



## **The Club Convergence of Efficiency in ASEAN Banking Sector**

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### **ABSTRACT**

The study examines the internal financial structure of ASEAN banking and its efficiency. In doing so, it concentrates on the characteristics of banking sector efficiency and practises within the ASEAN countries banking sectors by using Phillips and Sul (2007a, 2007b and 2007c) approach. Firstly, by applying non-parametric Data Envelopment Analysis (Simar and Wilson, 2007) technique, it considers the technical efficiency of ASEAN banks. The outcome confirms that, at the aggregate level, the ASEAN banking markets are diverging. Further investigation indicates comparatively weak convergence between banking sector of ASEAN though there is still potential of catching up process between them. It can be concluded that ASEAN countries are inter-related and most of the banks are catching up within the different club and different degree of convergence. In terms of efficiency, the results show that at aggregate level, the ASEAN countries are competitive among each other acknowledged by the identification of 3 convergence clubs. The study is able to gain an insight overview regarding ASEAN banking efficiency and its ability to catch up between member countries. These could lead to a successful financial integration, fulfilling the objective to create a potential single currency within ASEAN countries in the near future.

**JEL Classification:** G15, G21

**Keywords:** Banking sector efficiency, non-linear model, Asean, convergence.

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*Article history:*

Received: 23 July 2017

Accepted: 26 January 2018

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## INTRODUCTION

The development of banking sector in Asian countries had started long before Asian financial crisis in 1997 or Global financial crisis in 2008. However, banking industry in Asian region had to be restructured and reformed after the hit of financial crisis in 1997 and since then the financial sector in Asian region has developed significantly. In addition, banking sector in this region has fortified their balance sheets and as a result they are able to withstand or recover quickly from external shocks. Then after the Global financial crisis, banking sector in Asian countries have become increasingly intensified as stated by Remolona and Shim (2015). One of the efforts is the establishment of ASEAN Banking Integration Framework (ABIF) by central bank governors of ASEAN members. ABIF is the extension of ASEAN Financial Integration Framework (AFIF). The purposes of creating ABIF are; (1) to lower the interest rates of banking sector due to increase competition in banking sector and, (2) to build a strong and stable pan-ASEAN regional banks that can compete in financial global markets. Another effort is by forming ASEAN Economic Community (AEC) to make ASEAN region becomes more liberalize and mobilize in terms of goods, services, investment skilled labour and capital flow. Through AEC, financial sector among ASEAN member states will become more integrated with each other. Apart from that, AEC will liberalize its member's domestic financial market as well as capital account in which create free flow of capital market (Asian Development Bank, 2013). Regional network of major banks in ASEAN based on number of branches, representative offices in ASEAN which exclude home country. Malaysia's top major banks in regional network are Bangkok Bank, Bank Mandiri, United Overseas Bank and DBS Group Holdings. As for Singapore, the top major banks' regional network are Bangkok Bank, Malayan Banking and Bank Mandiri. In Indonesia, the top major banks for regional network are Bangkok Bank, Malayan Banking, United Overseas Bank and DBS Group Holdings. The top major banks' regional network for Thailand includes Malayan Banking, United Overseas Bank and DBS Group Holdings. Lastly as for major banks' regional network in Philippines consists of Bangkok Bank, Malayan Banking, United Overseas Bank and DBS Group Holdings. Overall, it can be seen that Singapore's state-linked bank which is DBS Group Holdings is at the top spot for regional network in the region and follow by United Overseas Bank (Singapore), Bank Mandiri (Indonesia), Malayan Banking (Malaysia), Bangkok Bank (Thailand), Kasikorn bank (Thailand) and lastly Hong Leong Bank (Malaysia). However, foreign banks from western countries remain dominant in ASEAN to the extent they are arranging Southeast Asia's mergers and acquisitions deals, with only Malayan Banking (May bank) got into the region's top five advisers.

