# *Educational Factors Predicting International Competitive Index for Industrialization in Southeast Asia*

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***Abstract:*** *The middle-income trap (MIT) refers to the state that middle-income economies have found it challenging to upgrade to reach the high-income stage over an extended period. Overcoming the middle-income trap (MIT) has long been discussed as the most significant social issue, primarily in Southeast Asia. One major problem in addressing the MIT is directly linked to fewer job opportunities and unstable income. Promoting industrialization has been the most efficient way to solve the problem. Little previous research has been conducted on the influence of the enrollment rate in secondary education on the international competitive index (ICI) in connection with the barrier issue of industrialization. Thus, this study aims to contribute to overcoming the MIT by clarifying the influence of the enrollment rate in secondary education on the ICI, notably in Southeast Asia. Tran's industrial development model was used to examine the predictive relationships between the education levels and the industrial development stages. Using secondary data compiled between 1999 and 2018 primarily from the World Development Indicators and the UN Comtrade Database, and multiple linear regression modeling, the strength of secondary education predicting the percentage change in R2 variance in the ICI was evaluated in nine Asian economies. As a result, using the natural data, secondary education alone was not found to be a superior predictor (F [1, 175] = .648, p = .422) for the ICI. Tertiary education was found to be a significant predictor in both models (F [1, 174] = 16.452, p = .000) and is thus a major factor in upgrading the ICI. Positive social change emanates through continued policy support of advancing education as a means to promote advancements of the ICI.*

***Keywords:*** *industrialization; international competitive index; middle-income trap; secondary education; southeast asia*

## Introduction

While the world economy has greatly advanced since World War II, a number of economies have struggled for growth, prosperity, and development. Indeed, certain parts of the world have seen higher achievement in growth and prosperity over many decades. Notably, East Asian economies, including Japan, South Korea, Taiwan, and China, have achieved significant development since World War II (Perkins, 2013). Nevertheless, further development, growth, and social welfare need to be promoted elsewhere in Southeast Asia. Gill and Kharas (2007) has paid close attention to the strategy of how to overcome the *middle-income trap* (MIT) in many parts of the world. These authors have classified all countries in the world into high-, middle-, and low-income groups according to various indicators and proposed the concept of the MIT in 2006. Southeast Asian economies, in particular, including Vietnam, Indonesia, and the Philippines, have been ranked as lower-middle income economies, while China, Thailand, and Malaysia as higher-middle income economies for 10 years or more. Indeed, data for the 1960s reveals 101 middle-income economies in the world, of which only 13 economies and regions achieved the high-income levels in 2008 (World Bank & PRC, 2012). Most countries have thus found it difficult to upgrade national income levels, thus having fallen into the MIT over the past 40 years (Tran, 2016). Also, given the wide range of situations among the middle-income economies, the World Bank (2007) classified them into higher-middle income economies (HMIEs) and lower-middle income economies (LMIEs). From this discussion, the urgent question of how to overcome the MIT emerges as a key social problem to be addressed. Remarkably, one of the key issues in addressing the MIT is linked to the opportunity for securing employment and increase the individual income through industrialization. In linking the problem, what I am going to contribute through this study is to observe the possibility of promoting industrialization by enhancing the ICI through education, and ultimately informing public-policy changes in upgrading the index, notably in Southeast Asia.

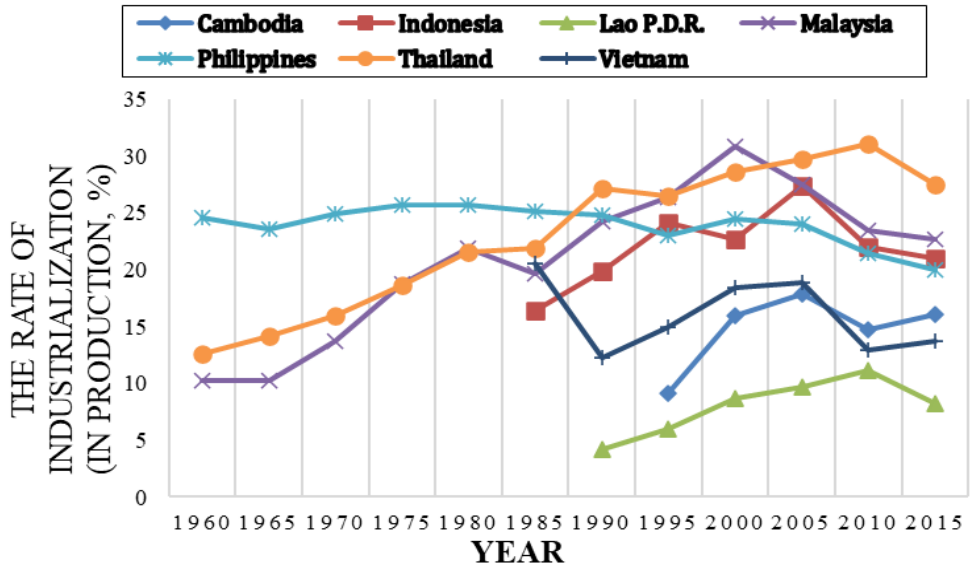
## Summary of the Literature Review

Previous studies by other researchers have shown the MIT to be potentially one of the most significant social problems in the world. Existing research has shown that promoting industrialization would be the best way to escape the MIT (Huang et al., 2018) in securing the opportunity for employment and enhancing the productivity for income increase. In reviewing growth and prosperity among Asian economies since the 1950s, industrialization has clearly contributed to economic development, increasing the productivity of capital while also enhancing human capital development through training and education, especially from the 1960s to the 1980s (Perkins, 2013). During the industrialization process, labor-intensive industries have been replaced by capital-intensive industries, thereby leading to rapid accumulation of labor and capital and increases in income levels (Watanabe, 2012). From this perspective, industrialization can be considered a significant catalyst for promoting economic development and overcoming the MIT in Southeast Asia.

