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Does Urbanization Affects Economic Growth? Panel Analysis on Selected ASEAN Countries

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Abstract

This research study is conducted to examine the relationship between economic development, population, carbon dioxide (CO2) emission, energy consumption and foreign direct investment during the process of urbanization in selected countries namely Brunei Darussalam, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. The annual dataset is taken from 2010 to 2017 in World Bank and CEIC. Software Eviews 10 is used for panel data analysis and tests used are Descriptive analysis, Pooled Ordinary Least Square (POLS) Method, Correlation Test, Random Effect Model, Fixed Effect Model, Breusch-Pagan LM test, Hausman Test, Panel Unit Root Test, Panel Cointegration Test and Panel Granger Causality Test. Results shows that all variable data is valid as the mean for each variable was below the range of minimum and maximum values reflect that there is no possible outlier. In addition, majority of the variables are in 1st order and found to be cointegrated, indicating the existence of a long-term equilibrium relationship between carbon dioxide emissions, FDI, population and energy consumption in terms of GDP. In the short term, there are three uni-directional Granger causality that run from GDP, energy consumption and foreign investment to population, while ECT shows that population and energy use exist in the long run. Policies such as decentralization, business and industry. and human resources need to be implemented by policy makers in selected ASEAN countries to ensure economic growth without affecting the environment during the process of urbanization.

Keywords: GDP, Population, Carbon Dioxide (CO2) Emission, Energy Consumption, FDI, Selected ASEAN Countries

Introduction

Urbanization is defined as a movement of people from rural area to urban area with population growth equals to the urban migration, and it has been one of the prominent trends since 20th century (Street, 1997; United Nations, 2010). At the regional scale or broad city, urbanization is defined as the spatial configuration of fixed elements (Anderson, Kanargoglou, & Miller, 1996). It is a dynamic process which involves various stages and expressed with the urban population rate. Northam (1975) depicts the urbanization process with an S curve, starting from initial stage to acceleration stage and lastly, terminal stage. Firstly, the urban population rate slowly increased at initial stage until it reaches about 30%, then the rate at acceleration starts to increase until 65%, and finally become constant at terminal stage when the rate is over 70%. The concentration urbanization mainly refers to the heavy growth of urban population with similar development of industry during the initial stage, and suburbanization refers to the population growth at an outlying district of a city due to urban expansion, while counter-urbanization happens when the people emigrate for some reason such as inefficiency to solve urban problems including crime, congestion and pollution (Blind, 1980; Enyedi & Hungary, 1990). Lastly, re-urbanization happens when the government uses policy to attract people back to urban areas. Both counter urbanization and re-urbanization occur at the terminal stage of urbanization. Figure 1 illustrates the urbanization process.

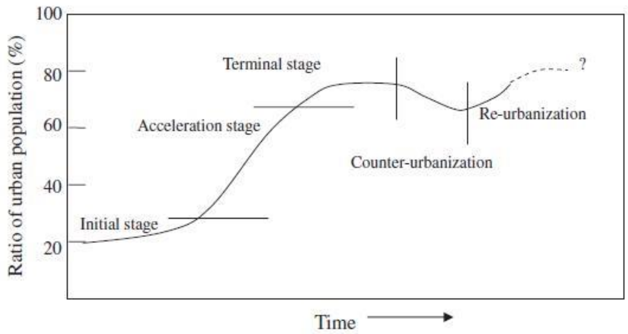


Figure 1: The Process of Urbanization
Source: Adapted from Northam (1975)

The urbanization process brings changes in terms of physical formation, economics, politics and social to a city or country in order to satisfy the needs of an increased urban population (Pivo, 1996). The most important is that urbanization has a close link with economic which presents both challenges and opportunities in achieving urban sustainability (Bettencourt, Lobo, & Helbing, 2007). While other studies argue this conclusion, they proposed that urbanizations only present both benefit and problems in economic, social and politics (Alberti & Marzluff, 2004; Christopher, 2008; Glaeser, 1998; Li et. al., 2009; Yigitcanlar, 2009).

Urbanizations generally consist of a number of features which is the population, energy use, carbon dioxide (CO2) emission and foreign direct investment (FDI) that can affect the economic growth of a country as shown in Figure 3 (Hakeem, 2017; Grossman & Krueger, 1995; David & Cutler, 2004).

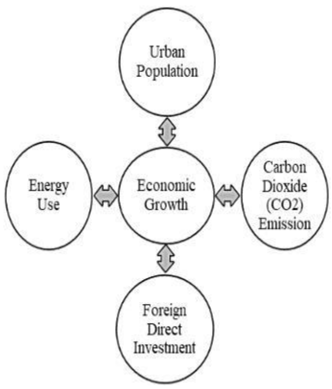


Figure 3: Elements of Urbanization That Affect the Economic Growth

Population plays an important factor influencing economic growth (Yegorov, 2015). Theoretically, high population density means more labour force and more product activities can be undertaken which can contribute to the gross domestic product. The higher the population, the more the labour force contributes to economic growth. At the same time, high population is also closely linked to greater innovation and technical skills. According to Stephan and Nestmann (2006), the higher the population, the greater the proportion of human capital who will carry out inventions and discoveries. Thus, population density has positive relationship to innovation, which also contributes to economic growth.

However, instead of having a positive effect, there also exists opposite effect. The increase of population density is at geometric pace, whereas food production is increased at arithmetic pace. When a population of one country starts to grow, there is an existence of issues such as disease, poverty, hunger and survival (Malthus, 1798). In urban economics perspective, the denser the population in a geographic unit, the greater the environment quality affected (Hakeem, 2017; Hansen, 2013).

Population is a complex concept with a number of interrelated dimensions. It may provide a measure of the number of people living in a given area. It is a social interpretation dependent on individual characteristics and thus may differ from resident to resident (Churchman, 1999). Jenks and Dempsey (2005) stated that population density entered the consciousness of United Kingdom policymakers in the nineteenth century where during that time, urban areas were growing rapidly, and overcrowding and appalling living conditions was mostly among the poor.

Energy use is defined as the total amount of energy consumed by an individual, firm, organization or the process of such consumption. Lee and Chang (2008) stated that reducing the energy use while maintaining economic growth has been one of the major concerns of energy and environmental protection policy in every country. There were many research carried out where the energy use is a key variable impact to economic growth (Stern, 2011; Pirlogea & Cicea, 2012). Usually, the neoclassical growth model always considered land, labour and capital as the main factors of productions, while energy act as an intermediate input produced by the main factor of productions. Despite this, neoclassical economists often assume that energy consumption and capital are substitutable (Solow, 1974).

Source: Adopted from Hakeem (2017), Grossman and Krueger (1995) and David and Cutler (2004),

In reality, decrease in energy use does not reflect the conditions of economic efficiency; in contrast, this will result in decrease in economic growth. This point of view leads to a focus on the economic growth theory on capital and labour, more specifically that land and transport is a subcategory of the capital (Hong, Albert, & Michael, 2009). Energy plays a minor role in economic growth, but this statement has been strongly critiqued by the concept of ecological economics, which is the laid in the bio-physical theory of the role of energy. The law of thermodynamics, founded by Rudolf Clausius and William Thomson in 1850 concluded that a minimum quantity is required to carry out the transformation of every matters (Hutchison, 1981). Based on this theory, since all the economic production involves the transformation of matters, hence energy is important for the economic growth. A good example is Japan where they lack energy resources and always depend on the import of gasoline, crude oil and coal for their transportation, industrial activities and electric generation (Mehrara, 2007). Thus, energy use and economic growth seems have a positive relationship to each other, and the environment quality and global climate change has become major concerns for the past decades, which will result in the rise of carbon dioxide (CO_2) emission if not solved efficiently.