After the Asian Financial crisis in 1998, in Malaysia, initially, the merger programs in banking sector were introduced by Bank Negara Malaysia (Central Bank) to tackle economic issues that have caused financial intermediaries especially banks to collapse

during Global economic recession in 1980 and Asian financial crisis 1997. This merger programs act as a tool to promote efficiency, economies of scale and financial liberalization so that Malaysian banking sector become resilient and more competitive in domestic and global markets. There were 10 anchor banking groups as a result of consolidation and merger among 54 lenders in a country as in August 31, 2000. Those 10 anchor banks were May bank Group, Bumiputra Commerce Group, RHB Bank, AMMB, Hong Leong Bank, Affin Bank, Multi-Purpose Bank, Southern Bank, EON Bank and Public Bank Group. To date, the top Malaysian banks are May bank, CIMB, Public Bank Berhad, RHB Bank, Hong Leong Bank, AMMB holdings, United Overseas Bank, Bank Rakyat, OCBC Bank and HSBC Bank. Additional austerity procedures were established that includes cutting down government expenditure, narrowing bank credit and stock market finance raising, fixed the exchange rate. After the Asian Financial crisis in 1998, six smaller private banks have been taken over by Thai government as they were indebted or inadequate to satisfy re-capitalization requisites. Particularly, these banks were combined with three state controlled banks, namely, Krung Thai Bank, Bank Thai and Siam City Bank. In 2005, in association with Bangkok Bank and with the Finance Ministry as the widest investor, a specialist bank to function small and medium enterprises was appropriated. In 1998 and 1999, to satisfy recapitalization purposes, several banks, which disappeared nationalization were urged to lead in overseas shareholders. By 2006, out of seventeen commercial banks, consisting of the largest banks (Bangkok Bank, Kasikorn bank and Bank of Ayudhya were by Thai owned, six had a detectable overseas investor and four were state controlled. To protect banking sector, the central bank restricted nonviable financial companies (fifty-six finance enterprises), intervened in poorly performed banks, and recapitalized the banking sector and increased rates of interest to protect the currency.

In Indonesia, the banking industry is the basis of the financial sector and also serving as a primary means of external financing for the corporate sector. Between the period 1997 and 2006, private banks dropped from 164 to 71 (more than halved). During the same periods, the number of foreign and joint venture banks was decreased from 44 to 28, at the same time, state owned banks declined from seven to five as an outcomes of mergers. The central bank proceeds to push smaller banks to combine. During the periods, the government of Indonesia has been liberalized international trade and investment, dismantled internal monopolies, and expanded privatization programme and the central bank of Indonesia, maintained a stable monetary policy to stabilize the currency. Banks in Philippines are classified into eight categories which are Universal Banks, Commercial Banks, Thrift Banks, Rural Banks, Cooperative Banks, Islamic Banks, Government Owned Banks and Other Banks. On the other hand, foreign banks in Philippines operate through branches, subsidiaries or affiliates that are licensed as universal or commercial banks. There are 41 banks that are operating in Philippines. In Philippines, banking sector reforms were initiated in the late 1980s, which had successfully equalized enthusiasm across actions. The financial sector

that appropriated the banking operation to advance, national and overseas entrants contributed to a managerial and technological enhancing of the procedure. Simultaneously, these reforms combined achieved a further adequate system of investment. After Asian Financial Crisis in 1997, the government initiated many efforts to strengthen clarity, institute prudential regulations includes international standards, diminish corruption, and other administrative regulations that impacted the banking and financial sectors to reduce the crisis in the region. The central Bank of Philippines also adapted the currency floating, restructured the monetary policy to sustain the banking system. Financial services industry is a main sector in Singapore as it is a key driver of nation's growth. Until today, Singapore's banking sector consists of 125 banks in total including commercial banks, retail banks, foreign banks and merchant banks. Additionally, there are 5 domestic banks in which two of them are major subsidiaries of the three major local banks and 122 foreign banks that involve in foreign full banks, wholesale banks and offshore banks. Central bank of Singapore; Monetary Authority of Singapore (MAS) allows banks to engage in universal banking. In other words, it allows banks to combined commercial and investment banking activities in one entity. In terms of efficiency, DBS, OCBC and UOB banks in Singapore are the most efficient banks in terms of cost controlling. Despite having considerable reserves of foreign exchange and a strongly-organized financial sector, Singapore's currency and stock market were as well influenced adversely during Asian Financial Crisis. To protect the banking sector, the Central Bank of Singapore has let the currency to depreciate since July 1997.