Figure 1 represents the rate of industrial production (within total economic production) from 1960 to 2015 in the ASEAN economies. From the 1970s to the 1980s, these countries were successful in shifting from import substitution toward export-oriented industrialization, leading to the contribution of the industrial sector to the total economy.

From the 1970s to the 1980s, these countries were successful in shifting from import substitution toward export-oriented industrialization, leading to the contribution of the industrial sector to the total economy. Regarding the development pattern in Thailand, Ohshima (1987) paid attention "agriculturalization" (Ohshima, 1987, p.58) and observed labor surpluses and shortages following the impacts of the Monsoon season (Ohshima, 1987). Mitigating these seasonal labor surpluses, increasing wages, and mechanizing the labor process became the significant contributors to increasing labor productivity in agriculture. As a result, workers were able to migrate to industrial sectors and engage in manufacturing industries, raising the export rate in Thailand since the 1980s.

***Figure 1. The Rate of Industrialization (in Production) in Southeast Asia (1960-2015)***




*Note*. From "WV1. World Development Indicators: Size of the Economy," by World Bank, 2020 (http://wdi.worldbank.org/tables). In the public domain.

A similar shift from agriculture to manufacturing was also observed in Malaysia. In turn, in the Philippines, despite a proportion of industrial activity reaching approximately 20% of production and 60% of exports, the economy has remained within the LMIE group. Otsuka and Banerjee (1998) stressed the significance of industrialization in rural areas by suggesting that creating new job opportunities both in urban and rural areas in East Asia. In turn, when observing the proportions in the LMIEs, including Vietnam and the Lao P.D.R., the industrial contribution remains at approximately 7.5% to 12.5% of the national economy in 2015, although it increased from the 1990s to the 2000s. Other economies, such as the Philippines and Indonesia, remain over 20% since the 1990s, although the Philippines had a recent decrease in the industrial proportion of the economy, with figures of ranging between 20% to 25% for the past 55 years.

Theoretically, the flying geese pattern of industrialization offers a theoretical framework to explain the catch-up process for the least-developed nations, describing the trajectory in East Asian economies from importing products from overseas, to import

substitution, then exporting products (Watanabe, 2012). For this framework to be feasible, Ohno (2009) has stressed that international competitiveness must be enforced cyclically in these industries, leading to catch-up industrialization. For international competitiveness to be enhanced, improving the skills of the labor force should be a key priority. Promoting secondary education can therefore assist developing countries to increase the number of skilled workers in manufacturing industries, leading to further industrialization, and contributing to economic growth in the developing world by enhancing national international competitiveness through labor skills, especially given the economic development history in East Asia (Lewin & Caillods, 2001; Meyer & Hannan, 1979).

In relation to the industrialization rate in East Asia, Tran (2016) classified manufacturing products into three levels according to value added in production (Low, Middle, and High skill-intensity industries). The author observed the change in the ICI in each industry as the flying geese pattern of industrialization represents the process to enhance the international competitiveness by using the amount of import (M) and export (X) in the UN Comtrade database, and then calculating the international competitiveness using the index (Tran, 2016). The international division of labor can be seen through changes in factor endowment conditions corresponding to the structural transformation of the national economy and its resulting comparative advantages. The MIT can persist as long as the shift from the labor-intensive industry to the capital-intensive industry/technology-intensive industry is not successfully made. In this catch-up process, the three skill levels of workers, namely “low skill,” “medium skill,” and “high skill,” correspond to the successive stages of economic development, so that the predominantly “low-skill intensive industry” economy gives rise to the “medium-skill intensive industry” and finally the “high-skill intensive industry” among high-income nations (Tran, 2016). In other words, to enhance their international competitiveness, middle-income economies need to develop the skill levels among their manufacturing industry labor force in particular.

Although Tran (2016) pointed to the potential to enhance the international competitiveness of the manufacturing industries through cultivating the skills of workers, notably in the context of overcoming the MIT in East and Southeast Asia, far less research has looked at the impact of secondary education rates on the ICI. From the perspective of improving secondary enrollment rates in Southeast Asia, the influence of net enrollment rate in secondary education on the ICI is a crucial issue. Reviewing the literature from the perspective of methodologies and variables employed, the role of education in promoting industrial development and labor skills was often examined qualitatively, and the effect of secondary education on the ICI was never uncovered. From this point of view, the relationship between the ICI and the rate of enrollment in secondary education, in the context of Southeast Asian industrialization, needs to be examined, notably in helping me contribute to filling up the study gap.

