Is the ASEAN Ready for Economic Integration? The Evidence from Panel Data Regressions*

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ABSTRACT

Complementary to the commitment of building the ASEAN Economic Community (AEC) is the necessity to assess productivity and economic growth across the region. The prior experience of similar economic communities posit the importance of a strong production base in order to achieve a unified growth trend. In recent years, the general growth behavior of several ASEAN member states, taken individually, have been optimistic. In this paper, the paradigm for evaluating readiness towards economic integration used a Cobb-Douglas production function to identify key factors that may affect the sustainability of integration. The results of the panel data regression analysis reveal that both labor and capital are significant contributing factors to economic growth, taken individually among countries and collectively as a region. The evidence further indicates that the region is not yet ready for economic integration and that country-specific characteristics are apparent. This implies that in order to achieve a sustainable economic integration that benefits all ASEAN member states, further assessment and unification of economic policies within and among nations has to be made, especially those relating to the development of home-grown technologies and the establishment of a truly strong market and production base.

Keywords: ASEAN, aggregate productivity, growth, economic integration, production function

INTRODUCTION

The vision of the people of the Association of Southeast Asian Nations (ASEAN) to create an integrated community is a statement of commitment. In 2008, the Association established the ASEAN Charter

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which includes the mandate to implement this integrated ASEAN Economic Community (AEC). Following 2008, the Association created several guiding principles to aid each nation in accomplishing the mandate of the Charter. Mutual reinforcement is key to achieving this common goal, and after the 2008 mandate, each member state is undergoing local reviews of its policies in order to meet the requirements of economic integration (ASEAN Annual Report, 2009). An economic community could be a dream or a nightmare for the member states. This boon or bane dichotomy seems daunting at first because it takes two, or in this case ten, to tango. The ASEAN economic integration would be important to the world economic scene because a strong group of developing nations building a cooperative community would have a great influence not only in regional growth, but in global economic development as well (Barro and Lee, 2011). In order to promote a holistic integration of these rapidly-developing nations, there must be a unified set of socio-economic policies. Quah (1995) suggested that empirical research on economic growth must be undertaken in order to determine the extent of readiness and to fully understand the sustainability of regional economic integration. Among the many facets of integration that is required for each member state to accomplish, the main resolve must be to identify the actual state of growth in the region. A better understanding of the growth process in the region entails a better understanding of how each member state, and the region in general, can address the issues in its socio-economic policies and introduce the necessary reforms to prepare for a clearer and smoother transition to the AEC by 2015.

Organized in the beginning as a supranational body, the ten-member ASEAN is known as a "durable and successful regional grouping in the developing world" (Hill and Menon, 2010). Since 1976, the region began its plans of economic cooperation and integration. Economic growth in the economies of the ASEAN have been studied and its implications analyzed. In recent ASEAN studies, the nominal GDP (Gross Domestic Product) of the region grew to US$ 2.31 trillion (5.7 percent growth) in 2012. It was also identified that there was an increase in GDP per capita at US$ 3,751 from US$ 3,591 in 2011, which means that average income has increased by as much as 5.1 percent in the ASEAN 5, namely Indonesia, Malaysia, Philippines, Singapore, and Thailand, the five founding members of the Association. This is supported by an impressive growth in the services sector, contributing "more than 80 percent of the GDP of most

ASEAN economies" (ASEAN Secretariat, 2013). Studies conducted by the Asian Development Bank (ADB, 2013) found that the structure of the Asian transformation has been unprecedented but otherwise heterogeneous. The agency also confirmed that Southeast Asia is a service region, as measured by GDP. They also cited that, even if Southeast Asia has a lot of resources, the region still needs to build a firm industrial base and diversify those resources. Despite this lag in resource diversity, the association has continuously improved in terms of performance, and currently it is proving that it is indeed one of the most successful regional grouping in the developing world.

Looking back, the ASEAN have experienced major fluctuations in the history of its growth and productivity as a region. These historical fluctuations in regional growth should best be scrutinized in order to assess and evaluate whether the AEC would be sustainable in the future prior its 2015 implementation. The main path to mitigating the future issues that might inflict the AEC now rests on understanding the structure of regional growth. In addition, it would be crucial to figure out whether this regional growth is homogenous or heterogeneous in nature. This understanding would uncover the truth whether the implementation of the AEC would achieve sustainability and effectiveness and if it will address the socio-economic ills that plague the region in the present as well as in the future. In the advocacy of combating the socio-economic ills and promoting the goals of a consistent and sustainable regional economic growth and development prior to the implementation of the AEC by the year 2015, the primary driving force must be a closer look at the nature of regional growth, efficiency, and productivity. An integrated region stocked with highly diverse, stable, and productive capital and labor is seen as an ideal step, if not a giant leap, into understanding the keys to achieving long-run economic growth toward a successful regional integration.

In the economies of the ASEAN 5, a common goal in growth, especially in Real Aggregate Output is seen as an important step to achieve a sustainable and integrated community. In this view, a study on the readiness of the ASEAN 5 to be integrated in one community by studying the quantitative relationship of Real Aggregate Output and the productivity of factor inputs such as the Gross Capital Stock, and the Employed Labor Force used must be purposefully undertaken to contribute to the growing

literature needed in support of the necessary policy reforms that each member state could make to continuously meet the vision of the AEC by 2015.

Theoretical Framework

Production is an essential economic activity, seen by many as the foundation of all economic processes (Pindyck and Rubinfeld, 1995). Pindyck and Rubinfeld argued that at large, efficiency at the very least is the foundation of productive activity since firms tend to be profit-seeking; this could be translated into a reflection that a nation depends on the productivity of its factor inputs and the expected output is based on the efficiency of its use. This means that economic growth is influenced by the productive capacity of an economy.

Since production is central to the idea of economic growth, an assessment of its impact must be undertaken. A ubiquitous form of aggregate production function was designed by the economists Paul H. Douglas and Charles W. Cobb, known as the Cobb-Douglas Production Function (Cobb and Douglas, 1928). Their production function explored the elasticities of these factor inputs and their corresponding share in the production of output. Since the theory of production designed by Cobb and Douglas illustrates the interaction of input and output to determine growth and productivity, these concepts can be utilized in understanding the underlying principles of regional growth. This would imply greater reliability in methodology since the ubiquity of the model has been tested since its inception in the early 20th century. Furthermore, the usage of the model would aptly describe an important aspect of regional growth observable in the AEC.

Using the theory of production and the ubiquitous Cobb-Douglas production function, the state of regional growth within the ASEAN 5 can be empirically assessed. This study focused on estimating the quantitative relationship between the collective Real Gross Domestic Product in terms of PPP (GDP, PPP), the Gross Capital Stock (GCS), and the Employed Labor Force (LFE) of the economies of the ASEAN 5 by utilizing a Cobb-Douglas production function in order to determine the readiness and sustainability of productivity and economic growth prior to the AEC

2015. Using this paradigm, the quantitative relationship of the GCS and the LFE, and the corresponding Real GDP, PPP in the economies of the ASEAN 5 was estimated collectively using panel data regression analysis. This particular method is suitable for unlocking both the individual and collective characteristics of the five founding member states. It would aptly describe not only the quantitative relationship between the variables identified in the study, but how this relationship affects the ASEAN 5.