According to Levine (1997) & Dell' Ariccia and Marquez (2004), the significance of the banking sector is committed on the ground that banks are the leading channel of savings and appropriations of credit in an economy. Furthermore, King and Levine, (1993a, 1993b) demonstrated that, by converting deposits into productive investments, the banking sector provides considerable financial intermediation function. Whiles in emerging nations, financial markets are undersized and sometimes entirely absent, advanced countries, financial markets and banking sector works in unison to transmit funds (Turner and Arun, 2004). Commercial banks have been dominating the financial systems of Indonesia, Singapore, Malaysia, Philippines and Thailand. The capital markets in ASEAN is still underdeveloped in compare with other developed countries and banking sector is the dominant vehicle of financial mediation, as well the leading channel of monetary policy to pass. The financial markets, notably the banking markets are exposed to the competitors from the regional and also outside of the region. Through financial integration, the fundamental advantage is to minimize the costs of cross-border transaction, hence, cross-border lending may likewise be an attractive choice for developing funds to promote investments without a direct local representative. Since 1999, the concept of a similar currency union in ASEAN was appeared after the Euro was introduced as a sole currency and belonged to a long-term policy for the ASEAN policy makers. Arguably, one of the benefits of financial

integration is that it will promote financial markets competition by decreasing cross-border obstacles, and thus promote the economic progress through efficient production process and credit allocation. Obviously, the ASEAN members are yet much aside from meeting those convergence criteria of the European Monetary Union (EMU), however any tendency of convergence to a common level of those macroeconomic indexes would be regarded as beneficial to a prospective monetary alliance. A stable financing structure can be beneficial for further economic integration and acceleration of intra-regional single market and trading activities for the region.

ASEAN has taken a new step forward towards an integration which can be seen through banking market. In Asian countries, banking sector is a primary form of financial intermediary and it acts as a middleman between two parties that involve in financial transaction domestically and globally. Banking sector in all over the world and specifically in Asian region are now becoming more integrated with one another due to rapid globalization, liberalization and financial innovation (Karim et al., 2010). On the other hand, banking sector includes commercial banks, investment banks, retail banks, credit unions and central banks plays a major role in an economic development of a country as it helps to boost industrial development as well as capital preservation. Therefore, a well-functioning and stable banking sector is a favourable condition for economic development and growth to happen in a country (Ferreira, 2012). Moreover, developing countries are very dependent with banking sector performance. Thus, efficient banking sector is important to ensure a productive channelling funds. Besides, the sustainability and growth of a country are reflected through its banking sector level of efficiency. In other words, the higher the efficiency level of banking sector in a country, the higher the sustainability and growth.

The concept of economic convergence can be defined as, where by domestic economies display growing similarities in the patterns of their performance. The hypothesis of convergence specifies that in comparison with developed countries, impoverished nations with comparatively initially lower per capita, GDP grow quicker so that income levels converge across nations over time. For policy direction among ASEAN economies to be an exclusive advantage, it is essential to be some sort of “convergence” among the participant nations. Even though there are variations in the initial situation (income), developing and developed economies in term of their economic growth rates, ultimately, these countries will converge, which is stated by the income convergence hypothesis. Convergence theory is an economic theory in which two or more economies tend to reach a similar level of development and wealth (Barrientos, 2007). However, for the purpose of this study convergence theory can be defined as a process in which two or more banks within ASEAN countries tend to reach a similar level of efficiency. There are two types of convergence namely absolute convergence and conditional convergence. In the context of this study, absolute convergence happens when the low efficient banks approach steady state much faster than banks with high efficiency. Meanwhile, conditional convergence occurs when

banks with high efficiency reach a steady state with less faster banks with low efficiency. Banking operational efficiency convergence at regional level is an obvious symptom for the adaption to advanced technology from efficient banks to inefficient banks and over time, the inefficient bank can reach to the efficient bank. At institutional level, this convergence is likewise an important indicator for the degree of banking market integration. Based on the Central Bank of Europe, the economic efficiency would be enhanced through a strongly-integrated financial process by lowering capital cost and further appropriation of financial resources, and stronger financial integration could as well promote the financial stability of the region.

The Association of Southeast Asian Nations (ASEAN) was founded in 1967, with initially by five countries, which include, Indonesia, Malaysia, the Philippines, Singapore and Thailand with an objective to establish the deeper regional integration among the member countries and later on extended with another five countries namely, Brunei Darussalam, Cambodia, Lao PDR, Myanmar, and Vietnam. Over the last four decades, in Asia region, ASEAN has become as one of the most vital regional grouping. At all levels, ASEAN has shown momentous participation and performances in achieving deeper cooperation within its participants, (Kesavapany, 2003). The ASEAN is accounted for approximately 628.9 million population, a combined GDP of USD 2.4 trillion or 3.3% of global GDP, total trade amount for USD 2269.9 billion. In 2002, to promote closer economic collaboration and promote the economic integration process among ASEAN has taken place, when the ASEAN leaders admitted to take the opportunity of transforming ASEAN into an ASEAN Economic Community (AEC) by 2020. To form a reliable, flourishing and remarkably competitive ASEAN economic region are the goals of the AEC. Based on Kumar (2002, 2005), Kesavapany (2003), Mohanty and Pohit (2007) and Dutta (2002), the AEC is a forthcoming expectation for ASEAN community.