The world has started to concern about the environmental quality and economic growth with a history of 25 years, starting with the UN Conference on the Human Environment (Simon, 1972). For the past decades, the environmental issue has received a new focal point in the concept of sustainable environmental development. Since 70% of the world population live in the cities, it is clear that the consequences of a rising world population are most keenly felt. Such consequences may be positive, for example access to education, culture, economics of scale and social contacts while also may be positive, for example traffic congestion, concentrated pollution, criminality and most importantly, the environmental pollution. Camagni et al. (2001) proposed that if the world population rises 10 to 15 billion people in the next century, all the cities will face major challenges and treat in the future in terms of environment. In various developed countries, the cities tend to grow faster than the average national rise in population. Hence, the general trend is one where all cities will grow and where the big cities may grow faster.

Throughout the history of mankind, the urban economics advantage of cities has stimulated economic growth. However, the pollutants discharged to the atmosphere are beyond critical concentrations. In many urban areas, atmospheric pollution causes severe problems. According to Nijkamp and Ursem (1998), among six types of emission which can pollute the urban atmosphere, carbon dioxide (CO_2) emission is the main contributor to the greenhouse effect. The problem is that CO_2 emission prevents heat escaping from the planet, which may result in global climate change. While Nijkamp and Opschoor (1997) modelling the climate change, by the year 2030 the CO_2 emission may result in the rise of earth average temperature between 1.5 and 4.5 degrees, which will result in the rise of sea level. It is important to note that some ASEAN countries are located in coastal area, thus CO_2 emission are not only a global threat but also a local threat.

Thus, in order to ensure all the negative impact of CO_2 emission to economic growth can be minimized, an effective policy to mitigate the global climate change should be created. The most widely use of hypothesis to study the link between the environment effect and economic growth is the Environmental Kuznets Curve (EKC), since 1990 (Kuznets, 1955). His paper shows that for a country to have economic growth, its environment will be damaged at first, then after a certain point, the environment quality will have a better outcome as a country's economic keep growing.

Theoretically, the poor are willing to pollute their surrounding environment in order to increase their own income (Shaun, Zeng, Morse, & David, 2011). However, beyond a certain level of economic well-being, environmental quality will act as normal goods because consumer demand for it increases as their income increases at the same time. Hence, there is an inverted U-shape relationship between economic growth in terms of GDP per capita and environmental and change of environment quality (Grossman & Krueger, 1995; Torras & Boyce, 1998; Barrett & Graddy, 2000).

Foreign direct investment (FDI) has a significant impact to every country as it can provide a stable flow of funds, and increase productivity, employment and trade (Sasi & Mehmet, 2015). At the same time, FDI also creates positive externalities which helps in developing advance technology, organisational learning, introduces new production method as well as assist domestic firm in creating a way to access to foreign markets.

Solow (1974) in his article stated that in a neoclassical model, the long-term economic growth only can be achieved through technological advancement and labour force growth. In macroeconomic theory, FDI can contribute to economic growth directly through high capital stock and new technology, and indirectly through improving a country's own human capital, urban infrastructure, institutions and spill-overs.

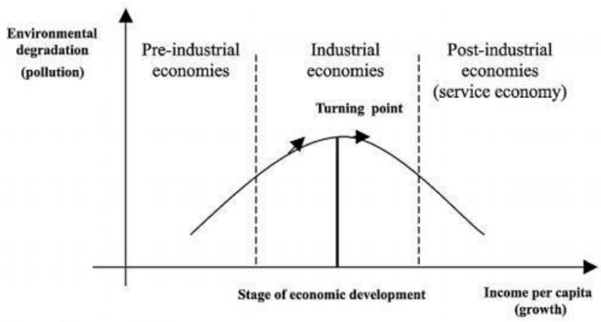
The adverse effect of FDI is also estimated in the economic growth model. Carkovic et al. (2005) questioned how FDI causes economic growth in long-term. Essentially, the government policies in the form of tax treatments can affect the domestic firm's incentive. If the foreign firms gain significant benefits form from their own countries, this could lead to a negative growth on economy (Easterly, 1993). Furthermore, Borensztein et al. (year) found that the inflow of FDI does not lead to high economy efficiency but only have a profit economics opportunity created by distorted incentives. At the same time, the size of government can be one of the factors in adverse economic growth effect government should invest in urban infrastructure in order to attract FDI, but this will increase the foreign debt and distortionary tax burden which will serve as an example of crowding out.

Literature Review

This section will present the framework that supports theoretical underpinning for empirical analysis of previous studies. Some of the important models will be used in this study.

Environment Kuznet Curve (EKC) Hypothesis

Figure 9: Environmental Kuznets Curve (EKC) Theory: An Environment Development Relationship



Source: Adopted from Clalani (2007) in Panayotou (1993)

The literature on environment and economic growth study concerns on the testing of the existence of EKC theory. Theoretically, energy use by industrial sector such as the consumption of petrol oil and burning of fossil fuel to produce goods will discharge a large amount of wasted chemical gases which contribute to the rise of carbon dioxide (CO_2) emission and finally pollute the environment. There are few previous empirical studies which proved the increase in energy use leads to the growth of economy. Thus, this study assume that energy use and income level have positive relationship on carbon dioxide (CO_2) emission.

Historically, EKC theory was founded by Grossman and Krueger in 1991 for different pollutant emission. The hypothesis describes that there is an inverted U-shape relationship between various indicators of environmental quality such as carbon dioxide (CO_2) emission, carbon monoxide and others emission with income per capita. This theory claims that carbon dioxide (CO_2) emission increases as the income per capita increase in developing countries but carbon dioxide (CO_2) emission decreases in developed countries. This is because the developed countries have achieved a high level of economic growth and are able to develop green and clean technologies that reduce the pollutant emission and allocate more effort to maintain the good quality of the environment. Thus, EKC theory summarizes the dynamic process of change that is when a national income grows through a period of time, the pollutant emission also grows as economic growth reached the highest level, but after it reached the turning point, it started to decreased.

The general explanation for the inverted U-shape in EKC theory is that environmental degradation increased as the structure of the economy changes from rural to urban and from agricultural to industrial due to the increase in mass production and consumption. In developing countries including the selected ASEAN countries, the government enhance economic performance through industrial activities with the assistance of foreign direct investment (FDI). As investment increases, production increases too, and finally lead to the increase of pollutant emission. This explains the early stage of EKC theory. After that, the pollutant emission decreases when the economy changed from industrial to service sector due to the lower environmental consequences of service sectors in the developed countries.

There are many previous studies investigating the existence of EKC theory between carbon dioxide (CO_2) emission and income per capita, but only concerned with other regions and not ASEAN countries. As a whole, environment quality and economic growth may or may not exist between the inverted U-shape with the general rule. Consequently, the lack of policy implications for different countries arises as pollution features differs. Continued studies need to be conducted on updated data and to design better environmental policies without influencing the economic growth of a country.

Based on the previous studies, the EKC theory is used to explain the results which include the studies by Cialani (2007), Saboori, Sulaiman and Mohd (2012), Sun, Zhou and Zhang (2011), Omay (2013), Vidyarthi (2013), Ahmed and Qazi (2014), Bozkurt and Akan (2014), Katircioglu (2014), Kivyiro and Arminen (2014), Albiman, Suleiman and Baka (2015), Heidari, Katircioglu and Saeidpour (2015), Lacheheb, Abdul Rahim and Siraq (2015), and Ozturk and Yildirim (2015).

Population Led Growth Hypothesis

Specifically, population plays an important role as the promoter of short and long run economic growth and is studied by assessing this hypothesis. Marinko and Sanja (2015) found that population growth has long-run relationship with economic growth. Fundamentally, the first theoretical framework that explained the relationship between population and economic growth was by David Hume in 2011. He proposed that population and economic growth are not in short-run business cycle but it is part of the long-run growth dynamics. Even David Hume, the father of economics, which Adam Smith mentioned(?) in his work The Wealth of Nations also emphasized that population is a key factor of economic growth (Soares, 2007). While Malthus (1998) opposed it, he saw that population growth will lead to poverty, famine and economy depreciation.