The paper aims to uncover evidences that describe the general behavior of the different productivity and growth variables to determine the extent of readiness and the possibility of sustainable regional economic growth towards economic integration in the AEC. The study focused on the general behavior of the variables in the five founding members of the ASEAN, namely Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Specifically, the study aims to determine the significance of the productivity and growth variables, country-specific characteristics, returns to scale, total factor productivity, and the long-run equilibrium relationship with the readiness and sustainability of economic integration in the region.

Review of Literature

Economic policies toward improving the influence of capital and labor is as important as both monetary and fiscal policies in its aim of achieving sustainable economic growth. If these assumptions are put to test, then a more generalized notion of how the growth process works will be uncovered. The study focused on identifying the quantitative relationship between the Real Aggregate Output, the Gross Capital Stock, and the Employed Labor Force in the ASEAN 5. Its goal was to understand the root causes of economic growth in the region, whether it is caused by capital, labor, or both factors, and to determine if the ASEAN is ready for economic integration. Once understood, policy implications on improving technical efficiency, labor productivity, and capital formation can readily be identified.

Economic growth and development is a multi-faceted activity. Romer (2006) defines economic growth as an activity where "people take resources and rearrange them in ways that make them more valuable." This view that economic growth as a mix of "ingredients" is shared by many

economists. It is believed that general economic development begins when the agents of economic growth, e.g. factor inputs, start being efficiently employed. Growth and development in the region has seen many historical highs and lows. In recent years, this trend sees a promising upturn. The literature on the miracle that is Asia has been investigated and discussed to explain why Asia is seen as the next frontier. Theories on this "Asian miracle" can be divided into two groups: (1) those who are claiming that growth was input-driven along their production function; and (2) those who are claiming that it was mastery of technology, stressing learning and innovation as keys to the appreciation of human and physical capital (Nelson and Pack, 1999). Recent growth theories suggest that regional growth is affected by individual growth rates of different countries which explains why growth are faster in some countries and slower in others. Klenow and Clare (1997), Kim and Lau (1994), Page (1994), and Sutthirak and Gonjanar (2012) all described the importance of sustained growth and rapid industrialization to achieving this Asian miracle. Since the ASEAN is planning for integration, an understanding of this process is significant. The effects of productivity and factor accumulation on growth cannot be denied. Initially, productivity was seen as a necessary step in achieving the goal of sustained long-term growth and development. Many of the literature reviews emphasized the need for government to act in accordance with the international norms relating to its support of improving the productive factors of the economy.

The points of view of different growth accountants, such as Cobb and Douglas, Solow (1957), and Mankiw et al. (1992) point to the importance of factor inputs and technology to growth. These reflect the wealth of literature on the subject of growth accounting. The literature and studies reviewed in this chapter points to this essential ingredient to growth. Among the many literature and studies reviewed, the most striking debate can be extracted from the arguments of Young (1995), Sarel (1997), and Chen (2002). The study of Young was pessimistic about the growth of TFP in the region. This was criticized by Sarel and Chen, who provided their own methodologies in extracting TFP. These arguments are largely tested using the estimation methodology used in this study. Furthermore, the major differences between all the studies reviewed is the kind of treatment and overall methodology used in their study of growth accounting. Heavy use of econometric and statistical methods augmented the expectations

from theory. Despite these differences in methods, the results of these studies point to only one thing—growth is indeed a production function.

In the ASEAN 5 setting and in view of the impending implementation of the AEC 2015, the need to further understand productivity dynamics is a commitment, much like the ASEAN vision itself. This means that in order to achieve the long-run benefits of a unified economic community, each nation must be ready to face the challenge.

Data and Procedures

In order to empirically analyze the sources of regional growth and the readiness toward economic integration of the economies of the ASEAN 5, a strategic plan must be developed and utilized. This particular empirical investigation used a *descriptive-causal research design* in its analysis on the quantitative relationship of the measured capital and labor shares in productivity to its corresponding Real Aggregate Output as measured by the Real GDP in terms of the PPP. It was *descriptive* due to its nature of contention that an observable behavior is apparent among the dependent and explanatory variables. The 32-year study, covering the years 1980 to 2012, made use of secondary annual panel data on each of the different productivity and growth variables and was gathered from two different sources. Two of the data used for the estimation of the Cobb-Douglas production function was gathered from the World Bank World Development Indicator online database: (1) Real Gross Domestic Product (GDP) in terms of Purchasing Power Parity (PPP, in constant 2005 US million dollars), and (2) Annual Gross Capital Formation (GCF) (in constant 2005 US million dollars). The data on the (3) Employed Labor Force (in thousand persons) was gathered from the online database of The Conference Board.

The strategy to answer the problems of the study involved a step-by-step examination of the quantitative relationship of Real Aggregate Output and the factor inputs, namely the Gross Capital Stock and the Employed Labor Force. Since the aggregate Cobb-Douglas production function estimates this relationship using stock values, the Gross Capital Formation data, a flow value, is used to construct a capital stock series. This is due to the lack of observable data in the region. The method used to estimate the

GCS is based on the definition set by the Organisation of Economic Co-operation and Development (OECD), known as the Perpetual Inventory Method (PIM). The PIM approach used in this study is the Harberger Approach (Harberger, 1978) which is consistent with the OECD definition and was used by Nheru and Dhareshwar (1993), Prinsloo and Smith (1997), Hall and Jones (1999), and Berlemann and Wesselhoft (2012). The formula is given as:

$$K_t = (1-\delta)\mathrm{K}_{t-1} + I_t \tag{1}$$

where K_t is the current estimate of the Gross Capital Stock of each ASEAN 5 economy, δ is the rate of depreciation, K_{t-1} is the initial Gross Capital Stock, and I_t is the current Gross Capital Formation. To estimate the initial Capital Stock, the formula used was:

$$K_0 = \frac{I_0}{\delta + g_{GDP}} \tag{2}$$

where K_0 is the initial estimate of the Gross Capital Stock, δ is the rate of depreciation, I_0 is the initial Gross Capital Formation, and g_{GDP} is the average growth rate of Real Gross Domestic Product for the period of study, which is 1980 to 2012.

Using equation 2, the initial capital stock that was estimated employed the neoclassical growth theory, wherein the economy is considered to be in equilibrium or steady state. Another assumption in the estimated initial capital stock is that the capital depreciation rate is constant at a geometric rate of 5 percent annually, based on the estimates of Sarel (1997) for the ASEAN 5. Furthermore, it was assumed that the average lifespans of capital are constant and that errors committed in the initial capital estimate diminishes due to the geometric rate of depreciation (Diallo, 2011). Therefore, the level of Gross Capital Formation in the initial year (1980 in this study), the assumed geometric rate of depreciation, and the growth rate of Real Aggregate Output would be sufficient in producing a Gross Capital Stock series.