**Research Objective**

The purpose of this study is to promote further industrialization through an examination of the enrollment rate in secondary education, clarifying the influence of enrollment in secondary education on the ICI, notably in Southeast Asia by using the multiple linear regression analysis of whether the $R^2$ increase in the dependent variable

(DV) of the ICI was significant. Research on the impact of secondary education on the ICI is substantially lacking in the context of industrialization in Southeast Asia. Therefore, the relationship between the ICI and the enrollment rate in secondary education was quantitatively examined for the purpose of invoking the ICI construct by employing several conceptual frameworks relevant to the industrialization.

This study can contribute to the research purpose by quantitatively evaluating the impact of enrollment rates in secondary education as a predictor for the ICI in the Southeast Asian society, an unstudied factor. More importantly, for practice, my findings can be valuable as potential applicability to the transformation of policy relevant to the ICI for further development in Southeast Asia and generalizable to other underdeveloped regions. In these ways, this study can be contributive to achieve the purpose.

**Theoretical Framework**

The theoretical framework refers to a specific theory regarding the perspective of human effort that is useful to the study of events based on previous theories in the existing study that has been examined and justified by other researchers. (Dickson et al., 2018). With this definition, in this study, two theoretical frameworks are employed in helping me signify the research purpose of this study, show connection among key variables and relation to the research approach and purposes, and contribute to the formulation of my theoretical framework as follows:

Two frameworks, the stages of industrialization in East and Southeast Asia formulated by Ohno (2009) and the Comparative Advantages Structure developed by Tran (2013, 2016), are particularly useful when examining the quantitative relationship between secondary enrollment rates and the ICI in the manufacturing industry in Southeast Asia.

First, as prepositions, Ohno (2009) developed the stages of industrialization in East Asia, observing the steps necessary for developing manufacturing industries in Vietnam, the Philippines, Thailand, and Malaysia (Ohno, 2009). More importantly, the author situated the MIT within this framework, emphasizing the importance of investing in opportunities for employees to enhance their skills and knowledge through training and education (Ohno, 2009). Tran (2013; 2016) then developed the Comparative Advantages Structure, presenting international competitiveness in relation to three sectors of industries: the primary (agricultural), secondary (manufacturing), and tertiary (service) sectors. His analysis showed the evolution of the International Competitiveness Index (ICI), which described the process of industrial development. LMIEs in East Asia held a competitive advantage in the first industry, with low skill requirements. Until the second industry, with medium skill requirements, becomes the area of comparative advantage, LMIEs cannot escape their lower level of development (Tran, 2016). At a later stage, when growth slows in the second industry and competitiveness also slows down, the third industry remains in the process of import substitution. This tendency can cause HMIEs to be trapped by the HMIT (Tran, 2016). Such a framework would imply that enhancing the skills of workers by creating training and especially secondary education opportunities, carries the potential to strengthen international competitiveness in manufacturing and is a key to success for Southeast Asian economies to escape from the LMIT and the HMIT.

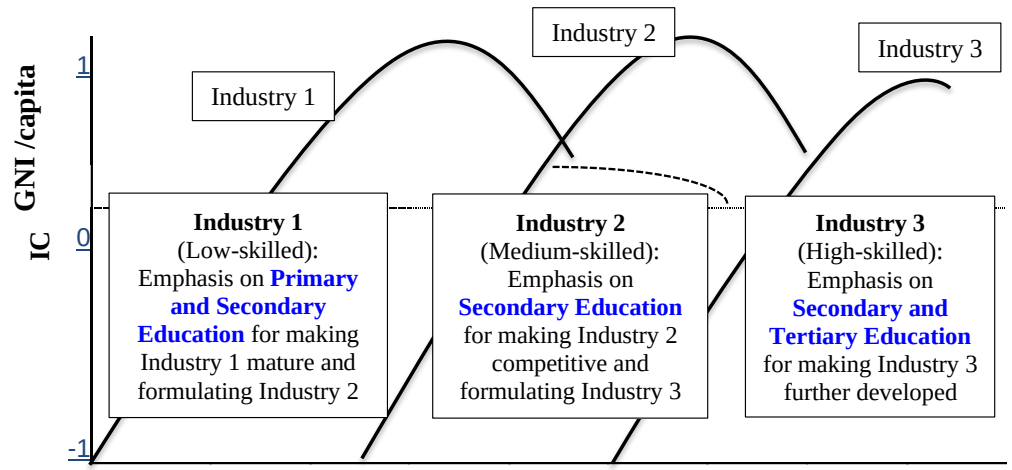
All in all, those two frameworks developed to interpret industrialization patterns in East Asia can address the second research question of this study. Together they suggest that developing the skills of workers through further opportunities for training,

particularly in secondary education, would enhance the ICI and offer a key to success in promoting industrialization and escaping from the MIT in Southeast Asia.

Based on these frameworks of Ohno (2009) and Tran (2016), I can hypothetically crystalize another framework. Figure 2 in the previous page demonstrates the conceptual relationship between the industrial development stages through the ICI and education levels, which is mainly applied from the model by Tran (2016). Specifically, as the author hypothesized, the three stages of industries with low- (industry 1), medium- (industry 2), and high-skilled (industry 3) levels should be progressed through the establishment of comparative advantage industries. Firstly, for low-income economies, industry 1 on the left side needs to be further mature through the expansion of labor supplies with, at least, primary education as well as secondary education. Secondly, for LMIEs to be able to develop the ICI in industry 2, highlighted in orange, it is indispensable to upgrade the enrollment rate in secondary education. Otherwise, the LMIT can occur. Also, for HMIEs to enhance the ICI in industry 3 for further competitiveness, it is significantly essential to stabilize the labor supplies with secondary education as well as tertiary education. Otherwise, the HMIT can happen. In short, this theoretical framework can demonstrate that the higher educated the labors are, the more advanced and competitive level of industrialization with the higher ICI can be expected in the LMIEs and HMIEs.

