variable.

Hanushek (2008) mentioned that it is important for policy purposes to assess the causal relationship between resources and performance. Thus, this research performed the quantitative analysis using bivariate Granger's causality tests applied in order to identified the causal relation between education and economic growth. Optimum lag for each pair of variables was examined using grid search procedure and Akaike information criteria (AIC). The tests are shown in the following Equations (18)–(21).

$$y_t = \sum_{p=1}^{m} \alpha_p y_{t-p} + \sum_{q=1}^{m} \beta_q x_{t-q} + \varepsilon_t \quad (18)$$

$$x_t = \sum_{p=1}^{m} \alpha_p x_{t-p} + \sum_{q=1}^{m} \beta_q y_{t-q} + \varepsilon_t \quad (19)$$

where $t$ is time, and the parameters $p$, $q$ and $m$ are lag-orders.

Similar to Wheeler (1980) and Hanushek and Woessmann (2012), the results from the causality tests were taken to construct structural equations and then estimate the structural model using two stage least square method (2SLS).

$$y = X_{ex}\beta_{ex} + X_{en}\beta_{en} + \varepsilon = X\beta + \varepsilon \quad (20)$$

$$X_{en} = Z_{ex}\Gamma_{ex} + Z_{iv}\Gamma_{iv} + \nu = Z\Gamma + \nu \quad (21)$$

where $X_{ex}$, $Z_{en}$, $X_{iv}$ are matrix of exogenous variables, matrix of endogenous variables, and matrix of instrumental variables. $\beta_{ex}$, $\beta_{en}$ are vector of exogenous parameters, matrix of endogenous parameters, respectively. $\Gamma_{ex}$, $\Gamma_{iv}$ are vector of exogenous parameters, and vector of instrumental variable parameters. $\varepsilon, \nu$ are vector of white noise error. If there was one-way causal relation, the model was reduced to the regression analysis with least square method. Estimating structural equations may experience problematic causal variables when dependent or endogenous variables are correlated with the error terms. The parameters can be estimated using the following Equation (22):

$$\hat{\beta}_{2SLS} = \left(X'Z\left(Z'Z\right)^{-1}Z'X\right)^{-1}\left(X'Z\left(Z'Z\right)^{-1}Z'Y\right) \quad (22)$$

## Results and Discussion

The causal relations between education variables and economic growth in Thailand are shown in Table 1 and Figure 1.

The evidence shown in Table 1 and Figure 1 indicates that, at 95 percent confidence interval, education variables do not cause the growth rate of both GDP and GDP per capita, but they can affect unemployment rate in Thailand. Notice that both of the GDP growth and the government spending on education can directly cause the change in foreign direct investment (FDI) and indirectly affect unemployment rate via human development (HDI). An increase in government spending on education (EXP) can significantly affect secondary school enrollment (POPSE), pupil–teacher ratio (PTR), and the average years of schooling (YOS). Fertility rate (FER) and population growth do not cause economic growth. It implies that the change in the amount of population can raise school enrollment. Increase in the per capita GDP can stimulate population growth.

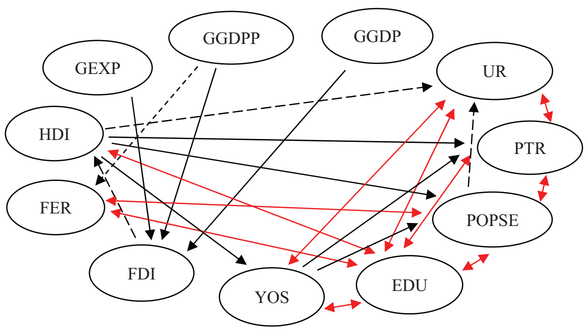


**Figure 1** The causal relation between education and economic growth in Thailand.
*Note:* —— and ---- denoted 95 and 90 percent confidence interval, respectively. The arrow indicates the direction of causal relation.

