

A Mediation Analysis on Level of Education and Economic Growth

Seuk Yen Phoong*

Department of Mathematics, Faculty Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900 Tanjung Malim, Perak, Malaysia

Seuk Wai Phoong

Department of Operations and Management Information Systems, Faculty of Business and Accountancy, University of Malaya, 50603 Kuala Lumpur, Malaysia

Xiao Jun Tan

Faculty of Economics and Administration, University of Malaya, 50603 Kuala Lumpur, Malaysia

Abstract

This paper examines the relationship between education and economic growth in Malaysia from 1984 to 2012 which is motivated by the issue of the inefficiency of government's expenditure on education. Specifically, this paper investigates how education levels affect Malaysia's economic growth directly and indirectly through mediators such as unemployment, fertility and technology innovation via mediation analysis. The empirical results show that primary and tertiary education affects economic growth positively, while secondary education gives a negative effect. It is also discovered that the impact of all education levels on economic growth via indirect effects is higher than the direct effects. Tertiary education has the largest total effect among the other education levels on economic growth and its indirect effect on economic growth through lowering unemployment and fertility and increasing technology innovation is found to be significant.

Keywords: Education; Economic growth; Mediators; Mediation analysis; Direct effect.



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1. Introduction

Vision 2020 (also known as Wawasan 2020) is an ideal in Malaysia which was introduced by Prime Minister, Tun Dr. Mahathir bin Mohamad to make Malaysia a fully developed country by year 2020. One of the goals in Vision 2020 is to become a world class educational system. In fact, TN50 was introduced in early 2017 as a continuation on Vision 2020. Throughout the years in achieving Vision 2020, a high amount of expenditure has been invested on education in Malaysia. The UNESCO Institute of Education Statistics shows that the expenditure on education as percent of GDP in Malaysia is the highest as compared to Singapore and Thailand. Nonetheless, the return on investment is not as highly attained as expected as its education performance still lags behind other countries with similar or lower expenditure levels on education, such as Singapore and Thailand. In other words, Singapore and Thailand have been more efficient in their expenditure on education while Malaysia may not have allocated the funds efficiently. According to an annual report done by [Universitas 21 \(2014\)](#), Malaysia's higher education ranks 27th out of 50 countries in overall; while in terms of resources invested, it ranks 12th out of 50 countries. However, the return on investment ranks only 44th out of 50 countries. The big gap between the ranking of resources invested and the return on investment show that Malaysia has not been efficient in its expenditure on education sector.

In Malaysia Budget 2016, the government reduced its allocation for governmental scholarship program where the budget for the ministry of education has reduced from RM 873 million in 2015 to RM 388 million in 2016 with 55.5% decrease. As for Ministry of Higher Education, the budget is reduced to RM 251 million, which is 16.4% lower as compare to previous year. This has been a concern for the citizens of Malaysia as the governmental expenditure being cut down in regards to education. Many have doubted the government's decision as they assume that the government sacrifices education due to the weakening economy in Malaysia. On a side note, as there is lack of evidence showing the effects of different levels of education on economic growth in Malaysia, it remains a question whether the funds allocated to support for free primary and secondary education in Malaysia is a wise decision.

In addition, there are various literatures focusing on the effect of education levels on economic growth but contrasting conclusion has been made from the studies. [Sachs et al. \(1995\)](#) concluded that primary and secondary education have insignificant impact on economic growth where lower education have no impact on economic growth. In contrast, both education levels are found to be important for economic growth by [Loening \(2005\)](#). Particularly for tertiary education, [Loening \(2005\)](#) concluded its significant positive relationship with economic growth yet [Adawo \(2011\)](#) found contrasting result of their negative relationship instead. The contrasting and mixed result in literature reported that the relationship between education level and economic growth remain debatable and questionable.