***Figure 2.***

***A Theoretical Framework of Industrial Development Stages per ICI and Education Level***




*Note.* Reprinted from "Emerging Economies and the Middle-Income Trap in Asian Perspective," *The Japan Society of International Economics, 67*, by Tran Van Tho, 2016, p. 86. Copyright 2015 by the Japan Society of International Economics.

What is emphasized in this theoretical framework is to suggest that the enhancement in the enrollment rate in secondary education is fundamentally the essential contribution to the industrial development in developing countries to be further developed. As Ohno (2009) implied, secondary education can play a significant role in developing the

fundamental skills of employees for industrialization in east Asia. With the implication, this framework implies that under any industrial stages, the enrollment rate in secondary education is a significant catalyst for improving the ICI for industrialization. From this point of view, this framework can show the connection between the key variables of the ICI and the enrollment rate in secondary education. With the main variables, the quantitative approach and the second research purpose are connected to this theoretical framework, notably in observing the impact of the enrollment rate in secondary education on the ICI. Thus, the theoretical framework can be generalized with the two existing models. In short, this theorization can play a role in visualizing the relationship between education level and industrial development process per the ICI and ultimately implying that promoting the enrollment rate in secondary education is the fundamental component in developing the industrial processes through the ICI in Southeast Asia. In this way, I can rationalize the choice of these two theories.

**Research Question (RQ) and Hypothesis**

Based on the study gap and purpose, here are the research question (RQ) and the hypothesis as follows:

*RQ:* Will the enrollment rate in secondary education predict a statistically significant percent change in the $R^2$ variance in the Southeast Asian ICI composite scores more than primary and tertiary education when controlling for labor force participation and the manufacturing employment rate?

$H_0$- There is no statistically significant contribution of the net enrollment rate in secondary education to the percent change of the $R^2$ variance in Southeast Asian ICI composite scores more than primary and tertiary education when controlling for labor force participation and the manufacturing employment rate.

$H_1$- There is a statistically significant contribution of the net enrollment rate in secondary education to the percent change of the $R^2$ variance in Southeast Asian ICI composite scores more than primary and tertiary education when controlling for labor force participation and the manufacturing employment rate.

**Key Variables of the Study**

1. Independent Variables (IVs):

Net enrollment rates in primary and secondary education, and gross enrollment rate of tertiary education were employed as continuous variable.

*** Net Enrollment Rate: The rate of students under the designated age enrolled at primary and secondary education per (%) from World Development Indicators (2020)

*** Gross Enrollment Rate: The rate of students regardless of the designated age enrolled at tertiary education per (%) from World Development Indicators (2020)

2. Dependent Variable (DV):

ICI (UN Comtrade Database, 2020) was used as the continuous variables.

3. Controlled Variables (CVs):

a) *Labor Force Participation Rate*: The labor participation rate of men and women with persons aged 15 and older from the World Development Indicators (2020) was employed as the continuous variables.

b) *Employment rate of manufacturing industry:* The employment rate of manufacturing

of men and women (% out of GDP) from the World Development Indicators (2020) was employed as the continuous variables.

**Methodology**

I employed the multiple-linear regression analysis this time. One reason for this is that I primarily observed the effect of the enrollment rate of secondary education on the ICI for industrialization in Southeast Asian economies, especially by gaining insight into the figures of $R^2$ variance as coefficients of determination. The multiple-linear regression analysis allows me to use the DVs' general values and the interval ratios of the IVs to be measured. In this regard, using the multiple-linear regression model allowed me to answer the research questions using the values of $R^2$ increase. The original formula for the multiple linear regression is shown as follows:

$$Y = \beta 0 + \beta 1X1 + \ldots + \beta nXn + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

For a brief explanation of each code, "Y" means the predicted value of the dependent variable, "β0" stands for the y-intercept (value of y when all other parameters are arranged to 0), "$\beta 1X1$" represents the regression coefficient ($\beta 1$) of the first independent variable ($X1$). It is worth describing how increasing the figure of the independent variable has on the predicted y value (Bevans, 2020). Then, "$\beta nXn$" demonstrates the regression coefficient of the last independent variable. Finally, "ε" represents model error. For example, how much variation there is in our estimate of "Y" needs to be considered. In applying the official formula (1) above to this study, I made the formula for the RQ as (2) below:

$$Y_{ici} = \beta 0 + \beta 1X1_{oth.facs} + \beta 2X2_{edu.pri} + \beta 3X3_{edu.sec} + \beta 4X4_{edu.ter} + \varepsilon \quad \ldots\ldots\ldots \quad (2)$$

For simplicity, I made each code per RQ specific, e.g.) the code "$_{ici}$" represents the ICI for as a DV. Also, the code "$_{oth.facs}$" means the alternative factors, including Governance, Industrialization, Labor Market, Employment, and Infrastructure fixed as the CVs. Finally, the codes "$_{edu.pri}$," "$_{edu.sec}$," and "$_{edu.ter}$" stand for the enrollment rates in primary, secondary, and tertiary education as the IVs.