**Table 1** The granger causality test for Thailand

| Null Hypothesis | Lags | Obs. | F-Statistic | Prob. |
|---|---|---|---|---|
| EDU does not Granger Cause GGDPP | 1 | 28 | 0.3507 | 0.5591 |
| GGDPP does not Granger Cause EDU | | | 2.2193 | 0.1488 |
| FDI does not Granger Cause GGDPP | 1 | 25 | 0.0129 | 0.9107 |
| GGDPP does not Granger Cause FDI | | | 8.0257 | 0.0097* |
| FER does not Granger Cause GGDPP | 1 | 28 | 0.6471 | 0.4287 |
| GGDPP does not Granger Cause FER | | | 3.7462 | 0.0643** |
| GEXP does not Granger Cause GGDPP | 1 | 28 | 0.0811 | 0.7782 |
| GGDPP does not Granger Cause GEXP | | | 0.6934 | 0.4129 |
| HDI does not Granger Cause GGDPP | 1 | 28 | 0.4749 | 0.4971 |
| GGDPP does not Granger Cause HDI | | | 0.0190 | 0.8913 |
| POPSE does not Granger Cause GGDPP | 1 | 28 | 0.2492 | 0.6220 |
| GGDPP does not Granger Cause POPSE | | | 0.1543 | 0.6978 |
| PTR does not Granger Cause GGDPP | 1 | 28 | 0.0258 | 0.8737 |
| GGDPP does not Granger Cause PTR | | | 0.0246 | 0.8766 |
| UR does not Granger Cause GGDPP | 1 | 28 | 0.7297 | 0.4011 |
| GGDPP does not Granger Cause UR | | | 1.0932 | 0.3058 |
| YOS does not Granger Cause GGDPP | 1 | 28 | 0.3513 | 0.5587 |
| GGDPP does not Granger Cause YOS | | | 0.7963 | 0.3807 |
| EDU does not Granger Cause GGDP | 1 | 28 | 0.7413 | 0.3974 |
| GGDP does not Granger Cause EDU | | | 2.0666 | 0.1630 |
| FDI does not Granger Cause GGDP | 1 | 25 | 0.0212 | 0.8856 |
| GGDP does not Granger Cause FDI | | | 6.7806 | 0.0162* |
| FER does not Granger Cause GGDP | 1 | 28 | 1.0949 | 0.3054 |
| GGDP does not Granger Cause FER | | | 2.7475 | 0.1099 |
| GEXP does not Granger Cause GGDP | 1 | 28 | 0.0322 | 0.8590 |
| GGDP does not Granger Cause GEXP | | | 0.6938 | 0.4128 |
| HDI does not Granger Cause GGDP | 1 | 28 | 0.9427 | 0.3409 |
| GGDP does not Granger Cause HDI | | | 0.0238 | 0.8785 |
| POPSE does not Granger Cause GGDP | 1 | 28 | 0.6425 | 0.4304 |
| GGDP does not Granger Cause POPSE | | | 0.2365 | 0.6310 |
| FDI does not Granger Cause EDU | 1 | 25 | 1.9587 | 0.1756 |
| EDU does not Granger Cause FDI | | | 0.0239 | 0.8786 |
| FER does not Granger Cause EDU | 1 | 28 | 12.8646 | 0.0014* |
| EDU does not Granger Cause FER | | | 8.0705 | 0.0088* |
| GEXP does not Granger Cause EDU | 1 | 28 | 1.8569 | 0.1851 |
| EDU does not Granger Cause GEXP | | | 0.1670 | 0.6863 |
| HDI does not Granger Cause EDU | 1 | 28 | 4.9433 | 0.0355* |
| EDU does not Granger Cause HDI | | | 13.7645 | 0.0010* |
| POPSE does not Granger Cause EDU | 1 | 28 | 7.2706 | 0.0124* |
| EDU does not Granger Cause POPSE | | | 26.2918 | 0.00002* |
| PTR does not Granger Cause EDU | 1 | 28 | 10.7837 | 0.0030* |
| EDU does not Granger Cause PTR | | | 7.9650 | 0.0092* |
| UR does not Granger Cause EDU | 1 | 28 | 10.7243 | 0.0031* |
| EDU does not Granger Cause UR | | | 4.6039 | 0.0418* |
| YOS does not Granger Cause EDU | 1 | 28 | 5.3534 | 0.0292* |
| EDU does not Granger Cause YOS | | | 5.2899 | 0.0301* |
| FER does not Granger Cause FDI | 1 | 25 | 0.0381 | 0.8470 |
| FDI does not Granger Cause FER | | | 1.3137 | 0.2640 |