To determine the quantitative relationship of GCS, and LFE and that of Real GDP in terms of the PPP, the *panel data regression analysis* was

used. The aggregate Cobb-Douglas production function used in this study is given as:

$$GDP_{it} = \beta_1 GCS_{it}^{\beta_2} LFE_{it}^{\beta_3} \mu^{e_{it}} \quad (3)$$

where GDP_{it} is the Real Gross Domestic Product in terms of the Purchasing Power Parity in the ASEAN economy i at time period t; GCS_{it} is the Gross Capital Stock at economy i at time period t; LFE_{it} is the Employed Labor Force at economy i at time period t; β_2 and β_3 are the elasticities of capital and labor, respectively; and the μ^{eit} is the stochastic error term. Since this model is non-linear, it was log-transformed to make it linear. Thus the model became:

$$\ln GDP_{it} = \beta_0 + \beta_2 \ln GCS_{it} + \beta_3 \ln LFE_{it} + \varepsilon_{it} \quad (4)$$

where $lnGDP_{it}$ is the natural logarithm of the Real Gross Domestic Product in terms of the Purchasing Power Parity of each ASEAN 5 economy at a given time period t; β_0 is the constant, where $\beta_0 = \ln \beta_1$; $lnGCS_{it}$ is the natural logarithm of the Capital as measured by the Gross Capital Stock at a given time period t; $lnLFE_t$ is the natural logarithm of the stock of Labor as measured by the Employed Labor Force at a given time period t; the parameters β_2 and β_3 are the elasticities of capital and labor inputs, respectively, which for this study was held at constant returns to scale; and the e_{it} is the stochastic error term. This particular model is the estimated model for the Pooled Least Squares Regression (PLS), where individual characteristics are deemed constant and that there are no effects across time (Maddala, 2001). Consequently, the Capital and Labor Stock drive the growth in Real Aggregate Output and the algebraic signs of the coefficients indicate the theoretical expectation on the influence of the explanatory variables to the dependent variable, where in this particular study, is positive. Furthermore, since the estimated model was log-transformed, the resulting coefficients of capital and labor based on the panel data regression are the same as the value of the elasticities of these factor inputs, thereby facilitating straightforward interpretation.

In order to identify and possibly address the differences and variations in country-specific characteristics, the Fixed Effects Model (FEM) was used. It is given as:

$$\ln GDP_{it} = \beta_{0i} + \beta_2 \ln GCS_{it} + \beta_3 \ln LFE_{it} + \varepsilon_{it} \quad (5)$$

i represents each individual ASEAN 5 economy. This model was expanded using differential intercept dummies of each country using Singapore as the reference country. The model is expressed as:

$$\ln GDP_{it} = \alpha_1 + \beta_2 \ln GCS_{it} + \beta_3 \ln LFE_{it} + \alpha_2 D_{2i} + \alpha_3 D_{3i} + \alpha_4 D_{4i} + \alpha_5 D_{5i} + \varepsilon_{it} \quad (6)$$

where D_i are the differential intercept dummy variables representing Indonesia, Malaysia, the Philippines, and Thailand, respectively. In order to avoid the dummy variable trap, only 4 dummy variables were utilized. Alternatively, the Random Effects Model (REM) is given as:

$$\ln GDP_{it} = \beta_{0i} + \beta_2 \ln GCS_{it} + \beta_3 \ln LFE_{it} + \varepsilon_i + \mu_{it} \quad (7)$$

where the error terms were divided into country-specific error, e_I, and the combined effects of country-specific error and time error, μ_{it}.

Since the model did not explicitly express the effects of technological progress on the production function of the ASEAN 5, the total factor productivity shall be derived using the Solow Residual:

$$SR_g = \Delta \ln GDP - \beta_2(\Delta \ln GCS) - \beta_3(\Delta \ln LFE) \quad (8)$$

where SR_g is the Solow Residual used to express the total factor productivity in the region; $\Delta lnGDP$ is the growth rate of the natural logarithm of the Real Gross Domestic Product, $\Delta lnGCS$ is the growth rate of the natural logarithm of the Gross Capital Stock; $\Delta lnLFE$ is the growth rate of the natural logarithm of the Employed Labor Force; β_2 and β_3 are the respective elasticities of the Capital Stock and Labor Stock respectively.

To provide a scientific analysis and interpretation of the data toward the resolution of the problems ruled out at the beginning of this paper, several statistical treatment were conducted. To determine stationarity and the order of integration, the Im, Pesaran, and Shin *W*-statistic (Im et al., 2003) was used under the assumption that *ordinary least-squares* (OLS) regression can be performed if the computed *p*-value is less than 0.05 level of significance. Autocorrelation was tested using the Durbin-Watson

d-statistic, whereby the computed *d* for all observations and explanatory variables falls between the critical *dU* and *4-dU* values. Necessary corrections for the first and second order autoregressive models were employed upon the detection of the presence of autocorrelation. Correlation between random effects and the explanatory variables were determined via the Hausman Test, which also laid out the appropriateness among the three econometric models. To examine the true value of the parameters and the returns to scale based on sample estimates, the Wald Coefficient Test and the General *F*-test was employed. Harrell (2001) noted that parameters are consistent if the sum of the coefficients is equal to 1 for a constant returns to scale. Danao (2002), on the other hand, posits that if the respective *p*-values of the Wald statistic do not exceed the 5 percent significance level, the sum of the coefficients is not equal to 1, thereby suggesting either an increasing or decreasing returns to scale. The Autoregressive Conditional Heteroskedasticity Lagrange Multiplier (ARCH-LM) effect model was used to test the auxiliary regression for heteroskedasticity specification based on Engel (1982). Goodness of Fit was assessed using the Coefficient of Multiple Determination R^2 while the significance of parameter estimates were tested using the *t*-test. To identify where there is significance in the overall OLS regression, the *F*-statistic Analysis of Variance (ANOVA) was used. Lastly, to identify whether there is a long-run equilibrium relationship between the GCS and LFE, and the Real GDP in terms of PPP in the ASEAN 5, the Johansen-Fisher Panel Cointegration test was employed (Hjalmarsson and Osterholm, 2007).

RESULTS AND DISCUSSION

A. Behavioral Analysis of Productivity and Growth Variables

The prominence of establishing the AEC by the year 2015 would bring about massive changes in the *status quo* within Southeast Asia. With a massive economic architecture needed to construct such a community, it would be of paramount importance to historically analyze the patterns and processess of growth so that it can be surmised if the community would be sustainable and likely to succeed in its goal of bridging the region towards a unified and integrated community.