From these points of view, it is necessary to appropriately adjust the methodology to appropriately approach the research questions. The basis of the multiple linear regression model using interval-ratio level data allows relevant interpretation of these data. Thus, I switched to the multiple-linear regression model this time.

**Data Collection Procedures**

The data was primarily gained through the publicly open websites from the World Bank and the United Nations in 1999 to 2018 with nine economies in Southeast Asia (Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, Timor-Leste, and Vietnam). In this section, I will discuss the review of the results of the sampling procedure, the methods of the missing data, and the characteristics of the sample.

Specifically, the three IVs of the enrollment rate of primary, secondary, and tertiary education, the DV of the ICI, and the CVs of labor force participation rate and

employment rate in the manufacturing industry were probed. Specifically, for the DV of the ICI, I used the UN Comtrade Database (2021), as explained in Chapter 3. For a quick review, the ICI is calculated from the formula i = (X-M)/ (X+M; Tran, 2013, 2016) using data on the international trade in goods and services. The figure ranges from -1, 0, and to 1. The value of -1 represents the industry's introduction by importing with the figure of export 0. Secondly, 0 stands for the equivalency between export and import in completing import substitution. Finally, 1 means less import and export expansion (Tran, 2016). With this notion, I used the items of goods import (US$) and goods export (US$). As a result, 136 samples for these two items were obtained from the UN Comtrade Database (2021). Second, regarding the three IVs of the enrollment rate in primary, secondary, and tertiary education, I used the data method as for the research question relevant to the influence of the enrolment rate in secondary education on the MIT (Hara, 2022). Thus, I obtained $n$ = 113 for primary education, $n$ = 112 for secondary education, and $n$ = 132 for tertiary education from the WDI (2021). Finally, the CVs of *Labor Force Participation Rate and Employment Rate in the Manufacturing Industry* helped me obtain the samples from the WDI (2021). As for the former, I chose the item *Labor Force Participation Rate* for ages 15+, total (%) with the modeled ILO estimate and then collected the maximum number of samples ($N$ = 180). For the latter, I selected the item *Employment Rate in Manufacturing Industry* (% of GDP) and obtained the maximum amount of data ($N$ = 180) as well.

In analyzing the data, entirely, some missing data were identified, especially in the IVs of the enrollment rate of primary, secondary, and tertiary education. As for the required minimum sample size, in quickly reviewing the data-collection from G*Power as a tool for calculating the size, I indicated the figure of $p < .05$, the minimum condition of the alpha level is .05 with power analysis .80 under the appropriate condition of effective size $f^2$ of .15 to be at a significant level with the three IVs of enrollment rate of primary, secondary, and tertiary education vis-à-vis one dependent variable for observing the $R^2$ increase. With these conditions, the minimum required sample size should be 78 in using linear regression with a fixed-effect model. From this point of view, the number of all the CVs still seem to be sufficient in sample size.

Furthermore, admittedly, the number of resultant samples of the enrollment rate in primary and secondary education exceeds the minimum size of 78. However, several critical lacking data were identified; Firstly, there was no data from Vietnam entirely between 1999 to 2018. Also, several countries, notably Cambodia and the Philippines, do not have enough data in the WDI. While the highest volume of the data within the IVs is the tertiary education ($n$=132), the size of the enrollment rate in primary and secondary education should be equivalent to the number in tertiary education as the primary parameter in this study. I used the other existing data relevant to the enrollment rate in primary and secondary education from WDI (2021) to cover as much lacking data as possible. The specific methods of the secondary data are below:

Firstly, as for the enrollment rate in secondary education, I used the similar variable of "Adjusted net enrolment rate, lower secondary, both sexes (%)" from WDI (2021), and thus adding up eight more resultant samples of Cambodia and the Philippines in 2010 to 2017. Moreover, as for the enrollment rate in primary and secondary education in Vietnam, I looked for the secondary data from the official government website, called the General Statistics Office of Vietnam (GSOV, 2020). It is also officially allowed to use this statistic as publicly accessible data retrieved directly through the website. I

chose the item of "Pupil of Lower-Secondary Education" from the category of "Number of classes, direct teaching teachers and pupils of general education as of 30 September" (GSOV, 2020) for sampling. It is justifiable to use the Lower secondary education data since secondary education refers to completing the provision of primary education that started at the basic level (WDI, 2021). For this notion, the enrollment rate in secondary education should be equivalent to the one in lower-secondary education. Consequently, I employed 20 more resultant samples from 1999 to 2018 at this time. As a result, the total number of sampling data of the enrollment rate in primary education is 133, while secondary education is 140.

On the other hand, since I found the missing data relevant to the ICI in Timor-Leste and Lao P.D.R. for 20 years, I employed the alternative data from WDI (2020) as the secondary data due to the primary parameter in this RQ. Specifically, the additional data of "Goods imports" (BoP, current US$) and "Goods exports" (BoP, current US$) was obtained through the WDI (2021). Consequently, 39 more resultant samples were gained, thus being in total $n = 175$ as of this variable's sampling.