At the first half of 20th century, the neoclassical growth theory, which is commonly known as Solow-Swan growth model, assume that the model is constant return to scale, diminishing return for each inputs and there is some positive and elasticity of substitution between the inputs. After that, some of the economists upgraded the model by adding factors in such as human capital, technology, research and development, and most importantly the long-run relationship of the growth process.

Based on the previous studies, the Population-Led-Growth Hypothesis is used to explain the results which includes Kelley, Schmidt (1996), Bloom, Williamson (1997), Thornton (2001), Nakibullah (2010), Huang, Xie (2013) and Yao, Kinugasa, Hamori (2013).

Pollution Haven Hypothesis

This hypothesis explained that the FDI inflow can affect the environment quality of the host country while at the same time increases a country's environmental issue. There is discussion from previous studies in both theoretical and empirical studies which are mostly related to the relationship between FDI inflow and environment policies, and the empirical result are mixed. Generally, this hypothesis from previous studies shows two types of relationship between both variables.

Right off the bat, the two factors in general have positive relationship which centers around various nations and the effect of capital is being evaluated. Baumol and Oates (1988) found that salary level has positive relationship with ecological quality and reasoned that market size will change from higher to bring down natural guideline zones because of an ascent in government charges. The ecological arrangement is exogenous in nature by Motta and Thisse (1994) implies that the natural approaches can be produced endogenously in an open market through campaigning of operators. Conversely, when strategy is treated as exogenous, it demonstrated positive relationship inflow of FDI (Maskus & Penubarti, 1995). Lucas et al. (1992) and Birdsall and Wheeler (1993) guaranteed that the monetary development in creating nations mostly elevated in periods when natural approaches is strengthened. Besides, research done by Levinson (1996) that utilized various techniques indicated that there is a major impact from rigid ecological measures where it brings down a lot of inflow remote direct speculation.

The second connection between outside direct venture and natural guideline shows that there is no proof of condition contamination that influences remote direct speculation (Levinson, 1996; List & Co, 2000; Keller & Levinson, 2002; Xing & Kolstad, 2002; Fredriksson et al., 2003; Eskeland & Harrison, 2003). McConnell and Schwab (1990) utilized a logit model and discovered that the outcomes on the impact of natural approaches on the spot choices for new plants dependent on information from the year 1973 to 1982. Scherp and Suardi (1997) sealed that there is no proof demonstrated the earth contamination is brought about by the movement of European businesses to creating nations.

Data Sources
The research focused on selected ASEAN countries specifically Brunei Darussalam, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam with a panel data of 40 observations starting from year 2011 to year 2015. The source of the data was collected from CEIC Database and World Bank and is presented as below:

GDP= Gross Domestic Income (per capita)
POPULATION= Population Density (per square km)
EU= Energy use (oil equivalent used per capita)
CO2= Carbon Dioxide (CO2) Emission (kiloton)
FDI= Net Inflow of Foreign Direct Investment (% of GDP)

Model Specification
The empirical model for this study can be formed as below:

$$GDPi,t = \alpha + \beta 1LPOPULATIONi,t + \beta 2LLEUi,t + \beta 3LCO2i,t + \beta 4LFDIi,t + \acute{\varepsilon}\ i,t$$

where:
GDPi,t is the gross domestic income per capita

LPOPULATIONi,t is the logarithm for population density per square km
1. *LLEUi,t* is the logarithm for energy use (oil equivalent used per capita)
2. *LCO2i,t* is the logarithm for carbon dioxide (CO2) emission (kiloton)

LFDIi,t is the logarithm for net inflow of foreign direct investment (%of GDP)
The equation above shows the relationship between economic growth, population, energy use, carbon dioxide (CO2) emission and foreign direct investment in the selected ASEAN countries**.**

Descriptive Statistics
The descriptive statistics are widely used to describe the basic features of the data in a study. Through this method, the coefficient efficient of all the variables are discovered. Furthermore, the purpose of this test is to sum up all the study for this study which will be shown in the form of descriptive measures which is the measure of central tendency and its variability. The measures of central tendency consist of mode, mean and median, while the measures of variability consist of variance, standard deviation and the coefficient of variation.

Pooled Ordinary Least Square (POLS) Method
POLS method is used to estimate the parameter in a linear regression model. The purpose is to fit closely to the function with data by reducing the sum of squared errors from the data. With POLS, it enables the estimate of the value of dependent variables on the basis of independent variables. Other than this, the significant relationship between both dependent and independent variables can be examined. The linear regression model is stated below:

$$Y=\beta 0+\beta 1X1+\acute{\varepsilon}$$

The null and alternative hypothesis are stated at below:

$$H0:\beta 1=0$$
$$Ha: \beta 1 \neq 0$$

The decision rule for the POLS method is that the null hypothesis will be rejected if the t-statistics is larger than t-critical value at 5% significance level. Despite using the t-test, the second part is to use F-test or F-distribution which is to test the overall significance. The hypothesis consists of multiple parameters and the equality of variance of data sets which are stated below:

$$H0: \beta 1 = \beta 2 = \beta 3 = \ldots = \beta n = 0$$
$$Ha: \beta 1 \neq \beta 2 \neq \beta 3 \neq \ldots \neq \beta n \neq 0$$

The decision rule is that the null hypothesis is rejected if the f-statistics is larger than f-critical value at 5% significance level. Meanwhile, the last part is the test of Goodness of fit to equate an anticipated frequency to actual frequency. The method is similar to t-test and f-test. The decision rule is that the null hypothesis is rejected of the p-value is less than p-critical value at 5% significance level.

Correlation Coefficient Test

This test is to identify if the degree of any two variable's movement are correlated with one another. The test is where the probability of variables in the model are determined and how far the models depend on the data of variables in the previous year or more. There are three different correlation tests which are the Durbin-Watson h test, the d test, as well as the Breusch-Godfrey test. Eviews 10 software is utilized to compute the results for the POLS method and the result are obtained and interpreted.

Fixed Effect Test

The test is applied to ensure that the unobserved heterogeneity is under control when this heterogeneity is consistent after a certain period of time. By differencing the data, the heterogeneity can be removed because the first difference will remove any time invariant components of the model. Hence, it is important to carry out this test to ensure whether the sample has distinct constant that should be included in the model before evaluating the validity of the fixed effect model. The f-test is utilized to examine between fixed effects and Pooled Ordinary Least Square (POLS) method. The null and alternative hypothesis are stated below:

H0: All the constant is homogeneity
Ha: All the constant is not homogeneity

The decision rule is that the null hypothesis is rejected if the f-value is larger than f-critical value at 5% significance level. Thus, there is a conclusion that the fixed effect regression may detect every effect which are fixed to a certain individual and the one that does not change after going through a period of time.

Random Effect Test

Another option to estimate the model is through random effect test. The model is built through the hypothesis that the fixed effect are not varying together with the independent variables and with a postulation that the fixed effects test makes strict boundaries to the panel data. The difference between both fixed effect and random effect test is that random effect test grasps the constant for every part as random parameter. The advantage for this test is that it contains lesser parameters for estimation as compared to fixed effect test. This method also permits for additional independent variables such as dummy variables that have equivalent value for all observations within a group. The null and alternative hypothesis is stated below:

H0: All the constant is homogeneity
Ha: All the constant is not homogeneity

The decision rule is that the null hypothesis is rejected if the f-value is larger than f-critical value at 5% significance level. Thus, there is a conclusion that the independent variables have significant impact on the dependent variable.