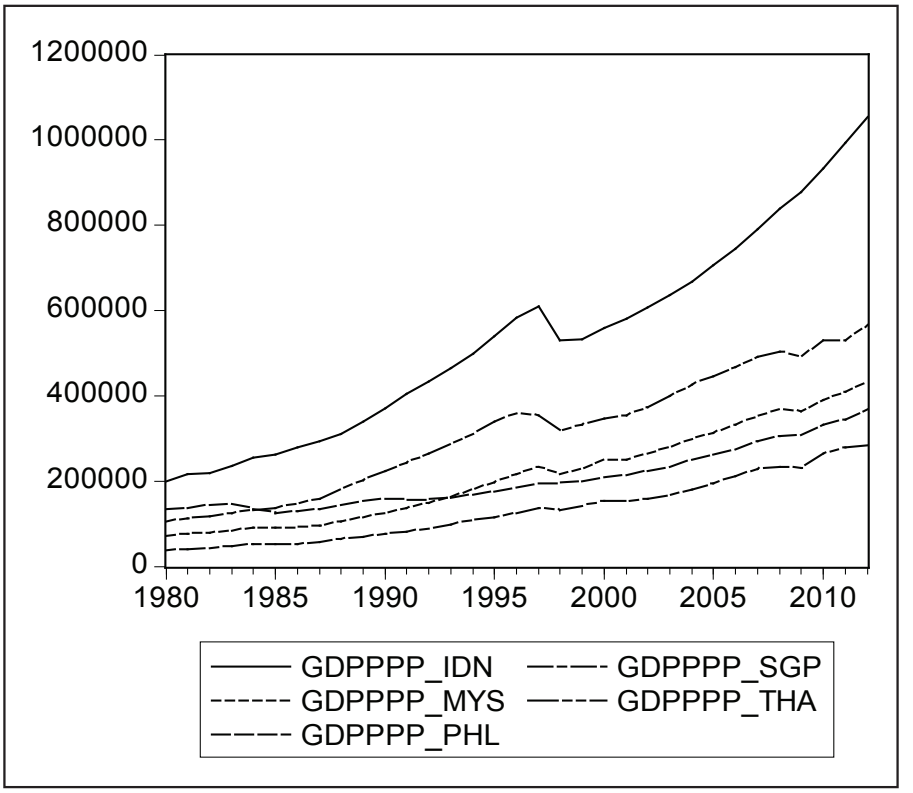

Figure 1
Real GDP, PPP of the ASEAN 5 Economies, 1980 to 2012

Aggregate output as measured by Real GDP in terms of PPP among the ASEAN 5 is brimming with optimism. Figure 1 illustrates this general behavior. Indonesia, the largest ASEAN economy and a major emerging market in the world exhibits rapid growth due to its export-orientation, having grown from US$199,519.24 in 1980 to US$1,054,482.67 (both in millions), its present value. A similar but albeit steady growth is seen in Malaysia, with an annual GDP growth rate of 5.64 percent. The Philippines, seen as one of the fastest growing economies in the ASEAN, posted a 6.81 percent GDP growth rate in 2012, one of the highest in the region. This obvious upturn of growth in the region is supported by a boosting Thai economy, despite setbacks in the 1997 Asian Financial Crisis, boasting one

of the largest outputs in the region, with an average annual growth of 5.48 percent. The apparent economic leader in the region, Singapore also boasts impressive numbers in terms of factor inputs and real aggregate output with an average annual GDP growth of 6.69 percent.

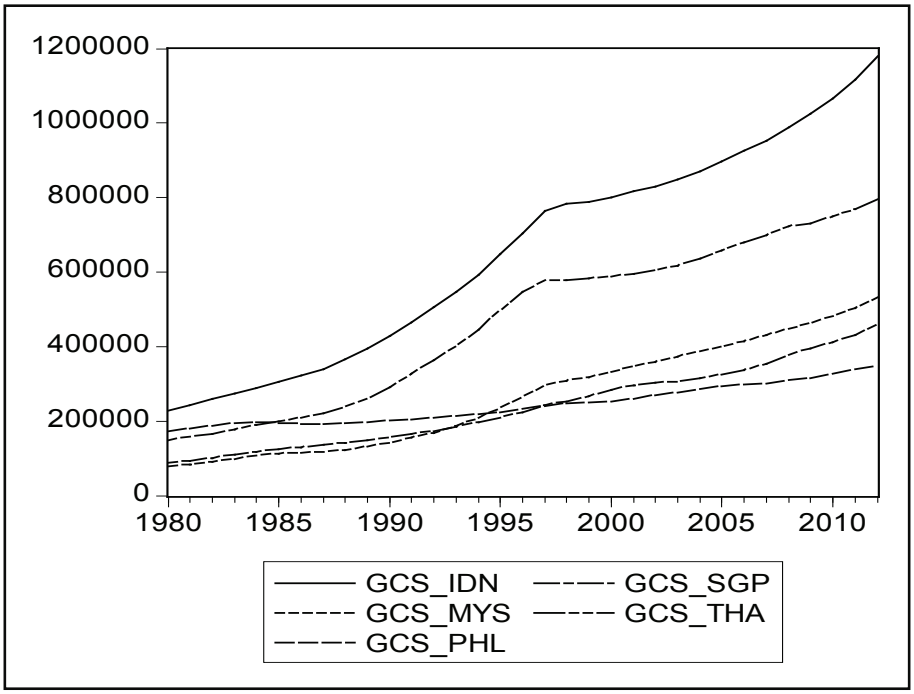

Figure 2
GCS of the ASEAN 5 Economies, 1980 to 2012

Similarly, the Gross Capital Stock data across the ASEAN 5 exhibits a steady upturn. According to the Australian Consortium for 'In-Country' Indonesian Studies (ACICIS), debt structuring programs of the Indonesian government boosted the overall growth in gross investments from 4 to 6 percent. Malaysia also had a boost in capital stock during the 30-year study, from US$77,586.13 in 1980 to US$533,121.25 (both in millions) in 2012. Similar observations can be extrapolated in Thailand and in the economic leader, Singapore. The Philippines also exhibits the same pattern, with an average annual growth rate of 2.22 percent from 1980 to 2012.

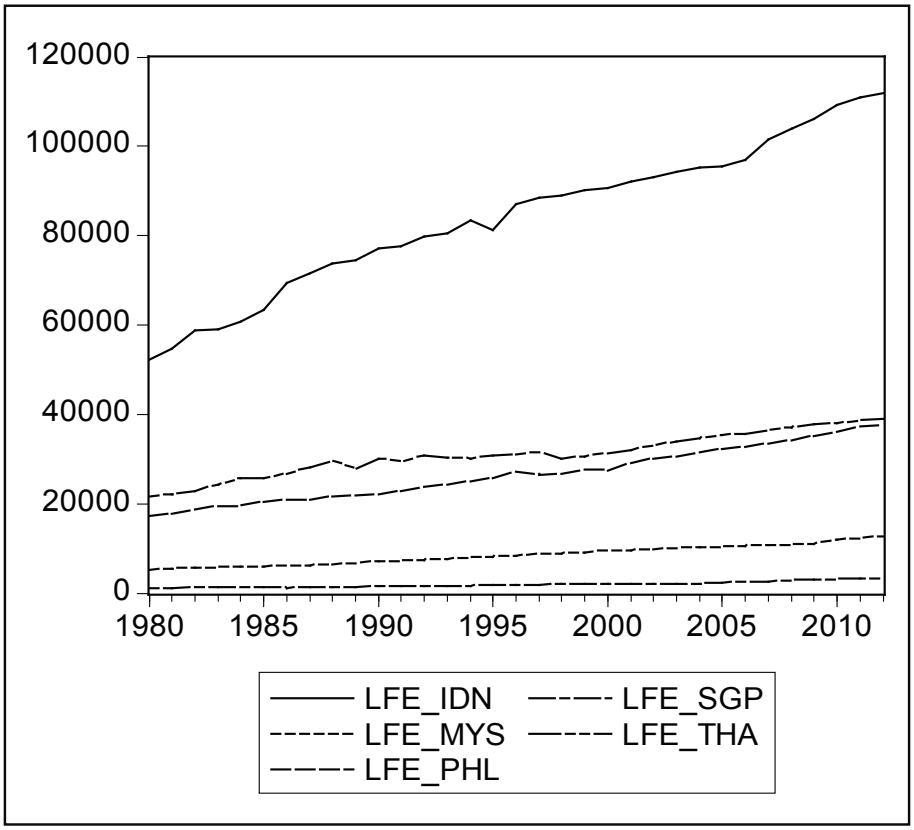

Figure 3
LFE of the ASEAN 5 Economies, 1980 to 2012

The growth of employed labor among the ASEAN 5 has also seen a slow but steady rise. Figure 3 illustrates the apparent leadership of Indonesia, largest in terms of population, growing from 52,353.61 in 1980 to 111,982.73 (both in thousand persons) in 2012. Analogous to this apparent trend is the steady rise of employed labor in Malaysia, The Philippines, Singapore, and Thailand.