Finally, one more way of handling the missing data is to employ the multiple imputation method. I used SPSS ver. 25 for statistical analysis this time, and it is beneficial that it has the function of imputation that is the process of automatically replacing the missing data with estimated figures (StatsGuild, 2020). On behalf of this approach, it was not necessary to omit the lost data. Though the replaced missing value is returned based on statistical algorithms from the present values (Enders, 2010), the multiple-imputation method would not sound incomplete.

Overall, in considering several approaches to handling the insufficient data, it would be defensible for me to take the missing data by employing the imputation with the SPSS ver. 25 this time, which can maximize the sample size ($n$=180) and keep the analysis unbiased.

**Study Results**

As the procedure for analysis to answering the RQ, a multiple linear regression model was employed. The multiple-linear regression model allowed me to estimate the relationship between two or more independent variables and one dependent variable. With the several matched conditions of the assumption testing, including homoscedasticity, normality, independence of errors, and linearity, the multiple linear regression analysis was executed using SPSS ver. 25. The dependent variable is ICI (DV2_ICI), while IVs are the enrollment rates in primary education (IV1_Ed_Pri), secondary education (IV2_Ed_Sec), and tertiary education (IV3_Ed_Ter). Also, I also used two CVs of the "Labor force participation rate" (CV5_Indust_2) and the "Employment rate in the manufacturing industry" (CV6_Indust_3).

In handling the dataset with the SPSS ver. 25 technically, these CVs were placed together in model 1, and then the other three IVs for which I am not holding "control" will then be entered one at a time as I progress through the models. All CVs will then be entered into the "Independents" box first. Once I have those CVs entered, since the "Next" button became available, I put the enrollment rate in primary education (IV1_Ed_Pri) in the box. After that, I clicked that "Next" button for placing the enrollment rate in secondary education (IV1_Ed_Sec) secondly. Finally, I entered the enrollment rate in tertiary education (IV1_Ed_Ter). That is how I put the DV, IVs, and CVs in running the regression model. Besides, before running the regression model, it

was necessary to choose the "exclude case pairwise" in this option field for appropriately handling the missing data available in my dataset.

Table 1 shows the results of the most appropriate models executed. The summary of the output was generated from the SPSS with the pairwise deletion. In paying close attention to the items of "R Square ($R^2$)," "Adjusted R Square (Adjusted $R^2$)," and "R Square Change ($R^2$ Change)," accordingly. Model 1 had the figure .521 in *R*, while $R^2$ .272 with adjusted $R^2$ .264, respectively. With these outcomes, the $R^2$ change had the value of .272 with Significance in F change .000 eventually. Model 2 is the case of putting the enrollment rate in primary education (IV1_Ed_Pri) with the figure of the $R^2$ was .273 with adjustment $R^2$ .274. Then, the $R^2$ change had the value of .015, which is deducted from the $R^2$ in Model 1. Then, Model 3 is the case of entering the variable of the enrollment rate in Secondary Education (IV2_Ed_Sec) as well as the one in primary education (IV1_Ed_Pri) with the figure of the $R^2$ was .289 with adjustment .273, while $R^2$ change had the value of .003, which is a deduction from the $R^2$ in Model 2. Finally, Model 4 is the case of putting all the enrollment rates, including in Tertiary Education (IV1_Ed_Ter) with the figure of the $R^2$ was .350 with adjustment .332, while $R^2$ change had the value of .061 deducted from the $R^2$ in Model 3.

**Table 1.** ***The Result of Multiple-Linear Regression Model***

**Model Summary [e]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Model Summary | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square change | F Change | df1 | df2 | Sig. F Change |
| 1 | .521[a] | 0.272 | 0.264 | 0.25075 | 0.272 | 33.034 | 2 | 177 | 0.000 |
| 2 | .535[b] | 0.286 | 0.274 | 0.24892 | 0.015 | 3.604 | 1 | 176 | 0.059 |
| 3 | .538[c] | 0.289 | 0.273 | 0.24917 | 0.003 | 0.648 | 1 | 175 | 0.422 |
| 4 | .592[d] | 0.350 | **0.332** | 0.23885 | 0.061 | 16.456 | 1 | 174 | **0.000** |

a. Predictors: (Constant), CV6_Indust_3, CV5_Indust_2
b. Predictors: (Constant), CV6_Indust_3, CV5_Indust_2, IV1_Ed_Pri
c. Predictors: (Constant), CV6_Indust_3, CV5_Indust_2, IV1_Ed_Pri, IV2_Ed_Sec
d. Predictors: (Constant), CV6_Indust_3, CV5_Indust_2, IV1_Ed_Pri, IV2_Ed_Sec, IV3_Ed_Ter
e. Dependent Variable: DV2_ICI
Durbin-Watson value = 0.510.
*Note*. Hara (2021) adapted from SPSS output

Further, in paying attention to the item of "Sig. F change," the figures are .059 in Model 2 and .422 in Model 3, were not found to be significant ($p > .05$). Moving to Model 4, the F Change figure of .000 illustrated significance. In a word, I can see the significance only in Model 4 with the missing data imputed. To further investigate these significant outputs, I evaluated the regression model ANOVA outputs for RQ2. All ANOVA Models 1 to 4 were significant ($p < .000$) illustrating a significant fit of data (see Field, 2018). With the Durbin-Watson figure computed less than 1.00, I remain cautious in assuming my IVs are acting independently in the overall models.