Moving on, studies also found that education has its indirect effect to economic growth through the human capital accumulation. According to Gupta and Chakraborty (2006), human capital accumulation is the source of economic growth while Benhabib and Spiegel (1994) added that educated labor force promotes innovation and contribute to the economic growth. However, there is a lack of studies that have conducted empirical test to show and prove the indirect effect of education level on economic growth. Therefore, this study is carried out to look deeper into the possible direct and indirect effects of education on economic growth of Malaysia. The findings serve as a recommendation to assist government in allocating funds more efficiently according to the levels of education. As such, Malaysia can improve its education performance and achieve the world education system which is one of the objectives of Vision 2020.

2. Methodology

This study adopts mediation analysis to study the impact of education on economic growth, both directly and indirectly. It is conducted by forming a series of regression models to study the values and significances of total effect, direct and indirect effect of education on economic growth in Malaysia. There are three mediators included and the product of coefficient approach is used to compute the value of indirect effect through each mediator respectively. After computing the value of the indirect effect, bootstrapping test will be conducted to calculate the standard error of each indirect effect in order to study their significance. Under mediation analysis, the only assumption is that the homogeneity of regression needs to be tested in order to ensure that the direct and indirect effect do not cross each other and can be interpreted.

2.1. Sample and Data Description

There are several variables included in this study such as GDP per capita, three education levels and mediators such as fertility rate, technology innovation and unemployment. The secondary data selected are ranged from year 1984 to 2012.

2.2. Econometric Techniques

Mediation, which is also called as indirect effect, occurs in an observed relationship between the X and Y through the inclusion of third explanatory variable. This third variable is known as the mediation variable or mediator (M). In this study, lnGDPPC is the dependent variables while PRI, SEC, and TER are the independent variables. The three mediators are UNEM, FER and lnTECH.

The statistical mediation analysis has two main approaches which are causal steps strategy and product of coefficient approach. However, it has limitation in which it is not readily adjustable compared to other method in accommodating problem such as the violation of normality assumption (Preacher and Hayes, 2014). Thus, product of coefficient approach is carried out to study the indirect effect of education as recommended by Preacher and Hayes (2014). It computes the indirect effect through each mediator respectively which enables us to compare the effect intermediated by each mediator. This research used the notation of the study done by Russell *et al.* (2009) to form several regression models in order to examine the total effect, direct effect as well as indirect effect.

2.2.1. Total Effect Model

Total effect model is a model in which the dependent variable serves as a function of the independent variables, in which the mediators are excluded from the model. The alpha coefficients (α_i) in this model represent the total effect of each level of education on economic growth.

$$\text{Model 1: } \ln\text{GDPPC}_t = i_1 + \alpha_1\text{PRI}_t + \alpha_2\text{SEC}_t + \alpha_3\text{TER}_t + e_{1t} \quad (1)$$

Where subscript t represents the year, i_1 represents the intercept of model 1, α_1 , α_2 and α_3 denote the total effect of primary, secondary and tertiary education on economic growth respectively, e_1 denotes the unexplained variability in model 1.

2.2.2. Direct Effect Model

Direct effect model is a model of dependent variable serving as a function of all the independent variables together with the three mediators. The beta coefficient (β_i) represents the direct effect of each education level on economic growth.

$$\text{Model 2: } \ln\text{GDPPC}_t = i_2 + \beta_1\text{PRI}_t + \beta_2\text{SEC}_t + \beta_3\text{TER}_t + m_1\text{UNEM}_t + m_2\text{FER}_t + m_3\text{lnTECH}_t + e_{2t} \quad (2)$$

Where i_2 represent the intercept of model 2, β_1 , β_2 and β_3 denote the direct effect of primary, secondary and tertiary education on economic growth respectively after adjusting for the effect of unemployment rate (1st mediator), fertility rate (2nd mediator) and technology innovation (3rd mediator), m_1 , m_2 and m_3 are the mediators of unemployment rate, fertility rate and technology innovation to economic growth respectively, e_2 denotes the unexplained variability in model 2.