It is interesting to note that the general behavior of the ASEAN 5 is apparently positive, based on the analysis of the pertinent data in the region. The obvious leader, Singapore, leads the pack in all levels of growth and development. However, the rest of the region seems to catch-up, especially

the Philippines who had been the underdog in the past due to historical turmoil. This can be seen as a closing of the gap between haves and have-nots in the ASEAN region. This implies that there is a generally positive outlook to the sustainability of a region aiming for complete integration.

A. Panel Data Regression Analysis

In order to identify the stationarity and order of integration of the variables used in determining the production function in the economies of the ASEAN 5 prior to regression analysis, the Im, Pesaran, and Shin (Im et al., 2003) W-statistic for panel data was utilized. Based on the results of the IPS W-statistic test summarized in Table 1, all the variables used to describe the production function of the ASEAN 5 are stationary at second difference and are integrated in the order of 2, *I(2)* since the probability of the IPS W-stat of each variable is less than the 0.05 level of significance. Since the data are integrated in the second order, the regression analysis of the identified variables at level is feasible.

Table 1
Summary of Panel Unit Root Test

Variable	At Level		At First Difference		At Second Difference	
	IPS W-Stat	Probability	IPS W-Stat	Probability	IPS W-Stat	Probability
LNGDP	2.13349	0.9836	-7.38751	0.0000	-12.1182	0.0000
LNGCS	-0.75462	0.2252	-0.52646	0.2993	-6.82625	0.0000
LNLFE	-2.32761	0.0100	-10.4470	0.0000	-15.2692	0.0000

To estimate the quantitative relationships between the (natural logarithms of) GCS and LFE, and the (natural logarithm of) GDP, panel data regression analyses were performed. Three panel data regression models were employed: Pooled Least Squares (PLS) Model, Fixed Effects Model (FEM), and the Random Effects Model.

Table 2
Summary of Pooled Least Squares Regression Corrected for Autocorrelation

lnGDP = – 0.265847 + 0.870035(lnGCS) + 0.175428(lnLFE)							
t-Statistic		*(–0.189246)*	*(8.036079)*	*(2.590952)*			
$\mathbf{R^2}$	=	0.997492		**Adj R^2**	=	0.997425	
$\mathbf{F_{(4, 150)}}$	=	14916.27		**DW**	=	1.918369	
Critical Values							
$\mathbf{F_{(4, 150)}}$		2.43		**DW**	dU		1.760
***t*-ratio**$_{(0.05)}$ (one-tail test)		1.645			4-dU		2.240

Based on the results of the initial PLS regression, the explanatory variables, lnGCS and lnLFE, were found to be statistically significant at 5 percent level of significance, since the computed *t*-values, 45.670 and 13.429 respectively, are greater than the critical *t*-value of 1.645 on the basis of the one-tail test. However, since the initial pooled regression yielded a calculated *d*-statistic of 0.092 which is less than the critical dU value of 1.767, there is positive autocorrelation detected. Consequently the pooled regression model was corrected. Table 2 shows a summary of the PLS regression corrected for autocorrelation.

The computed *d*-statistic of 1.918 became greater than the critical dU value of 1.760 and less than the critical 4-dU value of 2.240 at 5 percent level of significance. Therefore, no autocorrelation was detected, whether positive or negative, in the pooled least squares regression model.

A one-tail *t*-test was used because both lnGCS and lnLFE are expected to have a positive effect on lnGDP (Gujarati, 1999). lnGCS was found to be significant at 5 percent level of significance with a computed *t*-value of 8.036 which is greater than the critical *t*-value of 1.645. This implies that, *ceteris paribus*, for every one percent increase in GCS, GDP in terms of PPP increases by 0.870035 percent. Moreover, this implies that an increase in GCS by one million US dollars in the ASEAN 5 will, on average, increase GDP by US$2,386,994.40. Therefore, in the PLS regression model, the null hypothesis that the Real Aggregate Output in the economies of the ASEAN 5 is not significantly affected by the Gross Capital Stock, is rejected.

Similarly, lnLFE was found to be significant at 5 percent since the computed *t*-value of 2.591 is greater than the critical value at 1.645. Based on the computed coefficient, *ceteris paribus*, a one percent increase in Employed Labor Force increases GDP in terms of PPP by 0.175428 percent. This implies that a rise in the number of employed labor force in the ASEAN 5 by 1,000 persons will bring about an increase in GDP by US$1,191.76. Therefore, in the PLS regression model, the null hypothesis that the Real Aggregate Output in the economies of the ASEAN 5 is not significantly affected by the Employed Labor Force, is rejected.

The F-statistic of 14916.27 greatly exceeds the 5 percent level of significance with a critical F-value of 2.43, with 4 and 150 degrees of freedom. This means that the PLS regression model is statistically significant. Thus, in the PLS regression, the null hypothesis that Real Aggregate Output in the economies of the ASEAN 5 is not significantly affected by the Gross Capital Stock and the Employed Labor, taken collectively, is rejected.

The coefficient of multiple determination R^2 of 0.9975 implies that 99.75 percent of the variations in lnGDP was explained by the variations in the explanatory variables taken collectively. This means that only 0.25 percent are unexplained by the PLS regression model because of the other factors that were not included in the model and the stochastic error term. The signs of the coefficients of both explanatory variables are positive and are consistent with theoretical expectations.

Figure 4 illustrates the graph which exemplifies the effect of lnGCS and lnLFE on lnGDP in terms of PPP in the ASEAN 5. Based on the figure, the 32-year PLS analysis shows that the regression estimates produced by the estimated aggregate Cobb-Douglas production function appear to fit the actual behavior of the data. Moreover, the graphical presentation of the residuals amplifies the fact that the residuals of the series are stationary since the fluctuations are more or less centered on zero.

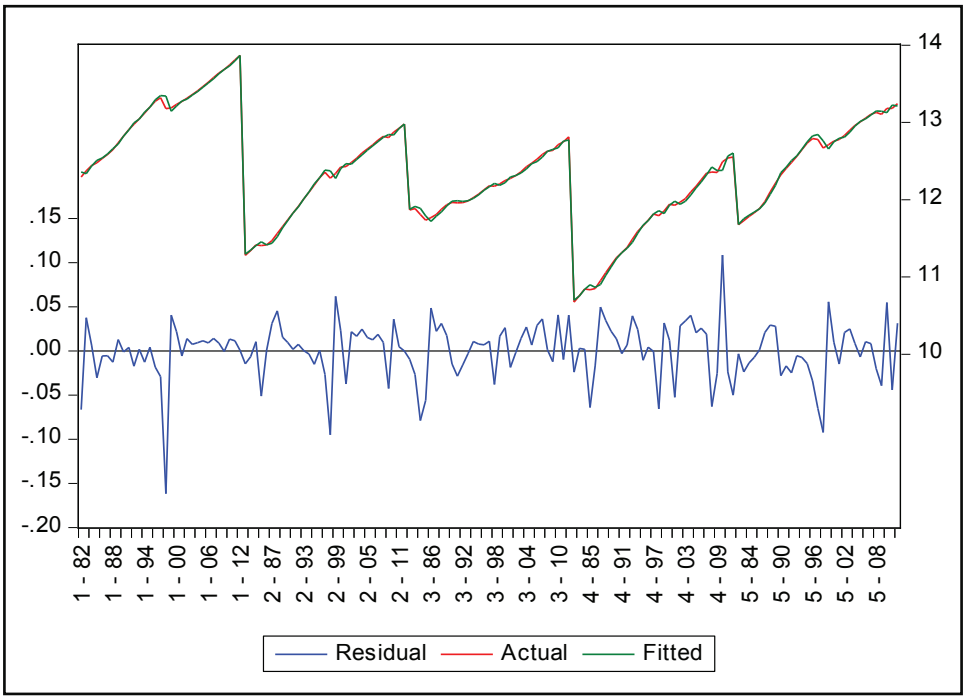

Figure 4
Plot of the Actual, Fitted, and Residual for Pooled Regression

Based on the FEM regression summarized in Table 4, the explanatory variables, lnGCS (*t*-value of 26.872) and lnLFE (*t*-value of 15.022), were found to be statistically significant at 5 percent level of significance, since the respective *t*-values are greater than the critical *t*-value of 1.645. However, since the initial regression yielded a calculated *d*-statistic of 0.290 which is less than the critical dU value 1.819, there is a positive autocorrelation detected in the initial FEM. The model was corrected for autocorrelation which is summarized in Table 3.