Breusch-Pagan LM Test

According to Breusch and Pagan (1979), the Lagrange Multiplier (LM) is used to evaluate the heteroscedasticity. Despite this, LM test also helps to decide between a random effect regression and POLS regression. This test computes how errors across the independent variables. Breusch and Pagan in their article stated that the error variances exist due to a linear regression of one or more independent variables in a model. The null and hypothesis are stated below:

H0: Var(u) = 0
Ha: Var(u) ≠ 0

The decision rule is that the null hypothesis is rejected if the LM-statistics is larger than LM-critical value. Alternatively, if p-value are less than p-critical value at 5% significance level, the null hypothesis is rejected. Thus, there is a conclusion of enough statistical evidence to prove that heteroscedasticity exists and the random effect test is appropriate. In contrast, if the null hypothesis failed to reject, then there is a conclusion of not enough statistical evidence to prove that there is significant difference between countries and therefore the POLS method can be used.

Hausman Test

This test is used to facilitate in formulating a decision whether fixed effect or random effect test are more appropriate to be used. According to Hausman (1978), there are two possible presumptions obtained regarding the individual specific effect which is the assumption of both of the regression. The assumption for the random effect is that the independent variables are not varying together with the individual specific effects. While for the fixed effect, the hypothesis is that the independent variables have two-way relationship with the individual specific effects. If the random effect presumption is true, the random effect test is said to be more coherent than the fixed effect test. In contrast, if the presumption is not true, the random effect test is said to be inconsistent. This test is frequently applied to separate and decide which test to be utilized, either fixed or random test.

The Hausman statistic is used as a distance measure between the fixed and random effects test. The null and alternative hypothesis are stated at below:

H0: Random effects are consistent and efficient

Ha: Random effects are inconsistent and inefficient

The decision rule is that the null hypothesis is rejected if the t-statistics is larger than the t-critical value. Large value of t-statistics shows that the random effect test is inconsistent and inefficient and fixed effect test should be used. Alternatively, small value of t-statistics shows that the random effect test is consistent and efficient and more suitable compared to fixed effect test.

Panel Unit Root Test

Generally, this test is mostly used by many researcher because of its high power compared to time series test. This method was introduced by Levin and Lin (1993), Levin et al. (2002), Im et al. (1997; 2003), Hadri (2000), Harris and Tzavalis (1999), and Maddala and Wu (1999), among others. These techniques enable the researchers to exploit the benefits from cross-sectional information to obtain much more definitive evidence regarding stationarity properties.

There are three types of unit root tests, namely Im, Pesaran and Shin, Fisher–augmented Dickey–Fuller (ADF) and Phillips–Perron test (PP) tests, that were used in this study. This test is a multiple time series that are modified for panel data by applying the cross-section into the unit root tests equations. The panel unit root tests allow the autoregressive coefficient to vary across the cross-sections. The regression is specified as follows:

$$\Delta y_{i,t} = \alpha y_{i,t-1} + \sum_{j=1}^{pi} \beta_{i,j} \Delta y_{i,t-1} + X'_{it}\delta + \varepsilon_{i,t}$$

While Fisher-ADF and Fisher-PP used Fisher's (1932) results to derive test that combine the p-value from individual unit root tests which is proposed by Maddala and Wu (1999) as well as Choi (2001). The null hypothesis for this panel unit roots tests can be written as follows:

H0: Unit root exist (Non-stationary)

Ha: Unit root does not exist (Stationary)

The decision rule is that the null hypothesis is rejected if the statistics is larger than critical value. Alternatively, if p-value are less than p-critical value at 5% significance level, the null hypothesis is rejected. Thus, there is a conclusion of enough statistical evidence to prove that that variable are stationary or I (1). In contrast, if the null hypothesis failed to reject, then there is a conclusion of not enough statistical evidence to prove that variables are stationary.

Panel Cointegration Test

This test is used to examine the long-run relationship between independent variables and dependent variable where the Pedroni cointegration test was used. Pedroni (2004) extended the Engle–Granger cointegration test that can be involved in panel data analysis. Pedroni made several tests for cointegration that allow the heterogeneous intercepts and trend coefficients to move across cross-sections. The regression is specified as follows:

$$y_{i,t} = \alpha_i + \delta_{i,t} + \beta_1 x_{1i,t} + \beta_2 x_{2i,t} + \cdots\cdots + \beta_{ki} x_{ki,t} + \varepsilon_{i,t}$$

$$\Delta LEU_{i,t} = x_0 + \sum_{i=1}^{m} \gamma_{1,i} \Delta LPOPULATION_{t-1} + \sum_{i=1}^{n} \gamma_{2,i} \Delta LEU_{t-1} + \sum_{i=1}^{p} \gamma_{3,i} \Delta LCO2_{t-1} + \sum_{i=1}^{q} \gamma_{4,i} \Delta LFDI_{t-1} + \mu_3 ECT_{t-1} + \varepsilon_{3t}$$

The null hypothesis for this panel unit roots tests can be written as follows:

H0: There is no cointegrating exist
Ha: There is cointegrating exist

The test null hypothesis of cointegration will be based on a number of cointegration statistics, namely Panel v-statistics, Panel rho-statistics, Panel PP-statistics and Panel ADF-statistics, while the group statistics consists of Group rho-statistics, Group PP- statistics and Group ADF-statistics. The first four cointegration statistics refer to the within-dimension test and the last three refer to the between dimension test. The decision rule is that the null hypothesis is rejected if more than half of the statistics is larger than critical value. Alternatively, if p-value are less than p-critical value at 5% significance level, then the null hypothesis is rejected. Thus, there is a conclusion of enough statistical evidence to prove that there cointegrating exist between variables. In contrast, if the null hypothesis failed to reject, then there is a conclusion of not enough statistical evidence to prove that each of the variable exist cointegrating.

Panel Granger Causality Test
One of the research questions of this study is to examine the short-run and long-run causal relationship between economic growth and population, energy use, carbon dioxide emission, and foreign direct investment in selected ASEAN countries. To answer this question, Granger causality test was used. Once the cointegration is identified in the panel cointegration test, the Vector Error Correction Model (VECM) Granger causality test was employed to examine the relationship between the variables (Granger, 1969). VECM is a restrictive of Vector Autoregressive (VAR) model that limits the endogenous variables behaviour in the long run in order to converge to the long run equilibrium relationship and allows long run dynamics. In the case of at least one cointegrating vector are found to exist among the variables, a corresponding error correction representation that connote the changes of the dependent variables can be formulated as function of disequilibrium in the relationship of the cointegration and fluctuations in other independent variables.

The regression equation for Granger causality test based on
VECM is expressed as follow:

$$\Delta LGDP_{i,t} = \alpha_0 + \sum_{i=1}^{m} \beta_{1,i} \Delta LPOPULATION_{t-1} + \sum_{i=1}^{n} \beta_{2,i} \Delta LEU_{t-1} + \sum_{i=1}^{p} \beta_{3,i} \Delta LCO2_{t-1} + \sum_{i=1}^{q} \beta_{4,i} \Delta LFDI_{t-1} + \mu_1 ECT_{t-1} + \varepsilon_{1t}$$

(3.X)

$$\Delta LPOPULATION_{i,t} = \delta_0 + \sum_{i=1}^{m} \emptyset_{1,i} \Delta LPOPULATION_{t-1} + \sum_{i=1}^{n} \emptyset_{2,i} \Delta LEU_{t-1} + \sum_{i=1}^{p} \emptyset_{3,i} \Delta LCO2_{t-1} + \sum_{i=1}^{q} \emptyset_{4,i} \Delta LFDI_{t-1} + \mu_2 ECT_{t-1} + \varepsilon_{2t}$$

(3.X)

$$\Delta CO2_{i,t} = \theta_0 + \sum_{i=1}^{m} \lambda_{1,i} \Delta LPOPULATION_{t-1} + \sum_{i=1}^{n} \lambda_{2,i} \Delta LEU_{t-1} + \sum_{i=1}^{p} \lambda_{3,i} \Delta LCO2_{t-1} + \sum_{i=1}^{q} \lambda_{4,i} \Delta LFDI_{t-1} + \mu_4 ECT_{t-1} + \varepsilon_{4t}$$

(3.X)

$$\Delta FDI_{i,t} = \varphi_0 + \sum_{i=1}^{l} \vartheta_{1,i} \Delta LPOPULATION_{t-1} + \sum_{i=1}^{l} \vartheta_{2,i} \Delta LEU_{t-1} + \sum_{i=1}^{p} \vartheta_{3,i} \Delta LCO2_{t-1} + \sum_{i=1}^{q} \vartheta_{4,i} \Delta LFDI_{t-1} + \mu_5 ECT_{t-1} + \varepsilon_{5t}$$

(3.X)

where Δ is the lag operator, a_0, δ_0, x_0, θ_0, φ_0, β, $\emptyset$, γ,

λ and ϑ are the estimated coefficient, m, n, p and q are the optimal lags of the series number of population (POPULATION), energy use (EU), carbon dioxide emission

(CO2) and foreign direct investment (FDI). ε it represents the serially uncorrelated random error terms while μ measure a single period response to a departure from equilibrium of the dependent variable.