3.3.3. Indirect Effect Transmitted by Each Mediator

As mentioned previously, the product of coefficient approach is adopted to study the indirect effect. It is the multiplication of the extent to which the independent variables affect each mediator and the extent to which each of

the mediator changes the dependent variable, that are represented by m_1 , m_2 and m_3 in model 2. Model 3, 4 and 5 below show the extent of independent variables affecting the mediators respectively.

$$\text{Model 3: } UNEM_t = i_3 + \lambda_1 PRI_t + \lambda_2 SEC_t + \lambda_3 TER_t + e_{3t} \tag{3}$$

$$\text{Model 4: } FER_t = i_4 + \gamma_1 PRI_t + \gamma_2 SEC_t + \gamma_3 TER_t + e_{4t} \tag{4}$$

$$\text{Model 5: } lnTECH_t = i_5 + \delta_1 PRI_t + \delta_2 SEC_t + \delta_3 TER_t + e_{5t} \tag{5}$$

Where i_3 , i_4 and i_5 represent the intercept of model 3, 4 and 5 respectively, λ_1 , λ_2 and λ_3 denote the effect of primary, secondary and tertiary education on unemployment rate (1st mediator) respectively, γ_1 , γ_2 and γ_3 are the effect of primary, secondary and tertiary education on fertility rate (2nd mediator) respectively, δ_1 , δ_2 and δ_3 are the effect of primary, secondary and tertiary education on technology innovation (3rd mediator) respectively, e_3 , e_4 and e_5 denote the unexplained variability in model 3, 4 and 5 respectively.

3. Results

3.1. Total Effect Model

Table-1. Total Effect Model

Variable	Coefficient	Std. Error	t-statistic (p-value)
Primary Education	0.0367	0.0107	3.4142 (0.0022)***
Secondary Education	-0.0426	0.0095	-4.4876 (0.0001)***
Tertiary Education	0.0707	0.0049	14.2844 (0.0000)***

$R^2 = 0.9653$, F-statistics = 232.0017, P-value = 0.0000

Note: *** denote statistical significance at the 0.01 level.

Table 1 shows the results of the total effect of the levels of education on economic growth. It is shown that the three levels of education are significant to economic growth at $\alpha = 1\%$. Primary education and tertiary education are positively related to economic growth which is similar to the findings of Judson (1996) and Loening (2005). Secondary education level however, is found to be negatively related to economic growth. Such finding is supported by Matsushita *et al.* (2006) where the enrolment of the students into secondary school may delay their entrance into the labor market and contribute to the economy. However, the effect is only in short to medium term as they will eventually benefit economic growth in the long term as the productivity increased. Overall, by simply comparing the coefficients, we can conclude that the total effect of tertiary education was the highest, followed by secondary and primary.

3.2. Direct Effect Model

Table-2. Direct Effect Model

Variable	Coefficient	Std. Error	t-statistic (p-value)
Unemployment	-0.0602	0.0166	-3.6236(0.0015)***
Fertility	-0.3069	0.1012	-3.0322(0.0061)***
Technology	0.3758	0.0754	4.9855(0.0001)***
Primary	0.0107	0.0070	1.5238(0.1418)
Secondary	-0.0148	0.0055	-2.6705(0.0140)**
Tertiary	0.0204	0.0072	2.8272(0.0098)***

$R^2 = 0.9967$, F-statistic = 544.8680, P-value = 0.0000

Note: *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 levels respectively.

Table 2 presents the results of direct effect model of education economic growth which is the exposure effect of education without being mediated by the mediators. The significance of direct effect is an important indicator to determine whether the mediation process is fully mediated or partially mediated.

For primary education, the p-value is 0.1418 which is greater than the 0.10 significance level. Thus, null hypothesis of coefficient being equal to zero should not be rejected. It implies that the direct effect of primary education is insignificant which is similar to Sieng and Yussof (2014). It can be due to primary education being made compulsory in Malaysia and thus does not directly. Thus, it is concluded that the effect of primary education on economic growth is entirely through the indirect effect and it is said to be fully mediated by the three mediators.