**Table 1** Continued

| Null Hypothesis | Lags | Obs. | F-Statistic | Prob. |
|---|---|---|---|---|
| GEXP does not Granger Cause FDI | 1 | 25 | 6.7174 | 0.0166* |
| FDI does not Granger Cause GEXP | | | 1.4111 | 0.2475 |
| HDI does not Granger Cause FDI | 1 | 25 | 0.2183 | 0.6449 |
| FDI does not Granger Cause HDI | | | 4.1482 | 0.0539** |
| POPSE does not Granger Cause FDI | 1 | 25 | 0.4728 | 0.4989 |
| FDI does not Granger Cause POPSE | | | 2.2255 | 0.1499 |
| PTR does not Granger Cause FDI | 1 | 25 | 1.7509 | 0.1993 |
| FDI does not Granger Cause PTR | | | 0.8268 | 0.3731 |
| UR does not Granger Cause FDI | 1 | 25 | 1.2577 | 0.2742 |
| FDI does not Granger Cause UR | | | 2.675 | 0.1161 |
| YOS does not Granger Cause FDI | 1 | 25 | 0.0952 | 0.7606 |
| FDI does not Granger Cause YOS | | | 0.0006 | 0.9810 |
| GEXP does not Granger Cause FER | 3 | 26 | 1.9591 | 0.1544 |
| FER does not Granger Cause GEXP | | | 0.7025 | 0.5622 |
| HDI does not Granger Cause FER | 3 | 26 | 0.0685 | 0.9760 |
| FER does not Granger Cause HDI | | | 2.0407 | 0.1423 |
| POPSE does not Granger Cause FER | 3 | 26 | 5.8177 | 0.0054* |
| FER does not Granger Cause POPSE | | | 3.3345 | 0.0414* |
| HDI does not Granger Cause GEXP | 1 | 28 | 0.1275 | 0.7241 |
| GEXP does not Granger Cause HDI | | | 0.5909 | 0.4493 |
| POPSE does not Granger Cause GEXP | 1 | 28 | 0.0089 | 0.9254 |
| GEXP does not Granger Cause POPSE | | | 2.7611 | 0.1091 |
| PTR does not Granger Cause GEXP | 1 | 28 | 0.0384 | 0.8462 |
| GEXP does not Granger Cause PTR | | | 2.4746 | 0.1283 |
| UR does not Granger Cause GEXP | 1 | 28 | 1.7207 | 0.2015 |
| GEXP does not Granger Cause UR | | | 0.5957 | 0.4475 |
| YOS does not Granger Cause GEXP | 1 | 28 | 0.0985 | 0.7562 |
| GEXP does not Granger Cause YOS | | | 1.8458 | 0.1864 |
| POPSE does not Granger Cause HDI | 2 | 27 | 0.7655 | 0.4771 |
| HDI does not Granger Cause POPSE | | | 5.4839 | 0.0117* |
| PTR does not Granger Cause HDI | 2 | 27 | 1.0597 | 0.3636 |
| HDI does not Granger Cause PTR | | | 4.2648 | 0.0272* |
| UR does not Granger Cause HDI | 2 | 27 | 0.7613 | 0.4790 |
| HDI does not Granger Cause UR | | | 2.9899 | 0.0710** |
| YOS does not Granger Cause HDI | 2 | 27 | 0.5033 | 0.6113 |
| HDI does not Granger Cause YOS | | | 4.0726 | 0.0313* |
| PTR does not Granger Cause POPSE | 2 | 27 | 2.7252 | 0.0876** |
| POPSE does not Granger Cause PTR | | | 6.9902 | 0.0045* |
| UR does not Granger Cause POPSE | 2 | 27 | 0.0839 | 0.9198 |
| POPSE does not Granger Cause UR | | | 3.4248 | 0.0507** |
| YOS does not Granger Cause POPSE | 2 | 27 | 4.5348 | 0.0224* |
| POPSE does not Granger Cause YOS | | | 0.4763 | 0.6274 |
| UR does not Granger Cause PTR | 1 | 28 | 4.0385 | 0.0554** |
| PTR does not Granger Cause UR | | | 5.3065 | 0.0298* |
| YOS does not Granger Cause PTR | 1 | 28 | 6.8417 | 0.0149* |
| PTR does not Granger Cause YOS | | | 1.0959 | 0.3052 |
| YOS does not Granger Cause UR | 1 | 28 | 5.9513 | 0.0221* |
| UR does not Granger Cause YOS | | | 4.3157 | 0.0482* |

*Note:* *, ** denoted 95 and 90 percent confidence interval, respectively.

The correlation matrix is shown in Table 2. Table 3 represent the structural relationship between education variables and unemployment rate. Model 1 is the baseline model. The variables included in the model used to indicate structural relationship were selected by applying backward stepwise procedure. The statistical *t*-tests at 95 percent confidence interval were performed in the procedure to obtain Model 2 and Model 3. Some of these variables are expected to be highly correlated because the education index is computed by the weighted average of the years of schooling, literacy rate, and the gross enrollment ratio. However, the bivariate causality test was applied since correlation does not always imply causation. The problem of multicollinearity is minimized in Model 3 shown in Table 3, which is the final result.

