

Sustainability Indices and Gross Domestic Product Data of Selected Southeast Asian Countries: A Statistical Investigation

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Abstract— There are generally three (3) elements involved in sustainability: (1) human well-being; (2) environmental well-being and (3) economic well-being. Sustainability is said to have been achieved if these three elements are addressed without compromising the needs of the future generation, as per the definition of the Brundtland Commission (1997). In this study, the researcher employed regression analysis of sustainability indices of countries in Southeast Asia against the aforementioned elements as independent variables. The researcher also analyzed these countries gross domestic product data by treating such as a function of these three indices. Using multiple linear regression, it was shown that human and economic well-being are significant predictors of GDP per capita in terms of purchasing power parity among selected Southeast Asian countries.

Keywords—ASEAN, sustainability, regression analysis, policy implications, Southeast Asia

I. INTRODUCTION & LITERATURE REVIEW

Background of the Study. Sustainability is a multifaceted concept. In its simplest sense, it mean “*the ability to sustain*”. Essentially, it entails meeting the present needs without compromising the needs of the future generation as best defined by the Brundtland Commission (1997). Scott Cato (2009) presented the concept of sustainability using three so-called pillars. These are (1) the environment, (2) society, (3) the economy. This means that the environment, being the main resource, poses constraints to the society which has needs and wants. Consequently, the social science that explains how needs and wants are best met is termed as economics. Thus, economics is the science of constrained choice (Besanko and Braeutigam, 2007). To address the needs of society, the economy has to consider what the environment can offer and its capacity. Given these arguments, sustainability and economics will tend to overlap.

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Sustainable development, on the other hand, is described by Todaro and Smith (2009) as “*a pattern of development that permits future generations to live at least as well as the current generation*”. They also argued that “*future growth and overall quality of life are critically dependent on the quality of the environment*”. Sustainable development is also deemed as the organizing principle as to which finite or limited resources are used to meet the needs of the succeeding generations. It is said that some resources are non-renewable, thus they may not be replenished. If the rate at which these resources are consumed is greater than nature’s ability to replenish, then there is environmental degradation and the overall state of which is not sustainable. In other words, society has to consider whether nature is capable of replenishing these resources that are used up in pursuit of meeting society’s needs and wants.

Literature Review. In Southeast Asia, sustainability issues also exist. In an article by Tuppen (2015), various issues plague the region. To illustrate, Thailand suffers from a lack of a municipal water source, particularly in Phuket. Southeast Asia, in general, also suffers from poor municipal waste facilities, thus threatening the health of its constituents. In addition, Southeast Asia, though gifted with an abundance of natural resources and scenic spots, travelers to this region tend to leave carbon footprints. Furthermore, responsible food sourcing also proves to be a challenge -- do food products that originate from this region come from sustainable sources?

Aside from these, Southeast Asia faces issues as far as endangered species conservation is concerned. Air pollution has also become a pressing concern. As proof, haze is experienced in countries such as Malaysia, Singapore, Indonesia, and even in parts of Thailand and Brunei. Southeast Asia and its waters being rich in marine biodiversity become susceptible to destruction of coral reefs. Deforestation is also evident in Southeast Asia. Furthermore, increased urbanization also serves as a threat to sustainability (Matador Network, 2014).

To measure sustainability, one must consider that the three elements of human, environmental and economic well-being are interdependent and not independent (Sustainable Society Index, n.d.). Tradeoffs between the three elements are acceptable as long as their sum total does not decline. Furthermore, it becomes apparent that in sustainability there

is inter-generational equity, intra-generational equity, the recognition of ecological limits and the principle of precaution. It was also argued that sustainability is an enormous challenge for business and economics since it will call for changes in the social, political, technological, cultural and behavioral facets (SustainAbility, 2010). In the pursuit of a basic quality of life, institutions must consider both short-term and long-term needs.

Gross domestic product (GDP) is defined to be the “measure of aggregate output in the national income accounts” (Blanchard, 2003). Traditionally, this is obtained by adding the consumption, investment, government spending of a closed economy while adding the country’s net exports will give the gross domestic product of a country in an open economy. Increases in GDP are typically associated with economic well-being by economists, as more people enjoy more goods and services to satisfy their needs and wants. As countries focus on economic growth, it is also noted that they also engage in resource extraction from the environment and it was also projected that the worldwide consumption of goods and services is going to rise in the future.

Though GDP is a very common concept in the study of macroeconomic theory, it is interesting to note that there could be other factors that may explain GDP aside from the traditional consumption, net exports, investment and government spending. In the light of sustainability issues that concern society today, it would be interesting to explore GDP as a function of sustainability indices.

