International Conference on
Environment, Sustainability Issues,
and Community Development (INCRID)

CERTIFICATE

OF APPRECIATION

Number : 1100/UN7.P/HK/2020

THIS CERTIFICATE IS PRESENT TO

Andryan Setyadharma, PhD

HAS PARTICIPATED AS

PRESENTER

"Recent Updates and Challenges on Environmental Technology, Sciences,
Education and Innovations"

SEMARANG, 21 OCTOBER 2020

Dean

Ir. M. Agung Wibowo, M.M., M.Sc., PhD
NIP. 196702081994031005

Chair of Organizing Committee

Dr. Haryono Setyo Huboyo, S.T., M.T
NIP. 197402141999031002

PAPER • OPEN ACCESS

The inverted U-shape relationship between education and environmental degradation: case of seven ASEAN Countries

To cite this article: A Setyadharma *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **623** 012004

View the article online for updates and enhancements.

The inverted U-shape relationship between education and environmental degradation: case of seven ASEAN Countries

A Setyadharma[1*], P E Prasetyo[1], S Oktavilia[1]

[1] Faculty of Economics, Universitas Negeri Semarang, Semarang City, Central Java Province, Indonesia

andryan@mail.unnes.ac.id

Abstract. The empirical evidence on the impact of education on environmental degradation is not clear, with some studies find that education reduces environmental degradation, while others find the opposite direction. Unlike previous studies, this paper suggests that environmental degradation can be expressed as a quadratic function of educational level to investigate the existence of an inverted U-shape. The inverted U-shape means that at the beginning, increasing educational level deteriorates the environmental quality, and at a certain level, the rise of the educational level improves environmental quality. Therefore, the purpose of this study is to investigate the possibility of the existence of an inverted U-shape relationship between education and environmental degradation. This study employs panel data regression from seven ASEAN countries from 2011 to 2017. this study sets an equation model with two main variables, i.e., education level and square term of education level. The main results show that the education variable is statistically significant reducing the environmental quality. In contrast, the fair term of education level variable is statistically significant in improving environmental quality. In conclusion, this study confirms the existence of an inverted U-shape relationship between education and environmental degradation. The policy implications are also discussed based on the findings.

1. Introduction

Undeniably, the negative effect of environmental damage on humankind has put a public concern. The impact of airborne pollution on human health is tremendously severe. IEA (2019) estimates that approximately 450,000 people in 2018 died due to early deaths linked with air pollution in Southeast Asia [1]. However, Southeast Asia countries are still highly dependent on fossil fuel, where total energy demand has soared by greater than 80% since 2000, and the demand has been fulfilled by a doubling up in the use of fossil fuel and the projected fossil fuel consumption in Southeast Asia countries is still worrying, where there will be continuous growth in coal demand with estimated of a two-thirds increase in carbon dioxide (CO_2) emissions in 2040 [1]. IEA (2017) suggests that the significant expansion in fossil-fuel use drives to a 75% surge in energy-related CO_2 emissions [2]. In consequence, fossil-fuel energy consumption has created the main risk to public health. Despite the threats of higher CO_2 emissions, Southeast Asia countries have made significant efforts. In recent years, they have upgraded policy frameworks, such as fossil-fuel consumption subsidies and promoting green investment in the region [2].

Homo sapiens, or humans, are the main actors in the deterioration of the environment. Their *homo economic* actions have been blamed for the devastating condition of the earth. Since the individuals'

behavior is the core of the problem, education has extensively been acknowledged as a crucial aspect in tackling environmental matters [3]. However, education does not become the main policy to reduce environmental degradation issues in ASEAN. Adult literacy rate and primary school enrollment have increased significantly in ASEAN Countries, but there is still a problem with secondary school enrollment. The data shows that secondary education's net enrollment rate is under 80% in some ASEAN Countries [4]. A vast number of substantial studies on the broader literature have shown some indication that preservation of the environment can be achieved through better education [5-8].

However, the empirical evidence on the impact of education on the deterioration of the environment is not clear, with some studies find that education reduces environmental damage, while others find the opposite association [9,10]. Furthermore, a study by Kinda (2010) concludes that there is no influence of educational attainment on a higher level of air pollution [11]. In conclusion, there are discrepancies in education influences on the destruction of the environment based on previous studies. Unlike most previous studies, this paper is based on the basic idea that environmental damage can be written as a quadratic function of educational attainment [12]. The application of a quadratic function is aimed to confirm the presence of a turning point of education, where it is assumed that at the beginning, increasing level of education deteriorates the environmental quality, and at a certain level, the rise of the education level improves environmental quality. In other words, this paper aims to investigate the possibility of the existence of an inverted U-shape relationship between education and environmental degradation in seven ASEAN countries.