The hypotheses of the panel Granger causality test are:

H0: The independent does not Granger cause the dependent variable

Ha: The independent Granger causes the dependent variable

This test used p-value to determine the causality among the variables. The decision of significance series is based on critical value of 5% significance level where the rejection rule rejects the null hypothesis if p-value is less than p-critical value (0.05). Therefore, it is significant as the null hypothesis is rejected and concludes that the independent variable Granger cause the dependent variable at 5% significance level. In contrast, if the p-value is larger than 0.05, the series is insignificant as it failed to reject the null hypothesis and concludes that the independent variable does not granger cause the dependent variable at 5% significance level.

Results and Discussion

Results of Descriptive Statistics Analysis

The summary of the result for this research is explained in the following analysis.

Table 3

Descriptive Statistics Analysis Test Result.

Variables	GDP	POPULATION	EU	CO2	FDI
Mean	8.745605	16.55311	7.307324	11.58567	22.60320
Median	8.393577	17.04786	7.135654	11.88426	22.90908
Standard Deviation	1.311106	1.718427	1.107106	1.534672	1.463369
Minimum	6.895420	12.58226	5.633181	8.962312	18.82981
Maximum	10.96326	18.78737	9.193126	15.19106	25.03074

Notes: GDP is gross domestic income per capita, POPULATION is population density per square km, EU is energy use (oil equivalent used per capita), CO2 is carbon dioxide (CO2) emission (kiloton) and FDI is net inflow of foreign direct investment (%of GDP)

Based on the result above, the mean for the dependent variable GDP is 8.745605 while median is 8.393577 with a standard deviation of 1.311106. The minimum value is 6.895420 and the maximum value is 10.96326. The mean and median of independent variable POPULATION are 16.55311 and 17.04786, respectively, with a standard deviation of 1.718427. The minimum value is 6.895420 and maximum value is 10.96326. For the independent variable EU, the mean and median are 7.307324 and 7.135654, respectively, with a standard deviation of 1.107106. The minimum value is 5.633181 and maximum value is 9.193126. The mean and median for independent variable CO2 are 11.58567 and 11.88426, respectively, with a standard deviation of 1.534672. The minimum value is 8.962312 and the maximum value is 15.19106. Last but not least, the mean and median for independent variable FDI are 22.60320 and 22.90908, respectively, with a standard deviation of 1.463369. The minimum value is 18.82981 and the maximum value is 25.03074.

It is evident that all the data are valid as the mean for each variable are under the range of minimum and maximum value. It depicts that there is no possible outlier. As for the standard deviation value, it has a small range of value of all the variables which indicates that there is less dispersion in the data and it has much more variability relative to its mean.

Results of Pooled Ordinary Least Square (POLS) Method

Generally, POLS method is used to examine the relationship between the dependent variable and independent variable. The purpose of this test is to examine whether urban population, energy use, carbon dioxide emission and foreign direct investment net inflow has impact on economic growth. The result is shown in the table below.

Table 4

Pooled Ordinary Least Square (POLS) Model Test Result

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-3.801633	1.148384	-3.310420**	0.0016**
LPOPULATION	0.125063	0.088668	1.410458	0.1637
LEU	1.228511	0.087077	14.10840**	0.0000**
LCO2	-0.233619	0.060791	-3.842994**	0.0003**
LFDI	0.186105	0.035268	5.276920**	0.0000**
R-Squared	0.955324		F-Statistic	315.4037
Adjusted R-Squared	0.952295		Prob(F-statistic)	0.000000

Notes: Asterisks (**) denoted rejection of the null hypothesis at 5% significance level.
Based from the result above, the empirical model can be written as follow:

LGDPit = -3.801633 + 0.125063 *LPOPULATIONit* + 1.228511 *LEUit* - 0.233619 *LCO2it* + 0.186105 *LFDIit* + *it*

Where:

- *LGDPit* is the logarithm gross domestic income per capita
- *LPOPULATIONit* is the logarithm for population density per square km
- *LEUit* is the logarithm for energy use (oil equivalent used per capita)
- *LCO2it* is the logarithm for carbon dioxide (CO2) emission (kiloton)
- *LFDIit* is the logarithm for net inflow of foreign direct investment (% of GDP)

From the equation, an increase of 1% in LPOPULATION, while others held constant, will increase 0.125063% in LGDP. The null hypothesis cannot be rejected due to the p-value (0.1637) being larger than p-critical value (0.05). Therefore, it is not statistically significant at 5% significance level. Moreover, an increase of 1% in LEU, while others held constant, will increase 1.228511% in LGDP. The null hypothesis is rejected due to the p-value (0.0000) being smaller than p-critical value (0.05). Thus, it is statistically significant at 5% significance level. In addition, an increase of 1% in LCO2, while others held constant, will decrease 0.233619% in LGDP. The null hypothesis is rejected due to the p-value (0.0003) being smaller than p-critical value (0.05). Thus, it is statistically significant at 5% significance level. Lastly, an increase of 1% in LFDI, while others held constant, will increase 0.186105% in LGDP. The null hypothesis is rejected due to the p-value (0.0000) being smaller than p-critical value (0.05). Thus, it is statistically significant at 5% significance level.

Overall, in can be concluded that independent variables namely energy use, carbon dioxide emission and foreign direct investment is statistically significant at 5% significance level with GDP per capita while only population is not statistically significant at 5% significance level. The coefficient of determination value, R-Squared is 0.955324 are closer to 1. This implies that 95.53% of the dependent variable can be explained by the set of independent variables. The total variation showing that the regression fits better than the simple mean of the dependent variable and thus the model does best fit the regression variables.

Result of Correlation Test

The summary of the result for this research is explained in the following analysis.

Table 5

Correlation Analysis Test Result

Variables	LGDP	LPOPULATION	LEU	LCO2	LFDI
LGDP	1.000000				
LPOPULATION	-0.677243 [0.0000]	1.000000			
LEU	0.951983 [0.0000]	-0.717063 [0.0000]	1.000000		
LCO2	-0.254180 [0.0427]	0.763778 [0.0000]	-0.201783 [0.1098]	1.000000	
LFDI	0.044662 [0.7260]	0.537047 [0.0000]	-0.110820 [0.3833]	0.497797 [0.3833]	1.000000

H0: The independent variable has correlation with the dependent variable

From the result of correlation test, dependent variable LGDP is statistically significant at 5% significance level with independent variable LPOPULATION, LEU and LCO2 due to the p-value being less than p-critical value, however dependent variable LGDP is not statistically significant at 5% significance level with independent variable LFDI because p-value is larger than p-critical value. Thus, there is a conclusion that population, energy use and carbon dioxide emission has correlation with economic growth while foreign direct investment did not.