II. STATEMENT OF THE PROBLEM

In the light of the foregoing facts presented, the researcher aims to answer the following research problems:

- 1.) Using statistical tools such as correlation and regression analyses, which significant elements of the sustainability indices should Southeast Asian countries focus on for policy formulation and development?
- 2.) What is the relationship of the gross domestic product of Southeast Asian countries to the different sustainability indices?

III. OBJECTIVES OF THE STUDY

Based on the presented research problems, the following are the research objectives:

- 1.) To statistically analyze the most recent sustainability indices of Southeast Asian countries
- 2.) To determine the statistically significant variables that relate to the sustainability indices of Southeast Asian countries in aggregate
- 3.) To identify possible areas of concern in terms of sustainability and sustainable development in Southeast Asia
- 4.) To predict the gross domestic product of Southeast Asian countries using the sustainability indices as independent variables

IV. METHODOLOGY, RESEARCH DESIGN AND A PRIORI EXPECTATIONS

Research Design. This research paper is basically a quantitative study employing correlation and regression analysis on secondary data. First, the researcher gathered the sustainability indices of Southeast Asian countries from secondary sources. These are then arranged in tabular or spreadsheet form for ease of input to the statistical software.

The researcher gathered the most recent sustainability indices, as secondary sources may permit. The researcher will then formulate a regression model that will account for the overall sustainability index of Southeast Asia using three independent variables, namely: (1) human well-being; (2) environmental well-being and (3) economic well-being. These three independent variables are consistent with this paper’s working or operational definition of sustainability as suggested by Scott Cato (2009).

The researcher stringently employed 0.10 level of significance in the analysis of data. The researcher analyzed the data using Microsoft Excel as a computer software.

The researcher used multiple linear regression to determine or predict the values of the dependent variables using the independent variables using as predictors or regressors (Blay, 2013).

For this study, the researcher intends to regress gross domestic product (GDP) of the Southeast Asian nations using the following as predictors: human well-being, environmental well-being, and economic well-being.

The researcher also formulated following assumptions, or a priori expectations, or research hypothesis:

- *There is a significant positive or direct relationship between human well-being and gross domestic product (GDP).*
 - The researcher asserts that there is reason to believe that if a country’s citizenry or workforce enjoys a high standard of living, then they can contribute positively to the output of the economy. They can find work and be compensated for their efforts or contribution to the economy. Thus, they tend to become more productive causing a country’s GDP to rise, other things held constant.
- *There is a significant positive or direct relationship between environmental well-being and gross domestic product (GDP).*
 - The researcher also believes that since the environment serves as the source of raw materials in an economy, an environment that is well taken care of yields or produces more raw materials efficiently. As these raw materials are processed to produce goods and services, a country’s environmental well-being positively contributes to its gross domestic product, other things held constant.
- *There is a significant positive or direct relationship between economic well-being and gross domestic product (GDP).*
 - If an economy is said to be healthy characterized by increases consumption spending, investment, net exports and government spending, then it is said to positively

influence GDP. Thus, if a nation’s constituents are enjoying economic well-being, then GDP is said to increase, other things held constant.

In line with the foregoing discussion, the researcher intends to formulate a linear regression model using GDP as a dependent variable with human well-being, environmental well-being and economic well-being as independent variables of the study. This is given by Equation 1 as a functional form with Equation 2 as the multiple linear regression model as shown below:

$$GDP = f(\text{human well-being, environmental well-being, economic well-being}) \quad (\text{Equation 1})$$

$$GDP = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \varepsilon \quad (\text{Equation 2})$$

In equation 2, GDP stands for gross domestic product, β_0 shall serve as the intercept term—the expected value of GDP when all independent variables are equal to zero. This will be interpreted as the value of the GDP of Southeast Asian countries when their human well-being, environmental well-being and economic well-being indices are all zero. β_1, β_2 and β_3 shall serve as the slope terms. Analytically, these coefficients will give the marginal effects. β_1 shall give the change in the GDP should the human well-being index increase by one unit, other things held constant. β_2 shall give the change in the GDP should the environmental well-being index increase by one unit, other things held constant while β_3 shall give the change in the GDP should the economic well-being index increase by one unit, other things held constant. As mentioned in the hypotheses of the study, β_1, β_2 and β_3 are expected to be positively-signed. This means that all indices contribute or has a positive impact on GDP. As mentioned previously, these coefficients will also be tested for significance at a 0.10 level to determine whether they are indeed linearly related to the GDP data of Southeast Asian countries.

V. DATA PRESENTATION, RESULTS AND DISCUSSION

The table below shows the different countries belonging to Southeast Asia and their respective GDP as measured nominally in terms of millions of US dollars and in terms of purchasing power parity (PPP). The table also shows their respective various indices on human, environmental and economic well-being measured in 2014.