As for secondary education, the p-value of 0.0140 rejects the null hypothesis, indicating the insignificance of its direct effect at the 0.05 significance level. It is concluded that the negative effect of secondary education is statistically significant in the direct model. Despite the free of charge of secondary education in Malaysia, it has not been officially made compulsory and students leave schools freely before completing their study. According to Patel (2014), the number of student dropout from secondary school in Malaysia reaches into thousands. It signifies that the money funded by government is gone to waste on the students that dropout and thus reduces economic growth. The significance of secondary education on direct effect suggests that the three mediators partially mediate the impact of secondary education on economic growth.

Additionally, the p-value of tertiary education, 0.0098 is smaller than 0.01 significance level and thus indicating its significance statistically. The findings are might be due to Malaysia becoming one of the countries that have high proportion of international students pursuing higher education with increase of over 16% annually (The Sun Daily, 2015). Thus, it boosts economic growth and it is concluded that the mediators partially mediated the impact of tertiary education on economic growth.

3.3. Indirect Effect of Education on GDP

Table-3. Indirect effect of Education in GDP

	Mediators' effect on GDP		
Primary			
Unemployment	-0.2202**	-0.0602***	0.0133**
Fertility	-0.0240*	-0.3069***	0.0074
Technology	0.0143	0.3758***	0.0054
Secondary			
Unemployment	0.2017**	-0.0602***	-0.0121**
Fertility	0.0107	-0.3069***	-0.0033
Technology	-0.0330**	0.3758***	-0.0124**
Tertiary			
Unemployment	-0.1544***	-0.0602***	0.0093**
Fertility	-0.0580***	-0.3069***	0.0178***
Technology	0.0616***	0.3758***	0.0232***

Note: *, ** and *** denote statistical significance at the 0.10, 0.05 and 0.01 levels respectively.

Table 3 presents the indirect effect of different education levels on economic growth via mediation analysis. The multiplication of second column (impact of three education levels on the mediators) and third column (mediators' effect on GDP) results in the indirect effect of educations on economic growth which is in the fourth column. The significance of indirect effects is examined with the bootstrap confidence interval whereby the effect is significant if zero is not included in the interval.

3.3.1. Indirect Effect of Primary Education

Table 3 shows that 1% point increase in primary enrollment rate, the economic growth will increase by 1.33% through the reduction of unemployment. There is significant positive relationship between primary education and economic growth through unemployment which is also supported by the human capital theory (Nickell, 1979). An individual having further qualifications will obtain more skill and more likely to be employed. This shows that education helps lower unemployment and thus boosts the economic growth.

In addition, 1% point increase in primary enrolment rate lead to 0.74% increase in economic growth through lowering of fertility rates. This shows a positive relationship between primary education and economic growth through fertility. However, such indirect effect is found to be insignificant. It is supported by Tan and Haines (1984) whereby they failed to find relationship between primary enrolment and fertility as significant impact are not likely to be discovered with small amounts of primary education.

Besides, 1% point increase in primary enrolment rate lead to 0.54% increase in economic growth through increase in technology innovation. Such finding is supported by the New Growth Theory by Romer (1989) and Lucas (1988). Nonetheless, it is found to be statistically insignificant as shown in the result. Sieng and Yussuf (2014) supported such findings as economic growth is boosted by higher level of education but not mere primary education level.

In short, the primary education gives the largest effect to the economic growth through unemployment as the other mediator variables which are fertility and technology, the indirect effect is found to be insignificant.

3.3.2. Indirect Effect of Secondary Education

As shown in Table 3, 1% point increase in secondary enrollment rate will result in 1.21% decrease in economic growth through increasing unemployment rate, signifying the significance of the indirect effect. The negative relationship on economic growth is similar to the findings of Matsushita *et al.* (2006) whereby people are delayed to enroll in the labor market and thus reduce the productivity for economic growth as unemployment increases.