Result of Random Effect Model

This test is commonly used to examine how group and time influence error variance [Cov (λi,) = 0]. This model presumes that the data set being analysed consistently of a hierarchy of diverse population whose changes relate to the hierarchy. The result of this test is shown at below:

Notes: 0.00-0.30 indicates a weak relationship, 0.31-0.70 indicates a moderate relationship and 0.71-1.00 indicates a strong relationship. Figures in parentheses [ ] indicates the p-values.

The purpose of correlation analysis is utilized to approximate to what degree does the variables are correlated with each other. The relationship between the variables is clarified as larger value of positive coefficient shows that there is a strong positive correlation relationship between the variables, while larger value of negative coefficient shows a strong negative correlation relationship between variables.

Based on the correlation result above, LGDP and LPOPULATION has a correlation of -0.677243, which indicates that both variables have a moderate negative relationship. Furthermore, LGDP and LEU shows a strong positive relationship with the value of 0.951983 as an evidence. In addition, LGDP and LCO2 shows the correlation of -0.254180, which indicates that there is weak negative relationship, this is proved by the Environment Kuznet Curve (EKC) Theory that mentioned that if the GDP of one country increases, the government will have enough funding to develop a green technology with the purpose of minimize the carbon dioxide emission. Lastly, LGDP and LFDI shows the correlation of 0.044662 which indicates a weak positive relationship. The rest of the correlation analysis result are not necessary as the aim is to study the relationship between GDP per capita, urban population, energy use, carbon dioxide emission and foreign direct investment. The hypothesis of this test is stated at below:
H0: The independent variable has no correlation with the dependent variable

Table 6
Random Effect Model Test Result.

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	2.603933	2.133072	1.220743	0.2270
LPOPULATION	-0.103743	0.099655	-1.041021	0.3021
LEU	0.880796	0.128316	6.864261**	0.0000**
LCO2	-0.029043	0.034201	-0.849181	0.3992
LFDI	0.077828	0.021364	3.642884**	0.0006**

Notes: Asterisks (**) denoted rejection of the null hypothesis at 5% significance level.

Based from the result above, the empirical model can be written as follows:
LGDPit = 2.603933 – 0.103743 *LPOPULATIONit* + 0.880796 *LEUit* - 0.029043 *LCO2it* + 0.077828 *LFDIit + it*

Where:
- *LGDPit* is the logarithm gross domestic income per capita
- *LPOPULATIONit* is the logarithm for population density per square km
- *LEUit* is the logarithm for energy use (oil equivalent used per capita)
- *LCO2it* is the logarithm for carbon dioxide (CO2) emission (kiloton)
- *LFDIit* is the logarithm for net inflow of foreign direct investment (% of GDP)

Overall, there are positive and negative influence between all the independent variables LPOPULATION, LEU, LCO2 and LFDI towards the dependent variable LGDP. From the equation above, an increase of 1% in LPOPULATION, while others held constant, will decrease 0.103743% in LGDP. The null

hypothesis cannot be rejected due to the p-value (0.3021) being larger than p-critical value (0.05). Therefore, it is not statistically significant at 5% significance level. Then, an increase of

1% in LEU, while others held constant, will increase 0.880796% in LGDP. The null hypothesis is rejected due to the p-value (0.0000) being smaller than p-critical value (0.05). Therefore, it is statistically significant at 5% significance level. Also, an increase of 1% in LCO2, while others held constant, will decrease 0.029043% in LGDP. The null hypothesis cannot be rejected due to the p-value (0.3992) being larger than p-critical value (0.05). Therefore, it is not statistically significant at 5% significance level. Lastly, an increase of 1% in LFDI, while others held constant, will increase 0.077828% in LGDP. The null hypothesis is rejected due to the p-value (0.0006) being smaller than p-critical value (0.05). The hypothesis for this test is shown below:

H0: The independent variables have no impact on the dependent variable
Ha: The independent variables have impact on the dependent variable

Based on the rejection rule, null hypothesis will be rejected when p-value is less than critical value 0.05 according to each variable. From the result above, independent variable LPOPULATION and LCO2 failed to reject the null hypothesis at 5% significance level, then there is a conclusion of both independent variables does not have impact on dependent variable LGDP. While independent variable LEU and LFDI is rejected the null hypothesis at 5% significance level, then there is a conclusion of both independent variables has impact on dependent variable LGDP.

Result for Fixed Effect Model
This test is to examine the group differences in intercept [Cov (λi,) ≠ 0]. The result for this model is shown below:

Table 7
Fixed Effect Model Test Result.

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-7.570113	5.122773	-1.477737	0.1455
LPOPULATION	0.848567	0.350734	2.419404**	0.0191**
LEU	0.067198	0.242793	0.276769	0.7831
LCO2	0.000449	0.036131	0.012432	0.9901
LFDI	0.078442	0.021748	3.606893**	0.0007**

Notes: Asterisks (**) denoted rejection of the null hypothesis at 5% significance level.

Based from the result above, the empirical model can be written as follows:

LGDPit = -7.570113 + 0.848567 *LPOPULATIONit* + 0.067198 *LEUit* + 0.000449 *LCO2it* + 0.07844 *LFDIit* + *it*
Where:
- *LGDPit* is the logarithm gross domestic income per capita
- *LPOPULATIONit* is the logarithm for population density per square km
- *LEUit* is the logarithm for energy use (oil equivalent used per capita)
- *LCO2it* is the logarithm for carbon dioxide (CO2) emission (kiloton)
- *LFDIit* is the logarithm for net inflow of foreign direct investment (% of GDP)

Overall, there are positive and negative influences between all the independent variables LPOPULATION, LEU, LCO2 and LFDI towards the dependent variable LGDP. From the equation above, an increase of 1% in LPOPULATION, while others held constant, will increase

0.848567% in LGDP. The null hypothesis is rejected due to the p-value (0.0191) being less than p-critical value (0.05). Therefore, it is statistically significant at 5% significance level. Then, an increase of 1% in LEU, while others held constant, will increase 0.067198% in LGDP. The null hypothesis cannot be rejected due to the p-value (0.7831) being larger than p-critical value (0.05). Therefore, it is not statistically significant at 5% significance level. Also, an increase of 1% in LCO2, while others held constant, will increase 0.000449% in LGDP. The null hypothesis cannot be rejected due to the p-value (0.9901) being larger than p-critical value (0.05). Therefore, it is not statistically significant at 5% significance level. Lastly, an increase of 1% in LFDI, while others held constant, will increase 0.078442% in LGDP. The null hypothesis is rejected due to the p-value (0.0007) being smaller than p-critical value (0.05). The hypothesis for this test is shown below:

H0: The independent variables have no impact on the dependent variable
Ha: The independent variables have impact on the dependent variable

Based on the rejection rule, null hypothesis will be rejected when p-value is less than critical value 0.05 according to each variable. From the result above, independent variable LEU and LCO2 failed to reject the null hypothesis at 5% significance level, then there is a conclusion of both independent variables does not have impact on dependent variable LGDP. While independent variable LPOPULATION and LFDI is rejected the null hypothesis at 5% significance level, then there is a conclusion of both independent variables has impact on dependent variable LGDP.

Results for Breusch-Pagan LM Test
This test is conducted to test for the Pooled Ordinary Least Square (POLS) method against the Random Effect Model. It helps to decide between a random effect regression and a simple OLS regression. The result for this test is shown below:

Table 8
Breusch-Pagan LM Test Result

	Test Hypothesis		
	Cross Section	Time	Both
Breusch-Pagan	116.2451** (0.0000)	1.487751 (0.7644)	117.7329** (0.0000)

Notes: Asterisks (**) denoted rejection of the null hypothesis at 5% significance level.
Table above shows the result for the Breusch-Pagan LM Test for the relationship of LPOPULATION, LEU, LCO2 and LFDI towards LGDP. The hypothesis of this test is shown below:

H0: No random effects [$\sigma u = 0$]
Ha: Random effect model [Cov (μi, Xit) = 0]

Based on the rejection rule, null hypothesis will be rejected when p-value is less than p-critical value (0.05) which indicates that random effect model is more suitable. The result shows that p-value (0.0000) is less than p-critical value (0.05), therefore null hypothesis is rejected. There is enough statistical evidence to conclude that Random Effect Model is more appropriate than the Pooled Ordinary Least Square (POLS) Method.