Previous studies mostly assume a single direction of the impact of higher educational levels on the environment. However, we follow Balaguer and Cantavella (2018) model that expresses a possibility of higher educational attainment has two contrasting effects on environmental degradation throughout the time in seven ASEAN countries, where the deterioration of the environment is a function of a quadratic form of educational attainment [12]. The expression of a quadratic function of the educational level's impact on the deterioration of the environment will form an inverted U-shape curve, as shown in figure 1. The inverted U-shape means that at the beginning, increasing education level deteriorates the environmental quality, and at a certain level, the rise of the education level improves environmental quality.
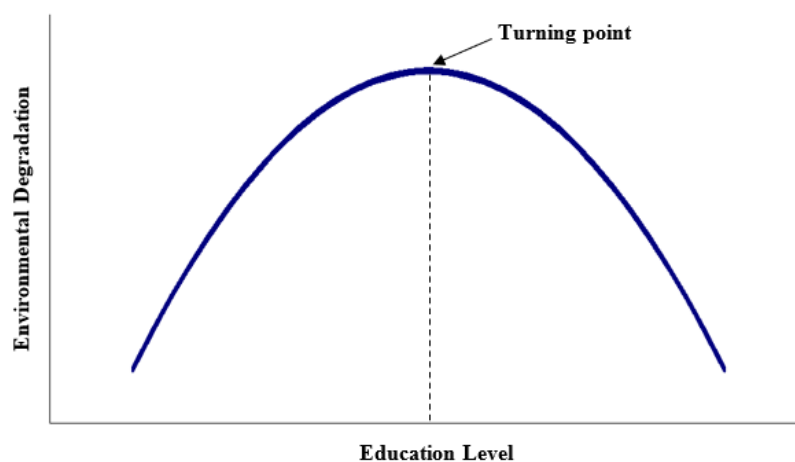
Figure 1. The conceptual inverted U-shape relationship between education and quality of the environment.

Balaguer and Cantavella (2018) divide the impacts into two different signs, as shown in figure 1 [12]. The first impact is the negative impact of education. When in a condition of low enrollment rates, an increase in schooling usually improves an individual's welfare through income channels. Higher-income boosts the higher demand for an on-sustainable energy resource and adds pollution. The negative impact continues until a certain point when it turns into a positive impact. The second positive impact occurs

when education gives knowledge and skills to create better technologies, but it also built awareness to improve environmental quality. At this point, education changes people to have environmentally harmless lifestyles and behavior. The educated individuals have a better awareness of the needs of protection of the environment, and they will enhance their demand for a higher level of environmental protection. Education is related to improvement in environmental awareness, concern, and action. Education can help environmental sustainability through two ways [3]: First, education will add new information on specific knowledge to create behavioral transformation to understand a common set of values about the best and most desirable activities to protect the environment. For example, education will lead to a better understanding of the importance of reducing electricity usage in houses and that people should use environmental-friendly energy in households. The second-way deals with education can give additional knowledge and skills to solve complex environmental issues, such as knowledge and skills, to produce eco-friendly products (reusable, green, and recyclable) and eco-friendly buildings.

The ASEAN region is blessed with abundant natural resources. However, the region is under pressure by immense environmental damage because of the uncontrolled population, fast economic growth, high poverty, unemployment, and income inequality among the ASEAN countries. There has been a concern that the overuse of natural resources and the growing population in big cities in ASEAN, such as Manila, Jakarta, and Bangkok, will make environmental sustainability a problematic task. This study aims to examine the likelihood of an inverted U-shape connection between education attainment levels and the environment's degradation. This paper will show that improving the education level in ASEAN is the best solution to its sustainability. This paper's remainder is arranged as follows: Section 2 describes the research technique while discussing the findings is presented in Section 3, and the last section is the conclusion.

2. Methodology

This study uses panel data regression with a fixed effect technique from seven ASEAN countries from 2011 to 2017. This study sets an equation model with five variables, i.e., educational attainment level, the square term of educational attainment level, country's competitiveness, population, and foreign direct investment, that may impact the environmental quality in seven ASEAN countries. As we test the possibility of an inverted U-shape form of the educational attainment variable, we will adopt [10]'s model. Then we construct a model with a quadratic function of educational attainment (symbolizes with ED^2) as follows:

$$Ln(EMI)_{it} = \beta_0 + \beta_1 Ln(ED)_{it} + \beta_2 Ln(ED)_{it}^2 + \beta_3 Ln(GCI)_{it} + \beta_4 Ln(POP)_{it} + \beta_5 Ln(FDI)_{it} + u_{it} \quad (1)$$

Where, *Ln* symbolizes the natural logarithm, *u* is the representation of the residuals that are assumed to be normally distributed, β_0 is a constant, β_1, β_2, β_3, β_4, and β_5 indicate the coefficients of the model. Environmental quality (EMI) is measured by total CO_2 emissions (Mt of CO_2). Educational attainment level (ED) and square term of educational attainment level (ED^2) are calculated by mean years of schooling, country's competitiveness (GCI) is measured by Global Competitive Index (with a scale of 0 up to 100, where 100 is considered as the most competitive country), some population measures population (POP), while foreign direct investment (FDI) is measured by the value of the foreign direct investment in Million USD. Data are collected from World Bank, World Economic Forum, and the International Energy Agency.