Examining Model 4 as the final model, the "Adjusted $R^2$" was 0.332; approximately 33.2% of all the IVs (primary, secondary, and tertiary education) account for the primary predictor variables of the ICI for industrialization in Southeast Asia. In a word, the international competitiveness in manufacturing industries is influenced by the accumulated effects of all three educational levels with a remaining 66.8% of the predictive influencers unmeasured or otherwise unidentified.

Based on these perspectives for testing the RQ2 hypothesis, however, the alternative hypothesis ($H_1$) states that there is statistically significant contribution of enrollment rate in secondary education to the percent change of $R^2$ variance in Southeast Asian International Competitive Index composite scores more than primary and tertiary education when controlling for labor force participation and manufacturing employment rate. With the significance of "Sig F change" and the lower figure of "Adjusted $R^2$" in Model 4, since I did not find greater significance of the enrollment rate in secondary education than that of primary and tertiary education at least in Table 11, it was difficult to be in favor of the $H_1$ at least from the statistical result. Consequently, I retained the null hypothesis ($H_0$).

**Interpretations of the Study Result and the Theoretical Framework**

I identified several significant components in this study. First, the multiple linear regression model allowed me to observe the effect of the secondary education enrollment rate on the ICI in Southeast Asian countries only from the value of the $R^2$ increase as the coefficient of determinations. Through the study, I retained the null hypotheses for both research questions. Nevertheless, as mentioned earlier, before wrapping up the study result, aside from the $R^2$ increase, several more perspectives from a broader interpretation for the respective research questions are added for discussion. The $R^2$ increase might not tell everything relevant to my study on education and development in undeveloped countries, especially in Southeast Asian economies. Indeed, many parts of the world's development issues are complicated, and many factors are considered. Thus, I summarize each research question and touch on how to analyze the broader interpretive components in the theoretical frameworks shown in Figure 2.

It can be evident that the ICI is one of the smallest values in all the components prepared for the analysis. Indeed, the figure ranges from -1 to 1 by using the difference in import and export with the total sum division (Tran, 2016). One substantial difference from the RQ1 is the number of CVs, far less than those in RQ1. I used two CVs of "Labor force participation rate for ages over 15" (CV5_Indust_2) and "Employment Rate in Manufacturing Industry" (CV6_Indust_3). It was evident that the other study factors of the enrollment rates in secondary education also had a more substantial influence on the GNI per capita rather than the ones in primary and tertiary education.

One of the most significant factors predicting ICI is how a nation can enhance manufacturing industry productivity with efficient human resource management and increase export overseas. Nevertheless, it was interesting to observe that Table 11 demonstrated the highest $R^2$ increase with Sig. F Change to be significant in Model 4. Still, since the Model 4 includes three levels of education contributing to the ICI, the enrollment rate in secondary education was not clearly identified as the strongest of the three predictor variables. Thus, I retained the null hypothesis.

On the other hand, the enrollment rate in secondary education had no increase in the figure of $R^2$. There was a slight increase in the $R^2$ rise in tertiary education with .003 this

time. Frankly, it might be challenging to interpret this study result. At the same time, it can potentially imply that primary education can pave the way for international competitiveness by increasing export overseas. Even in paying attention to the difference from 1999 to 2018 in each country of Southeast Asia, I found several patterns.

The first pattern is that there seems no correlation or impact between secondary education and ICI improvement. For instance, the three LMIEs of the Philippines, Indonesia, and Timor-Leste had a significant increase in the enrollment rate in secondary education over 20 years, while there was a decrease in the ICI figure in the period. The second patter demonstrates that the other three economies of Cambodia, Lao P.D.R, and Myanmar increase the ICI figure along with the enhancement in the enrollment rate in secondary education for 20 years. The third patter is, finally, that the rest of the three economies of Thailand, Malaysia, and Vietnam decreased the ICI figure, while the value of the enrollment rate in secondary education remained almost the same for 20 years within almost 3% up and down.

These three patterns I explained can potentially imply that it might not be possible to see the profound relationship between the enrollment rate in secondary education and the improvement in the ICI, at least in Southeast Asian economies. Indeed, the enhancement in the ICI through the expansion of the export can boil down to the industrial policies handled by the government, including taxation, the foreign direct investment (FDI), technological advancement, business easiness, including governance, business transparency, etc. aside from the educational factors (Ohno, 2009). Indeed, he stressed the significance of enforcing industrial export through vocational training and education, as well as school education, in developing countries. The opportunity for on-the-job-training (OJT) can upgrade the quality of job performance, resulting in the enhancement in productivity (Kuroda & Yokozeki, 2005).

In this respect, the educational factors, especially school education from elementary, junior and high-school, and to college level, can potentially be the minimum basic for upgrading the industrial export level, while some other factors should further be considered. Therefore, the impact on the ICI by identifying the $R^2$ increases was found to be significant, while I retained the null hypothesis of the research question as a significant factor predicting the ICI because of the lack of the evidence of the more impact of secondary education than those of primary and tertiary education from the statistical outputs. Thus, it would further be necessary for me to see how to upgrade the ICI in Southeast Asian economies from various perspectives.