The FEM results summarized in Table 3 indicates that there is no autocorrelation detected, whether positive or negative, since the condition $dU < d < 4–dU$ has been satisfied, i.e. 1.847 (dU) < 1.959 (d) < 2.153 ($4–dU$) at a=0.05. *lnGCS* was found to be highly significant at 5 percent level of significance with a computed *t*-value of 13.636 which is greater than the critical *t*-value of 1.645. This means that, *ceteris paribus*, for every one percent growth in GCS, GDP in terms of PPP increases by 0.836245 percent. This

would mean an increase in the GDP of the ASEAN 5 by US$2,307,685.33 when GCS increases by US$1 Million. Therefore, in the FEM regression, the null hypothesis that the Real Aggregate Output in the economies of the ASEAN 5 is not significantly affected by the Gross Capital Stock, is rejected.

Table 3
Summary of Fixed Effects Model Regression Corrected for Autocorrelation

lnGDP = – 2.290368 + 0.836245(lnGCS) + 0.487620(lnLFE) – *1.271047(D2)*						
t-Statistic	*(–4.303552)*	*(13.63648)*	*(4.829956)*	*(–3.713324)*		
	– 0.321570(D3) – 0.838020(D4) – 1.013984(D5)					
t-Statistic	*(–2.074845)*	*(–3.070050)*	*(–3.950919)*			
R^2 =	0.997741		**Adj R^2** =	0.997618		
$F_{(8, 146)}$ =	8062.331		**DW** =	1.959169		
Critical Values						
$F_{(8, 146)}$	1.99		**DW**	dU	1.847	
***t*-ratio$_{(0.05)}$** (one-tail test)	1.645			4-dU	2.153	

Correspondingly, lnLFE was also found to be highly significant with a computed *t*-value of 4.830, greater than the critical *t*-value of 1.645 at 5 percent level of significance. This means that, *ceteris paribus*, a one percent growth in Employed Labor Force increases GDP in terms of PPP by 0.487620 percent, implying that for every additional one thousand employed labor in the ASEAN 5, GDP will increase by US$1,628.44. Therefore, in the FEM regression, the null hypothesis that the Real Aggregate Output in the economies of the ASEAN 5 is not significantly affected by the Employed Labor Force, is rejected.

The model also incorporated 4 differential intercept dummies for Indonesia, Malaysia, the Philippines, and Thailand, respectively. Singapore was used as the reference country since it is perceived to be the regional leader based on the behavioral analysis of the identified variables. These dummy variables were used to represent the country-specific characteristics of each economy (Gujarati, 2004). Based on the results, the estimated coefficients show a gap with the estimated coefficient of Singapore in terms of growth in Real Aggregate Output. Furthermore, the *t*-values of the four ASEAN nations are all significant to the regression at 5 percent level of significance

(Indonesia, –3.713; Malaysia, –2.075; Philippines, –3.070; and Thailand, –3.951, respectively), with a critical *t*-value of 1.645. This implies that the coefficients of all ASEAN 5 are different. Therefore, the null hypothesis that the Real Aggregate Output is not significantly affected by the differences in country-specific characteristics of the ASEAN 5, is rejected.

Thus, it can be extrapolated that even if the growth pattern in the ASEAN 5 appears to be heading the same upward direction, it is highly affected by country-specific characteristics, implying that the possibility of achieving unified regional growth is not currently apparent in the historical data. Since the country-specific characteristics differ among countries in the ASEAN 5, it can be established, therefore, that the null hypothesis that the behavior of country-specific characteristics in the ASEAN 5 does not indicate readiness toward economic integration, is not rejected. This is an indication that the ASEAN 5 may not be ready toward economic integration as shown by the differences in the pattern of economic growth.

The F-statistic of 8062.331 greatly exceeds the critical F-value of 1.99 at 5 percent level of significance. This means that the FEM regression is statistically significant. Thus, in the FEM regression, the null hypothesis that Real Aggregate Output in the economies of the ASEAN 5 is not significantly affected by the Gross Capital Stock and the Employed Labor, taken collectively, is rejected. The coefficient of multiple determination R^2 of 0.9977 implies that 99.77 percent of the variation in GDP in terms of PPP was explained by the variations in the GCS and LFE, taken collectively. This suggests that only 0.23 percent are unexplained by the FEM regression because of the other factors that were not included in the stochastic error term. The signs of the coefficients of both explanatory variables are positive and are consistent with theoretical expectations.

Figure 5
Plot of the Actual, Fitted, and Residual for Fixed Effects Model

Figure 5 illustrates the graph which exemplifies the effect of lnGCS and lnLFE on lnGDP in terms of PPP in the economies of the ASEAN 5 using the FEM regression. Based on the figure, the regression estimates apparently fit the behavior of the actual data. It also implies that the FEM regression residuals are stationary since the fluctuations are more or less centered on zero.

Based on the REM regression results summarized in Table 4, the explanatory variables, lnGCS and lnLFE, were found to be statistically significant at 5 percent level of significance, since the corresponding *t*-values are greater than the critical *t*-value of 1.645. However, since the REM regression yielded a calculated *d*-statistic of 0.167 which is less than the critical dU value 1.767, there is a positive autocorrelation detected in the REM regression.

Table 4
Summary of Random Effects Model Regression

lnGDP = – 2.305630 + 0.816899(lnGCS) + 0.443890(lnLFE)							
t-Statistic			*(–11.50532)*	*(41.64925)*	*(12.33940)*		
R^2	=	0.974152			**Adj R^2**	=	0.973833
$F_{(2,162)}$	=	3052.699			**DW**	=	0.167250
Critical Values							
$F_{(2,162)}$	=	3.06			**DW**	dU	1.767
***t*-ratio$_{(0.05)}$** (one-tail test)	=	1.645				4-dU	2.233

lnGCS was found to be significant at 5 percent level of significance with a computed *t*-value of 41.649 which is greater than the critical *t*-value of 1.645. This means that, *ceteris paribus*, for every percentage point, GDP in terms of PPP increases by 0.816899 percent implying that for every US$1 Million increase in GCS, GDP increases by US$2,263,469.92. Therefore, in the REM regression, the null hypothesis that the Real Aggregate Output in the economies of the ASEAN 5 is not significantly affected by the Gross Capital Stock, is rejected.