3. Results and discussion

The panel data regression model in this study follows the fixed effect model. The model is also run with White Cross-section Weight procedure to anticipate the possibility of heteroscedasticity issues in the regression. Table 1 indicates the result of the panel data. The results show that the coefficient related to the education variable is positive, which means that in the beginning, an increase in educational level is significantly reducing the environmental quality. In contrast, the coefficient related to the square term of the educational level variable is negative, which means after a certain point, an increase in educational

level is significantly improving the environmental quality. Therefore, this study confirms the existence of an inverted U-shape relationship between the educational level and the environment's deterioration. In other words, this study confirms that the deterioration of the environment is a function of a quadratic form of educational attainment. This study strengthens the previous research by Balaguer and Cantavella (2018). While literature indicates that there is only a single way of influencing higher educational attainment levels on the environment, this study finds that educational attainment has two impacts on environmental damage, as suggested by Balaguer and Cantavella (2018).

Table 1. Result of the panel data model.

Explanatory Variables	Coefficients	t-statistics	p-values
Ln (ED)	18.379	3.517	0.001
Ln (ED^2)	-4.564	-3.378	0.002
Ln (GCI)	-1.294	-2.130	0.040
Ln (POP)	4.903	6.217	0.000
Ln (FDI)	0.040	2.842	0.007
Constant	-98.389	-6.614	0.000
Adjusted R^2	0.997		

Note: Explained Variable: Ln (EMI)

From the coefficients of ED and ED^2, we can see that the second effect has not exceeded the first one when educational attainment increases. It indicates that the current average years of schooling are not enough to compensate for the environmental damage made due to previous low education levels. It is becoming crystal clear that it is still needed to increase the educational level from the current level to strengthen education's positive impact on the better quality of the environment.

The corresponding coefficient associated with the country's competitiveness variable is negative as expected, and it is significant at the 95% confidence level. The country's competitiveness variable's negative coefficient implies that a country's higher competitiveness level is associated with lower emission. The GCI measures countries' capacity to provide welfare to their peoples by how effectively a country utilizes available resources. Therefore, countries with higher competitiveness are protecting the environment and wisely using their natural resources. In addition, the coefficient related to the population is positively significant at the 99% confidence level. As expected, a higher number of populations may result in higher emissions due to the higher demand for non-eco-friendly products. Last, the coefficient associated with FDI is positively significant at the 99% confidence level. It implies that higher FDI will increase the emission level. It occurs because most of ASEAN Countries attract FDI by providing natural resources to be exploited by international companies.

4. Conclusion

The awareness of the deterioration of the environment has been the main topic among researchers and policymakers, especially in less developed countries. An immense number of previous studies in the literature have shown that preserving the environment can be achieved through better education. The fundamental idea that environmental degradation can be expressed as a quadratic function of the level of education. This study finds evidence that an inverted U-shape connection between education attainment level and the degradation of the environment exists in the case of seven ASEAN countries. This study shows that the country's competitiveness, population, and foreign direct investment also impact seven ASEAN countries' environmental quality.

The correct policies to reduce environmental problems will not generate any significant result without considering education's role. Education is believed to improve environmental awareness, concern, and action. As mentioned previously, education can help environmental sustainability by adding new information on specific knowledge of the importance of protecting the environment and the

additional knowledge and skills to solve complex environmental issues. Therefore, the seven ASEAN countries' governments are strongly suggested to invest more effort into education. It seems to be the most realistic suggestion and cheaper costs from the economic standing point. In addition, improvement in educational attainment helps preserve the environment and transforms many individuals into a better life through a reduction in poverty, unemployment, income inequality, and improving health.

References

[1]   International Energy Agency 2019 *Southeast Asia Energy Outlook 2019* (Paris: IEA)
[2]   International Energy Agency 2017 *Southeast Asia Energy Outlook 2017* (Paris: IEA)
[3]   United Nations Educational, Scientific and Cultural Organization 2016 *the Global Education Monitoring (GEM) Report 2016 (*Paris: UNESCO)
[4]   The ASEAN Secretariat 2019 *ASEAN Key Figures 2019* (Jakarta: ASEAN Secretariat)
[5]   Dong Y, Ishikawa M, Liu X, and Hamori S 2011 *J. of Cleaner Prod.* **19(12)** 1306 – 14
[6]   Lange A and Ziegler A 2017 *Env. & Res. Econ.* **66** 113 – 33
[7]   Gangadharan L and Valenzuela, M R 2001 *Ecol. Econ.* **36(3)** 513 – 31
[8]   Aminrad Z, Zakaria S Z B S, and Hadi A S 2011 *The Soc. Sci.* **6** 15 - 9
[9]   Jorgenson A K 2003 *Soc Prob* **50(3)** 374 – 94
[10]   Ketenci N 2018 *Russian J. of Econ.* **4(3)** 249 – 65
[11]   Kinda S R 2010 *Elec. Bull.* **30(4)** 2612 – 26
[12]   Balaguer J and Cantavella M 2018 *Energy Econ.* **70** 289 – 96