Result for Hausman Test

This test is for the Random Effect Model against Fixed Effect Model. This test enables the comparison of random effects estimator to the fixed estimator directly (Gujarati & Porter, 1999). The result for this test is shown at below:

Table 9
Hausman Test Result.

	Coefficient			
Variables	Fixed	Random	Var (Diff)	Probability
LPOPULATION	0.848567	-0.103743	0.113083	0.0046**
LEU	0.067198	0.880796	0.042483	0.0001**
LCO2	0.000449	-0.029043	0.000136	0.0114**
LFDI	0.078442	0.077828	0.000017	0.8799
Chi-Square Statistics (4)	19.192835		Probability	0.0007**

Notes: Asterisks (**) denoted rejection of the null hypothesis at 5% significance level.
Table above shows the result of Hausman test that examines the relationship of LPOPULATION, LEU, LCO2 and LFDI towards LGDP. The hypothesis for this test is shown at below:

H0: Random Effect Model [Cov (λi,) = 0]
Ha: Fixed Effect Model [Cov (λi,) ≠ 0]

Based on the rejection rule, null hypothesis will be rejected when p-value is less than the p-critical value (0.05). The result above shows that p-value (0.0007) is less than 0.05, therefore null hypothesis is rejected. Here, there is enough statistical evidence to conclude that Fixed Effect Model is more appropriate to be used compare with Random Effect Model.

Summary for Panel Data Regression Analysis
Table 10
Summary of Pooled Ordinary Least Square (POLS) Model, Random Effect Model and Fixed Effect Model

	POLS Model	Random Effect Model	Fixed Effect Model
C	-3.801633	2.603933	-7.570113
	(-3.310420)**	(1.220743)	(-1.477737)
LPOPULATION	0.125063	-0.103743	0.848567
	(1.410458)	(-1.041021)	(2.419404)**
LEU	1.228511	0.880796	0.067198
	(14.10840)**	(6.864261)**	(0.276769)
LCO2	-0.233619	-0.029043	0.000449
	(-3.842994)**	(-0.849181)	(0.012432)
LFDI	0.186105	0.077828	0.078442
	(5.276920)**	(3.642884)**	(3.606893)**
Breusch-Pagan LM Test	117.7329** [0.0000]		
Hausman Test		19.192835** [0.0007]	

Notes: Asterisks (**) denoted rejection of the null hypothesis at 5% significance level. Parentheses ( ) indicates t-Statistics while parentheses [ ] indicates p-value.

Table above shows the summary of the result for all the regression test done in this research. The POLS Model depicts that independent variables LEU, LCO2 and LFDI are statistically significant at 5% significance level, while only LPOPULATION is not statistically significant. Then, the Random Effect Model shows that independent variables LEU and LFDI are statistically significant at 5% significance level, while LPOPULATION and LCO2 are not. Lastly, Fixed Effect Model shows that LPOPULATION and LFDI are statistically significant at 5% significance level, while LEU and LCO2 are not.

Then, by referring to the Breusch-Pagan LM Test, it shows that the p-value is rejected. Thus, there is a conclusion that the use Random Effect Model is more appropriate compared with POLS Model. This is the precondition to proceed with Hausman test. The test shows that p-value is rejected, then there is enough statistical evidence to conclude that Fixed Random Effect Model is the finalised and most appropriate to be used. The finalised regression of this study is shown below:

$$LGDP_{it} = -7.570113 + 0.848567LPOPULATION_{it} - 0.067198LEU_{it} + 0.000449LCO2_{it} + 0.07844LFDI_{it} + \varepsilon_{it}$$
$$(-1.477737) \quad (2.419404)^{**} \quad (3.606893)^{**} \quad (0.012432) \quad (0.276769)$$

(4.X)

Notes: The equation in parentheses are lag length where LPOPULATION is population density per square km, LEU is energy use (oil equivalent used per capita), LCO2 carbon dioxide emission per kiloton and LFDI is for net inflow of foreign direct investment (% of GDP)

The regression above shows that there is a positive relationship between LGDP and LPOPULATION, LEU as well as LFDI. An increase of 1% in population, energy use and foreign direct investment will lead to increase 0.848567%, 0.000449% and 0.07844% in GDP. At the same time, there is a negative relationship between LGDP and LEU. An increase of in energy use will lead to decrease 0.067198% in GDP.
Thus, the first research question has been answered.

Panel Unit Root Test
The purpose of this test is to examine if each of the variables is stationary or not. The result for this test is shown at below:

Table 11
Panel Unit Root Test Result.

	Im, Pesaran and Shin W-stat			
	Level		First Difference	
Variable	Intercept	Intercept and Trend	Intercept	Intercept and Trend
LGDP	-4.14477[1]**	-0.63397[0]	-1.67863[0]**	0.89821[0]
LPOPULATION	-6.24483[1]**	4.42554[0]	5.02689[0]	-2.99674[0]**
LEU	1.85410[1]	-0.57951[0]	-4.01991[0]**	-0.95901[0]
LCO2	0.67141[1]	0.41351[0]	-1.23744[0]	-0.09676[0]
LFDI	0.74212[1]	1.00417[0]	-0.13580[0]	0.85932[0]
ADF- *Fisher Chi Square*				
LGDP	50.6002[1]**	25.7704[0]	29.2235[0]**	7.33577[0]
LPOPULATION	84.3229[1]**	2.61508[0]	5.13302[0]	41.1316[0]**
LEU	7.18257[1]	25.6550[0]	47.4390[0]**	29.4861[0]**
LCO2	19.8030[1]	12.1403[0]	24.6242[0]	17.9605[0]
LFDI	18.8913[1]	12.9056[0]	26.5782[0]**	12.7445[0]
PP- *Fisher Chi Square*				
LGDP	85.1681[6]**	64.9260[6]**	49.1766[5]**	15.3940[5]
LPOPULATION	104.409[1]**	8.49684[6]	5.92390[5]	72.2881[5]**
LEU	9.10514[6]	38.7871[6]**	59.6288[5]**	53.5139[5]**
LCO2	12.4798[6]	27.5382[6]**	34.5488[5]**	33.7978[5]**
LFDI	15.1568[0]	18.5577[6]	34.1539[5]**	20.9370[5]

Notes: The unit root test was done with individual trends and intercept for each variable. The optimal lag length was selected automatically using the Schwarz information criteria.

Asterisks (**) represent statistically significant at 5% level of significance. Figure in bracket [ ] are the lag lengths.

Table above shows the panel unit root test results for the Im, Pesaran and Shin W-stat, ADF–Fisher chi-square and PP–Fisher chi-square. The result shows that majority of the variables are stationary at the first difference. The null hypothesis has been rejected which indicates that all the variables contain unit roots. Therefore, this is the precondition to apply the panel cointegration test to examine the long run relationship between variables GDP, population, energy use, carbon dioxide emission and foreign direct investment.

Panel Cointegration Test

Since majority of the variables are stationary at first difference, thus the panel cointegration test was conducted. The result for this test is shown below:

Table 12

Panel Cointegration Test Result

Variable: LGDP, LPOPULATION, LEU, LCO2, LFDI	
Panel cointegration statistics (within-dimension)	
Panel v-Statistic	-0.511271 (0.6954)
Panel rho-Statistic	1.788586 (0.9632)
Panel PP-Statistic	-5.707031 (0.0000)**
Panel ADF-Statistic	-4.875798 (0.0000)**
Group mean panel cointegration statistics (between-dimension)	
Group rho-Statistic	3.211249 (0.9993)
Group PP-Statistic	-7.916298 (0.0000)**
Group ADF-Statistic	-6.203673 (0.0000)**

Notes: The panel cointegration test was done with panel cointegration statistics (within-dimension) and group mean panel cointegration statistics (between-dimension) for all the variables. The optimal lag length was selected automatically using the Schwarz information criteria. Asterisks (**) represent statistically significant at 5% level of significance. Figure in bracket ( ) are the p-value.