Equally, lnLFE was also found to be significant with a computed *t*-value of 12.339 which is greater than the critical *t*-value of 1.645 at 5 percent level of significance. This agrees with theoretical expectations meaning that, *ceteris paribus*, a percentage increase in Employed Labor Force increases GDP in terms of PPP by 0.443890 full percentage point. This implies that for every additional 1,000 Employed Labor Force, GDP will increase by US$1,558.76. Therefore, in the REM regression, the null hypothesis that the Real Aggregate Output in the economies of the ASEAN 5 is not significantly affected by the Employed Labor Force, is rejected.

The F-statistic of 3052.699 greatly exceeds the critical F-value of 3.06 at 5 percent level of significance. This means that the random effects model regression was statistically significant. Thus, in the REM regression, the null hypothesis that Real Aggregate Output in the economies of the ASEAN 5 is not significantly affected by the Gross Capital Stock and the Employed Labor Force, taken collectively, is rejected. The coefficient of multiple determination R^2 at 0.9742 implies that 97.42 percent of the variation in GDP in terms of PPP was explained by the variations in the explanatory

variables, taken collectively. This means that 2.58 percent are unexplained by the random effects model regression or due in part because of the other factors that were not included in the stochastic error term. The signs of the coefficients of both explanatory variables are positive and are consistent with theoretical expectations.

Figure 6 illustrates the graph of the Actual, Fitted, and Residual Values, which exemplifies the effect of lnGCS and lnLFE on lnGDP in terms of PPP in the ASEAN 5. Based on the figure, the regression residuals are found to be non-stationary since the fitted values do not entirely fit the actual data and the residuals are not centered on zero.

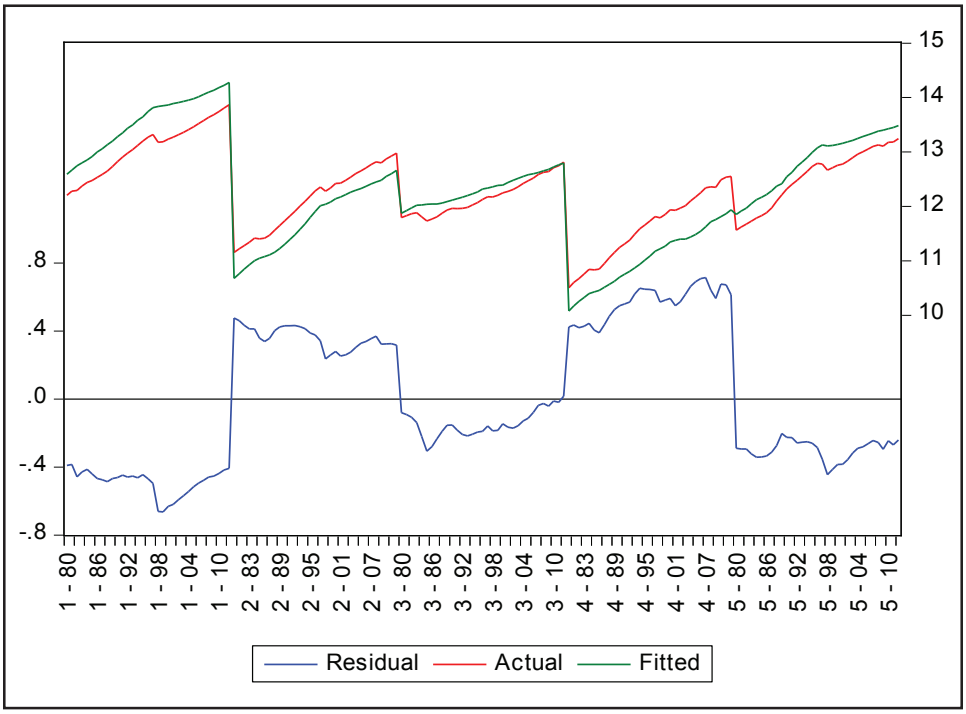

Figure 6
Plot of the Actual, Fitted, and Residual for Random Effects Model

Since the panel data regression analysis uses three distinct models, it is important to determine which among these three is the most appropriate and has predictive power. To determine which between the FEM and REM is more appropriate, the Hausman Test was conducted.

Table 5
Summary of Hausman Test

Test Summary	χ^2 Statistic	χ^2 df	Probability
Cross-section random	94.228744	2	0.0000

Table 5 summarizes the results of the Hausman Test. Based on the results, the fixed and random estimators are significantly different. This is because the probability of 0.0000 is much lower than 5 percent level of significance, which means that the FEM regression is much more appropriate than the REM regression. Table 6 compares the various estimators of the Pooled, Fixed and Random Effects models.

Table 6
Comparison of Pooled, Fixed, and Random Estimators

Variable	Pooled	Fixed	Random	Var(Diff.)	Prob.
lnGCS	0.881265	0.658120	0.816899	0.000275	0.0000
lnLFE	0.139422	0.807867	0.443890	0.001434	0.0000

As to which model is more appropriate between pooled and fixed effects models, the R^2 and the adjusted R^2 as goodness-of-fit measures would have increased to determine the adequacy of the regression model. But since the sample size *n* and the dependent variables are the same and the explanatory variables are in different forms, these two models cannot be compared in terms of their R^2 or the adjusted R^2, implying that both models can be used to answer the problems of the study. In this case, the model that best exhibits theoretical soundness would be more appropriate. Since the significance of parameter estimates of the FEM regression better fits the requirements of the theoretical expectations of the study, the FEM regression is the most appropriate model among the three panel data regression models. In order to confirm this assumption, the General F-test was used. It is summarized in Table 7. Based on the test, the *p*-value of the F-statistic did not exceed the 0.05 level of significance (F=13.21374, *p*=0.0000) implying that the differential intercept dummies are not equal to zero. This suggests that the dummy variables that represent the country-specific characteristics among the four of the five founding members influence the behavior of regression estimates of the FEM. This confirms greater predictive power and theoretical reliability from the results of the FEM regression.

Table 7
General F-Test

Test Statistic	Value	df	Probability
F-statistic	13.21374	(4, 146)	0.0000

Since the fixed effects model is the most appropriate model to be used in this empirical investigation, the structural equation for the ASEAN 5 production function is given as:

$$GDP_{it} = -2.290368(GCS_{it}^{0.836245})(LFE_{it}^{0.487620}) \quad (9)$$

The structural model is consistent with theoretical expectations of the ubiquitous Cobb-Douglas production function.

Table 8
Wald Coefficient Test and the General F-test

Test Statistic	Value	df	Probability
t-statistic	4.815150	146	0.0000
F-statistic	23.18567	(1, 146)	0.0000
Chi-square	23.18567	1	0.0000

In order to figure out if the economies of the ASEAN 5 exhibits constant, decreasing, or increasing returns to scale, the Wald Coefficient Test and the General F-Test was conducted. Table 8 summarizes the results of these tests. Based on the results, since the probability value of 0.0000 is below 5 percent level of significance means that the coefficients are statistically different from 1. Therefore, the null hypothesis that the aggregate production function of the ASEAN 5 is characterized by constant returns to scale, is rejected. Based on the linear restriction of $\beta_2 + \beta_3 = 1$, the sum of the coefficients is 1.323865, which is greater than 1. This denotes that the aggregate production function of the ASEAN 5 exhibited an increasing returns to scale.

In order to identify the total factor productivity not accounted for by the FEM regression, the Solow Residual was computed. The computed coefficients and the average growth rates of the natural logarithms of the variables were utilized. Based on the computed Solow Residual, technological progress contributes to the ASEAN 5 economic growth by

–0.000391829. This implies that on average, the Total Factor Productivity in the economies of the ASEAN 5 is –0.039 percent. The negative, if not zero total factor productivity in the ASEAN 5 is consistent with the results of Young (1995) since the data used was based on national income accounts. This implies that economic growth in the ASEAN 5 is characterized by resource accumulation and not technological progress.