Besides, increase in secondary enrolment rate decreases economic growth via increase in fertility rate. Thus, the indirect effect is found to be insignificant. Mohd *et al.* (2015) discovered that besides lack of education, there are also other significant risk factors for teenagers such as pregnancy and poverty which is also supported. Thus, it can be used to support the insignificance of the indirect impact found in the study.

Furthermore, 1% point increase in secondary enrolment rate lead to 1.24% decrease in economic growth through decrease in technology innovation, showing significant indirect effect. The findings can be supported due to the increasing of dropout rate of secondary education in Malaysia whereby skilled human capital is not reflected.

Overall, the indirect effect of secondary education through fertility is shown to be insignificant towards economic growth. As simply comparing between unemployment and technology, the negative effect of secondary education on economic growth is found to be higher through lowering the technology innovation than increasing unemployment.

3.3.3. Indirect Effect of Tertiary Education

Tertiary enrolment shows significant positive relationship with economic growth through lowering of unemployment. It is supported by Blinova *et al.* (2015) in which it increases employment and support the economic growth.

Moreover, statistically significant positive relationship also found between tertiary education and economic growth through lowering the fertility rate. Piotrowski and Tong (2016) supported the findings whereby fertility is perceived to be an opportunity cost for economic growth whereby newlyweds who acquire tertiary education are less likely to give birth but contribute to the expansion of economy.

Finally, tertiary education is also significantly related to economic growth positively through increase in technology innovation. Kruss *et al.* (2015) highlighted the importance of the tertiary education on technological innovation in terms of production and global development.

By comparing among the positive relationship of tertiary education through unemployment, fertility and technology, the indirect effects through technology is the highest as it gives the highest magnitude which is 0.0232.

4. Conclusions

This study investigates the impact of education on economic growth, both directly and indirectly. Mediation analysis is the main test in this paper which aims to identify whether mediators such as unemployment, fertility rate and technology innovation transmit the effect of independent variables (primary, secondary and tertiary education) to the dependent variables, economic growth. Testing of homogeneity of regression was first carried out and it is concluded that mediators have no relationship with the independent variables.

Mediation analysis is then conducted to examine the total, direct and indirect effect of education on economic growth. The results of total effect model show that all education levels are significant to economic growth and the total effect of tertiary education is the highest among the education levels followed by secondary and primary education. The primary and tertiary educations are positively related to economic growth when secondary education is negatively related to economic growth.

The direct effect model measures degree to which economic growth changes when education enrollments changes without passing through the mediators. The result shows the direct effect of primary education on economic growth is positively yet insignificant due to it being compulsory in Malaysia. The secondary education is found to have significant negative direct effect as students tend to drop out of school and result in waste of funding on secondary education. The tertiary education however found to have significant positive direct relationship to the economy growth due to the increase in international students that boosted the economy.

The indirect effect model however shows the effect of different education levels on economic growth through mediators such as unemployment, fertility rate and technology innovation. Among the three mediators, only unemployment is significant in transmitting the positive effect of primary education to economic growth whereby the other mediators are found to be insignificant. As for the indirect effect of secondary education, it is statistically negatively related to economic growth through increasing unemployment rate and lowering technological innovation, which is contrast to common findings. It is explained that people delayed their participation in labor market that result in increase in unemployment rate and reduction in economic growth. Besides, it also leads to unfavorable impact on technology innovation. The indirect effect of secondary education through fertility however is statistically negative to economic growth as there might be other reason such as poverty that affects the fertility rate in Malaysia. Finally, the indirect effects of tertiary education through all mediators are significantly positive related to economic growth through lowering unemployment and fertility rate as well as increasing technology innovation. To conclude, the indirect effect of education on economic growth is found to be larger than the direct effect.

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