TABLE 1
CONSOLIDATED DATA ON GDP PER CAPITA AND INDICES ON HUMAN, ENVIRONMENTAL AND ECONOMIC WELL-BEING OF SELECTED SEA COUNTRIES

COUNTRY	GDP (PPP) per cap (nominal USD in millions) [2015]	HUMAN [2014]	ENVIRON [2014]	ECON [2014]
Cambodia	\$3,486.00	5.72	6.25	3.03
Indonesia	\$11,702.00	6.41	5.54	4.27
Laos	\$5,335.00	5.5	7.03	2.73

Malaysia	\$26,141.00	6.41	4.09	4.86
Myanmar	\$5,164.00	5.16	6.67	3.12
Philippines	\$7,318.00	6.5	6.55	4.33
Thailand	\$16,279.00	7.25	4.34	5.08
Vietnam	\$6,020.00	6.72	4.94	4.13

The data on GDP were obtained from the International Monetary Fund (IMF) and these are as of October 2015, while the various indices were obtained from Sustainable Society Index as reported most recently in 2014. Surprisingly, there are no indices available for Brunei Darussalam and Singapore. Though the GDP data for these two countries are available, these were omitted for consistency purposes. This was done to enable the researcher to perform regression analysis. Thus, from an intended 10 countries ($n = 10$), the researcher ended up utilizing 8 countries ($n = 8$) in the process. It also makes economic sense to disregard Brunei and Singapore from the analysis since these countries are generally well-off compared to the rest of Southeast Asia.

Running a regression of the same GDP data on the three indices of sustainable yields the following results:

TABLE II
MICROSOFT EXCEL REGRESSION OUTPUT OF GDP ON SUSTAINABILITY INDICES SUMMARY OUTPUT

Regression Statistics				
Multiple R		0.921977117		
R Square		0.850041805		
Adjusted R Square		0.737573159		
Standard Error		3935.860149		
Observations		8		

ANOVA					
		df	SS	MS	F
Regression	3	351244383.4	1.17E+08	7.558034	
Residual	4	61963980.45	15490995		
Total	7	413208363.9			

	Coefficients	Standard Error	t Stat	P-value
Intercept	58570.34268	30826.72047	1.899986	0.130241
HUMAN	-10393.39957	4827.541934	-2.15294	0.097659
ENVIRON	-3959.11705	2466.512854	-1.60515	0.183732
ECON	9790.995887	4551.970693	2.150936	0.097879

The regression results showed an R-squared (R^2) squared value of 0.85. This implies that around 85% of the variation in the selected Southeast Asian nations’ GDP as expressed in millions of dollars in terms of purchasing power parity can be explained by the human, environmental and economic indices. Around 15% of the variation in GDP can be explained by other variables not covered in this study.

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Taking a look at the ANOVA table, it can be seen that the overall regression model in this study is significant since the p-value of 0.03999 is actually less than the 0.10 level of significance. However, an investigation of the coefficients reveal that only human well-being and economic well-being are significant with p-values of 0.097659 and 0.097879 respectively which are also less than the 0.10 level of significance. Thus, they are statistically different from zero. It is interesting to note that the environmental well-being of Southeast Asian countries studied in this model is not a significant variable when explaining the GDP as measured in millions of dollars per capita and in terms of purchasing power parity.

The regression results above also yields the equation 3 below for prediction purposes:

$$GDP = 58570.34268 - 10393.39957x_1 - 3959.11705x_2 + 9790.995887x_3 + \varepsilon \quad (\text{Equation 3})$$

Using the regression equation above, it is interesting to note that the indices of human well-being and environmental well-being have a negative relationship with GDP per capita. This also disproves the a priori expectations made earlier. However, it is only human well-being that is statistically significant at this point. However, the regression equation above supports the idea that a higher economic well-being translates to higher levels of GDP.

VI. CONCLUSION & RECOMMENDATIONS

Based on the foregoing discussion, it can be said that human well-being and economic well-being as indices are significant variables when explaining the GDP per capita in terms of purchasing power parity of selected Southeast Asian countries.

Human and environmental well-being are negatively related to GDP per capita in terms of purchasing power parity while economic well-being is positively related to the same dependent variable.

Environmental well-being is not a significant variable when predicting GDP per capita in terms of purchasing power parity in Southeast Asia.

For future researchers, they may want to explore the same study and replicate the same objectives using time-series or panel data to produce richer insights.

Though the regression analysis is robust given the ANOVA results, having a static analysis for one calendar year, may be too weak to generate a more encompassing statement for Southeast Asia in general.

ACKNOWLEDGMENT

The researcher would like to extend his acknowledgment to his family and friends who made this research project possible.