In order to determine whether the model is homoskedastic, the Autoregressive Conditional Heteroskedasticity Lagrange Multiplier (ARCH-LM) test was used. The results of the test are summarized in Table 9. Since the probabilities yielded from the ARCH LM test exceeds the 0.05 level of significance, homoskedasticity is apparent in the model.

Table 9
ARCH LM Test

F-statistic	0.983618	Probability	0.376234
Obs*R-squared	1.979936	Probability	0.371589

To determine if there is a long-run equilibrium relationship between the explanatory variables and the dependent variable in the economies of the ASEAN 5, the Johansen Fisher Panel Cointegration Test was performed. Table 10 summarizes the results of this test.

Table 10
Johansen Fisher Panel Cointegration Test

Hypothesized no. of CE(s)	Fisher Stat. (from trace test)	Prob.	Fisher Stat. (from max-Eigen test)	Prob.
None	203.8	0.0000	157.0	0.0000
At most 1	25.87	0.0039	19.79	0.0313
At most 2	14.34	0.1580	14.34	0.1580

Based on the results, since the respective probabilities of the Trace test and the maximum Eigenvalue test is below the 0.05 level of significance, there exists a long-run equilibrium relationship between GCS and LFE, and that of GDP. Thus, the null hypothesis that there is no long-run equilibrium relationship between the Real Aggregate Output, the Gross Capital Stock, and Employed Labor in the economies of the ASEAN 5, is rejected. The estimated model, therefore has predictive power and is not spurious.

Concluding Remarks

Complementary to the commitment of building the ASEAN Economic Community (AEC) is the necessity to assess productivity and economic growth across the region. In recent years, the general growth behavior of several ASEAN member states, taken individually and collectively, have been optimistic. Based on the general behavior of the key regional players, there is an upward trend among the productive and growth variables from 1980 to 2012. Singapore was perceived as the regional leader while Indonesia, Malaysia, the Philippines, and Thailand, followed suit. Singaporean leadership can be attributed to a relatively stable capital formation because of several beneficial economic policies in the country. The other four ASEAN founding members, on the other hand, are seen as following this leadership through similar policies, as exhibited in the average annual growth patterns across explanatory variables. With a massive architecture needed to construct such a community, it is of paramount importance to assess first the readiness of the region. This empirical investigation focused on the evaluation of one of the pillars of the AEC—a single production base—as basis for the assessment of readiness towards regional economic integration. In the AEC Blueprint, the importance of a clean transformation of the region towards a single market and production base cannot be overemphasized (ASEAN Annual Report, 2009). Because the economies of the ASEAN 5 exhibit an upward trend during the period of study, it would be imperative for the respective governments of Indonesia, Malaysia, the Philippines, Singapore, and Thailand, to revisit and enhance corresponding policies and programs that foster economic growth. Strategies included in the AEC Blueprint and in the ASEAN Charter must be thoroughly implemented.

The paradigm for evaluating readiness towards economic integration used a Cobb-Douglas production function to identify key factors that may affect the sustainability of integration. The Fixed Effects Model provided a more reliable estimate of the quantitative relationship between the change in Real GDP and the changes in the GCS and LFE. The results of the panel data regression analysis reveal that both labor and capital are significant contributing factors to economic growth, taken individually among countries and collectively as a region. Furthermore, the results of the panel data regression analysis show that the changes in Real Aggregate Output as represented by the GDP in terms of the PPP

was significantly affected, taken individually and collectively, by the GCS, and the LFE. The ASEAN 5 is characterized by increasing returns to scale. Both the GCS and LFE are inelastic and the algebraic signs of these estimated coefficients are positive and in accordance with theoretical expectations. This implies that the production and growth indicators are brimming with optimism, a signifier that economic integration under the 'single production base' argument is possible, implying that the ASEAN 5 should continuously promote a more conducive investment climate, both locally and internationally, so that there will be continued positive growth on the region's GCS. This would be essential if economic integration in the ASEAN is to become continuously sustainable. Seeing this, a careful implementation of the ASEAN Comprehensive Investment Agreement (ACIA), especially by Indonesia and Thailand who are yet to sign the agreement, must be undertaken to expedite investment in the region.

On average, the Total Factor Productivity as measured by the Solow Residual is –0.039 percent. This implies that technological progress has negative, if not zero contribution to regional economic growth and it can be surmised that this growth emanates from excessive capital accumulation, inferring the need for the development of home-grown technology. This means that the five founding members are not influenced by technological progress, as exhibited by the negative if not zero Total Factor Productivity despite massive acquisitions of technologies and ideas. Therefore, increased investment, especially on human capital, would enable each ASEAN 5 economy to increase productivity through learning by doing.

The evidence further indicates that the region is not yet ready for economic integration and that country-specific characteristics are apparent limiting that capability of the region to converge. This awareness of the apparent level of unreadiness in the region is important in identifying steps to mitigate future issues that may arise, especially its effects in terms of culture, governance, and cross-regional relations. In spite of the differing economic features of each country, it is apparent based on the general behavior of all examined variables that all five countries are exhibiting positive economic outlook, as observed by the similarities in the regional growth pattern. This signifies that further investigation on how to achieve holistic readiness must be undertaken since economic indicators show otherwise.

This evidence does not mean that the path towards regional integration must be discontinued; rather, governments within the economic community must work hand-in-hand towards identifying key policies that would aid the 'leap-frogging' of individual economies towards a converging growth climate. This implies that in order to achieve a sustainable economic integration that benefits all ASEAN member states, further assessment and unification of economic policies within and among nations has to be made, especially those relating to the development of home-grown technologies and the establishment of a truly strong market and production base. This can be done by improved allocation of both public and private funds in education and training of human capital. Governments of Indonesia, the Philippines, and Thailand could also address this issue through appropriate and timely educational reforms that meet the performance of fellow founding members, Malaysia, and Singapore. By increasing the capabilities of the education sector to educate the citizens of these nations, the better equipped they will become to alleviate this inadequacy. In addition to this, strengthening multilateral strategies involving the sharing of technology through a free flow of goods and services must be emphasized to improve technological progress in the region and to limit individualistic tendencies of countries to develop local technical know-how. Furthermore, in order to mitigate the dismal contribution of technological progress, the ASEAN 5 must delve into introducing more policies that prioritize research and development, protection of intellectual property rights, and the fostering of localized technological industries. The region should also focus on developing its own technologies instead of assimilating them. Information and Communications Technology zones, areas where technology is explored and developed, could also be introduced in the region. Moreover, cultivating an entrepreneurial atmosphere could pose as another solution to this problem. Economic planning agencies within each of the five founding members should look into boosting output by promoting labor productivity, possibly through improved labor conditions, better wages, and other productivity boosting policies. Likewise, there must be a borderless exchange of skilled and professional labor between the five founding members at the onset of the integration. The ASEAN should also focus on integrating ICT- and e-Commerce-based labor to induce and improve technical efficiency in the region.

It can be concluded therefore, that it is of paramount importance for individual countries to put primacy not only on localized economic policies but a truly cooperative set of programs that foster balanced growth across the region. Achieving collective economic growth takes time; therefore, the long-run sustainability and success of the AEC rests on the ability of individual member states to respond and correspond to the speed of productivity and growth in the region.

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