Finally, in quickly reviewing the theoretical framework representing the relationship between industrial development stages per ICI and education level that I showed in Figure 2, my interpretations are as follows: I hypothetically crystalized the framework based on Ohno's (2009) theories and Tran (2016). It demonstrates the conceptual relationship between the industrial development stages through the ICI and education levels, which is mainly applied from Tran's model (2016). What is emphasized in this theoretical framework is to suggest that the enhancement in the enrollment rate in secondary education is fundamentally the essential contribution to the industrial development in developing countries to be further developed. As Ohno (2010) implied, secondary education can play a significant role in developing employees' fundamental skills for industrialization in east Asia.

In confirming the case of accepting the results of the analysis shown in Table 1, this

theoretical framework can also be available as long as the $R^2$ increase in Model 4 was higher than Model 2 and 3 with the Sig. F change to be significant this time. Nevertheless, the ICI can potentially be further enhanced through vocational training in the worksites and school education. On behalf of on-the-job-training (OJT) opportunities employees can improve job performance quality, resulting in productivity improvement in the extended period. In this regard, it would further be necessary for me to justify the formulation of the second framework by observing different potential factors that I did not employ as study variables this time in the future, despite the justification of the developing the hypothetical framework that I made.

**Limitations of the Study**

Three possible limitations can be raised as follows.

Firstly, a potential limitation is that this study focused on the impact of the enrollment rate in secondary education on the ICI on condition that increasing the quantity of education is prioritized. Thus, the quality of education, including the way to enhance teaching performance, teaching methods for improving students' grades, will not be centered on this research discussion. Nonetheless, I emphasized the importance of increasing educational opportunities through quantitative expansion in developing countries to the ICI's further upgrade in Southeast Asia. The quality of education was not evaluated and serves as an opportunity for future research.

Secondly, since this study focused on MIT in Southeast Asia, the other economies in the other regions, including Eastern Europe, South America, Middle East, and sub-Saharan Africa, might have different results in examining the same analysis. Namely, there might potentially be other culprits of the MIT in these regions, including demographic factors, entrepreneurship, and external institutional anchors studied by Gill and Kharas (2017), aside from the enrollment rate in secondary education. In this regard, the availability of this study's results might be limited in examining the MIT in the other areas with the different cultural, historical, and social norms and backgrounds as potential biases to be considered.

Finally, one more thing to be reported through the actual study here is that the imputed data I employed has several weaknesses in the study results for the research question. Notably, I can see it in the way that the imputed data did not change the facts that Model 2 and 3 in Table 1 relevant to the primary variable of secondary education, were all significant in the actual data. In this regard, further investigation in future studies on how to handle the missing data for analysis will be made.

**Implications**

This study aims to contribute to overcoming the MIT and to promoting further industrialization by clarifying the influence of the enrollment rate in secondary education on the ICI notably in Southeast Asia for economic progress and human capital development. I used the multiple-linear regression model for testing assumptions and hypotheses, resulting in the null hypothesis' retainment for the research questions due to $R^2$ increase and Sig. F Change found to be significant. Based on the results, several implications of this study to theory, practice, and further development in the developing world can finally be shared for wrap-up as follows:

Firstly, theoretical research regarding the relationship between industrialization and secondary education through studying the influence of the enrollment rate in secondary

education on the ICI was conducted. Despite the significance of facilitating industrialization, the theoretical foundation between ICI and secondary education was not identified in reviewing the research problem. Thus, I also crystalized another conceptual framework of the relationship between the industrial development process per ICI and education levels visually as seen in Figure 1. The framework explains that the enrollment rate in secondary education is essentially a significant catalyst for improving the ICI for industrialization under any industrial stage. Through the quantitative study, with the lower figure of $R^2$ increase for the enrollment rate in secondary education is lower than those for primary and tertiary education, this framework should be further considered. Unlike the first theoretical framework, the ICI can be enhanced through vocational training in the worksites, instead of general school education. As described earlier, on behalf of the opportunity for training through on-the-job-training (OJT), employees can improve the quality of job performance, resulting in an enhancement in productivity. Nevertheless, this study can potentially contribute to the new aspect of ICI's conceptual framework by introducing the concept of enhancing the opportunity for secondary education as a cornerstone of education and industrialization.

Secondly, the contribution to promoting industrialization through the enhancement of the enrollment rate in secondary education will potentially be made. In reviewing the research problem, despite the significance of facilitating industrialization, the specific problems of how to promote industrialization in the middle-income economies in Southeast Asia were not addressed in the economic studies. Enhancing the ICI through the enhancement of the enrollment rate in secondary education can potentially be a solid catalyst for the middle-income economies to be encouraged to draw further attention to the viewpoint of the ICI and secondary education for practice. In this way, the contribution of facilitating the industrialization by focusing on the ICI and secondary education will potentially be made.

Finally, addressing the significance of enhancing laborers' skills through secondary education for contributing to the improvement primarily in the ICI can help the middle-income economies appropriately arrange the human resource management for promoting the industrialization in the private sectors. From this perspective, this practical study will be transferable to the other lower-middle-income economies for managing human resources.

Overall, despite the common recognition of the importance of education as a driver for economic development in many parts of the world, it is often pointed out that education might not be considered as the mainstream in international development. Several reasons can be possible; As previously described, unlike the alternative development factors, including infrastructure, governance, employment, labor market, and industrialization, education is an invisible investment, despite the long-term process. Therefore, out-of-school children and people have still not yet been eradicated in many parts of the world. Thus, on a larger scale, this study can have a greater potential to help other researchers, students, and practitioners for practicing international development and cooperation re-realize the significance of further investment in education.

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