In this model, once the EDU variable is omitted, the multicollinearity problem with HDI, YOS and POPSE would be reduced. In addition, the multicollinearity problem is also reduced when POPSE variable is omitted. According to UNDP, the HDI represents human capabilities for economic development in which it is a summary index measure of human development using the normalized geometric mean of the three dimensions including healthy life, education, and standard of living, while YOS only reflects the quantitative component of education. The geometric mean implies that a low achievement in one dimension is not linearly compensated for by a higher achievement in another dimension. Nonlinear relationship can reduce the severity of the multicollinearity problem.

The Model 3 results, shown in Table 3, indicate that at 95 percent confident interval school enrollment rate (POPSE) and education index (EDU) do not significantly affect unemployment rate. However, average years of schooling (YOS), pupil–teacher ratio (PTR), and human development indicator (HDI) significantly affect unemployment. These results implied that the quantity or the amount of student enrollment cannot solve the unemployment problem, but the process that creates the quality of education can.

Increasing literacy rate may not be enough to reduce unemployment. However, the average years of schooling, which indicates the length of time used for learning new knowledge and skills necessary to create productivity and innovation, can decrease unemployment. It is important to notice that pupil–teacher ratio and HDI significantly affect unemployment. The ratio of student per teacher is positively related to the unemployment rate, meaning that when the ratio of student per teacher decreases, unemployment can be reduced because of the improvement in education quality,

**Table 2** Correlation matrix for education and human development variables

| Variables | EDU | HDI | PTR | YOS | POPSE |
|---|---|---|---|---|---|
| EDU | 1.0000 | 0.9341 | -0.5590 | 0.9445 | 0.8603 |
| HDI | 0.9341 | 1.0000 | -0.7121 | 0.9283 | 0.8463 |
| PTR | -0.5590 | -0.7121 | 1.0000 | -0.6203 | -0.5761 |
| YOS | 0.9445 | 0.9283 | -0.6203 | 1.0000 | 0.9358 |
| POPSE | 0.8603 | 0.8463 | -0.5761 | 0.9358 | 1.0000 |

**Table 3** Estimates of the structural model using two-stage least square method

| Variable | Dependent Variable: UR | | |
|---|---|---|---|
| | Model 1 | Model 2 | Model 3 |
| C | -29.8301* | -29.7398* | -18.2999* |
| | (11.9349) | (11.6867) | (6.9261) |
| EDU | -11.9294 | -12.2831 | |
| | (10.5048) | (10.1566) | |
| YOS | -1.4216* | -1.4185* | -1.2447* |
| | (0.6410) | (0.6279) | (0.6169) |
| PTR | 0.4739* | 0.5202* | 0.4005* |
| | (0.2631) | (0.1361) | (0.0942) |
| HDI | 57.3301* | 55.2332* | 30.0859* |
| | (27.4918) | (25.0489) | (14.0955) |
| POPSE | -0.0223 | | |
| | (0.1076) | | |
| $R^2$ | 0.7191 | 0.7014 | 0.7014 |
| Adj. $R^2$ | 0.6580 | 0.6656 | 0.6656 |

*Note:* Sample from 1990 to 2018 included 29 observations and standard error in parenthesis.

because the ratio of student per teacher can be used as a proxy for education quality instead of using standard test result. HDI reflects the three important dimensions of people capabilities including the health dimension, the education dimension, and the standard of living dimension. This finding can be interpreted as a decline in education quality.

## Conclusion and Recommendation

Education development and reform has become one of the important issues in Thailand. Thai's Education currently prioritizes both integrity and knowledge. The Thai government uses education as an important mechanism to create both human capital and intellectual capital. Aiming for both quality and efficiency, decentralized system is implemented for flexibility to match the characteristic of the problems. Evidence from the long history of Thailand's education development indicates that the current educational system has not been really successful. These results indicate that various education variables do not significantly affect economic growth in Thailand but affect unemployment. To solve unemployment problems, analytical skills and student centric procedure are needed. The quantity of student enrollment cannot solve the unemployment problem, but the quality of education can. Therefore, these findings suggest that education in Thailand should focus more on the process of knowledge creation for sustainability. Our recommendation for future research is using the Human Capital Index (HCI) where the data is collected by the World Bank.

## Conflict of Interest

There is no conflict of interest.

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