From the table above, the empirical result shows that there is a statistical evidence to reject the null hypothesis of no cointegration since four out of the seven statistics provided by Pedroni (1999, 2001, and 2004) confirm cointegration. The rejection of null hypothesis of no cointegration between the I(1) series in the panel implies that these five variables do not drift apart in the long run steady state relationship. Despite the disparities among the eight ASEAN countries, the panel cointegration result conclude that LGDP, LPOPULATION, LEU, LCO2 and LFDI are cointegrated in the multi-country panel setting. Thus, the second research question has been answered where there is a long-run relationship between LGDP, LPOPULATION, LEU, LCO2 and LFD.

Panel Granger Causality Test

Table 13

Panel Granger Causality Test Result.

Dependent Variable	ΔLGDP	ΔLPOPULATION	ΔLEU	ΔLCO2	ΔLFDI	ECT	
	X^2 – statistics					Coefficient	t-ratio
ΔLGDP	-	1.49157 (0.2364)	2.26173 (0.1164)	1.98818 (0.1493)	2.10363 (0.1344)	-0.028424	-1.15785
ΔLPOPULATI-ON	4.77216 (0.0134)**	-	3.56807 (0.0368)**	0.96894 (0.3876)	5.03067 (0.0109)**	-0.020799	-3.71721**
ΔLEU	0.68561 (0.5092)	2.01232 (0.1461)	-	0.43207 (0.6520)	0.01131 (0.9888)	-0.043747	-2.33748**
ΔLCO2	0.1493 (0.3571)	0.51432 (0.6015)	0.10677 (0.8990)	-	0.48142 (0.6212)	-0.221764	-1.54835
ΔLFDI	1.51038 (0.2323)	1.04457 (0.3606)	1.52679 (0.2288)	1.01412 (0.3712)	-	0.010481	0.03491

Notes: The x^2 – statistics tests the joint significance of the lagged values of the independent variables, and the significance of the error correction terms(s). Δ is the first difference operator. Asterisks (**) indicate statistically significant at 5% significance level.

Table above shows the result of panel Granger causality test together with the ECT based on VECM. The maximum lag length 2 has been used after tested by the VEC lag exclusion Wald tests due to the p-value is less than the critical value. Thus, there is a conclusion that maximum lag length 2 is significant at 5% level of significance. Table 4.12 shows the result of VEC lag exclusion Wald tests.

Table 14
VEC Lag Exclusion Wald Test Result

	D(LGDP)	D(LPOPULATION)	D(LEU)	D(LCO2)	D(LFDI)	Joint
DLag 1	9.591822 [0.0877]	8.826815 [0.1162]	5.824763 [0.3236]	1.201969 [0.9447]	6.927031 [0.2261]	47.30134 [0.0045]**
DLag 2	4.158597 [0.5268]	6.075724 [0.2989]	15.30349 [0.0091]	6.458902 [0.2641]	4.298819 [0.5072]	56.17657 [0.0003]**

Notes: The Dlag 1 and 2 represent the lag length while the asterisks (**) represent significant at 5% level of significance.

Theoretically, the ECT of the variable must fulfil three rules of thumb where the coefficient must be negative, less than one and significant. Table 4.11 shows variables POPULATION and EU does meet the ECT three rules of thumb, which indicates that both variables exist in the long-run equilibrium and are responsive to the adjustment towards long-run equilibrium. The speed of adjustment for variable POPULATION is about 2.08% per year and this implies that selected ASEAN countries will require about 48.08 years to adjust back to the long-run equilibrium. The speed of adjustment for variable EU is about 4.37% per year and this implies that selected ASEAN countries will require about 22.88 years to adjust back to the long-run equilibrium.

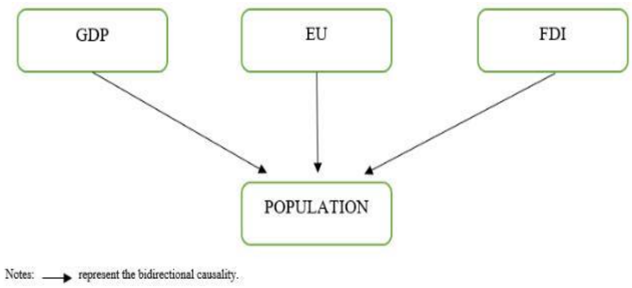


Figure 10: Causality direction for variables LGDP, LPOPULATION, LEU, LCO2 and LFDI

The figure above shows the causality relationship between the variables LGDP, LPOPULATION, LEU, LCO2 and LFDI. The figure above shows that there is a bidirectional causality that runs from LGDP, LEU and LFDI to LPOPULAION in the short-run. Thus, the third research question has been answered.

Conclusion

For most of us, urbanised city or country are incredibly phantasmagorical. The same places at different times we can know and not know, love and hate, revere and revile, yearn to leave and ache to return. It is not only in this subjective sense that the urban area continually changes but it is an objective sense that it can rapidly transform itself.

Almost certainly that the job of urbanization is significant for a creating nation as it go through changes in terms of physical arrangement, financial matters, legislative issues and social to a city or nation. This investigation looks at the connection between monetary development (subordinate variable) and populace (POPULATION), vitality use (EU), carbon dioxide (CO_2) emanation and remote direct speculation (FDI) at 8 ASEAN nations chosen specifically Brunei Darussalam, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. The target of this examination is to analyze the connection between financial development with populace, vitality use, carbon dioxide emanation and outside direct venture. A board information examination was completed to acquire the observational outcomes. Information was obtained from every year from 2010 to 2017 with all out 64 number of perceptions.

In this study, 95% significance level is set for the entire methodology. Firstly, the results of descriptive statistics analysis showed that all the data are valid due to the mean for each variable are under the range of minimum and maximum value. It depicts that there is no possible outlier. Secondly, the result from the summary of panel data regression analysis showed that Fixed Effect Model is the finalised and most appropriate to be used as the p-value is rejected in the Hausman test.

The empirical result shows that LPOPULATION and LGDP is statistically significant and positively related based on fixed effect model. Therefore, population is a determinant of economic growth in the process of urbanisation as it shows a significant relationship. Other than this, the result indicates that independent variables energy use (EU) and carbon dioxide emission (CO_2) are not statistically significant and have negative relationship with economic growth (GDP) which indicates that high energy use will release more carbon dioxide that results in reduction of income revenue in ASEAN countries. However, independent variable foreign direct investment (FDI) is statistically significant and shows positive relationship with economic growth (GDP). Hence, the first research question has been answered.

After going through the basic panel regression analysis, the non-stationary time series analysis was conducted. The panel unit roots test shows that majority of the variables are stationary at first difference which indicates that variables contain unit roots. Panel cointegration test conclude that all the variables are cointegrated in the long run since four out of seven statistics are significant at 5% significance level. The panel cointegration test shows that both variables POPULATION and EU exist in the long-run equilibrium and require about 48.08 years and 22.88 years to adjust back to the long-run equilibrium. Thus, the second research question has been answered. When comes to VECM test, the X^2 – statistics shows that there is a bidirectional causality that runs from LGDP, LEU and LFDI to LPOPULAION in the short-run, thus the third research question has been answered.

Overall, it is proven that population and energy use have a significant relationship with selected ASEAN countries economic growth in long term urbanisation process. Thus, government of these emergent countries should enhance their current policies in order to follow up the trend of fourth industrial revolution.

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