The ASEAN-5 is known as Indonesia, Malaysia, the Philippines, Singapore and Thailand, which are the five initial members and founders of ASEAN. These five members are as well the five mega economies and collectively estimates for 80-90% of the overall GDP of the ASEAN community. More than 70% of the overall population of ASEAN countries inhabited in these ASEAN-5 countries. Provided the leading economic capabilities of ASEAN-5, their perspectives on regional collaboration and integrations, would be consequently vital for the present and subsequent improvements of the overall ASEAN. The economic influence of them has established the five members together an acceptable delegate for the entire region in many situations. Although the economies of ASEAN have been shown to give the most welfare gain, a crucial issue that requires to be focused on, whether the inter and intra banking sector productivity converge to each another, of selective ASEAN participants. The improvement of financial sector development frameworks of various nation will be considered to identify as to whether the structure of banking sector of these countries appear any similarities or are they persistently different. The banking sectors

productivity aspects is examined on for five major ASEAN countries, is whether these nations are possibly to be applicable candidates for the Asian Economic Community (AEC). Alternatively, if two or more countries have reached a satisfactory convergence level of productivity, it can be favorable to establish an economic union. According to Imbs and Wacziarg (2003), In the existence of structural convergence exhibit that nations adopt identical development stages and that nations may converge to a structural 'steady state' in which the sectoral production process develops into similar within nations, which is represented by the up's and down of similar sorts of sectors as income grows. The presence of structural convergence among the country groupings would likewise recommend that economies at the domestic and regional/industrial level are approximately identical and synchronized.

As Asian economies experience various phases of advancement, the transition path in economic achievement may be remarkably varied across countries. Hence, to identify convergence in transitional dynamic economies by using the standard time series framework may not be convenient. Our investigation recommends that an essential character process of the growth is non-linear. This is a vital point to mention, as the investigation of either growth convergence or determinants of growth under technological heterogeneity, by standard panel stationarity tests is not accurate. Durlauf et al. (2005) contended, in a magnificent survey that growth econometrics is yet in its inception and it is required to establish modern econometric techniques for investigating the convergence hypothesis that can evaluate the transitional dynamics of growth paths as well as the long run convergence across countries. In line with this consideration, for the investigation of convergence, contributed by Nahar and Inder (2002) and Phillips and Sul (2007a) is a resolution to the requirement of unit root and co-integration. The technique is powerful to the series stationarity properties within investigation, for instance, it does not depend on any specific expectations regarding trend stationarity or stochastic non-stationarity. Particularly by mechanisms of a straightforward empirical algorithm, depend on a relatively simple formation of a non-linear time varying factor model, countries can combine into clusters. Therefore, not identifying convergence may not simply illustrate an overall divergence, it could contribute to club convergence. Convergence of internal banking sector and ASEAN regional financial integration on the performance in financial markets is considered by this investigation, especially, in the banking market by using the recent methodology of non-linear method to provide powerful outcomes.

## **LITERATURE REVIEW**

Adam et al. (2002), were the first researcher that adapted the concept of financial integration, within the euro area, by selecting interbank rates, 10 year bond yields, mortgage and corporate loans rate, the authors estimate the degree of integration

between nations. There was confirmation indicating a deepening degree of integration within the Euro area, when interbank rates collapsed into a single market during the period 1999, although the long-term bond market had not achieve adequate integration and convergence speed of mortgage and corporate loan rates were comparatively slow. Between 1999 and 2009, an investigation among stock market of Asia and its integration with the world market has been done by Rizavi et al. (2011) to explore the presence of convergence within the markets of Asia with the world market. The authors found that the beta coefficient exceed the maximum rate of -1 and was moving on an upward tendency. The investigation confirmed by the sigma convergence outcome, there appear to be divergence than convergence. The distribution appears to be declining in 1994-2004 implying an expansion in integration, accompanied by a rise in the dispersion from the criterion, and was considered as a sign that the markets are turning aside from convergence.

Some analysts employ the concepts of convergence that are adopted from the literature of growth to banking efficiency applications and examine the bank efficiency convergence across countries. By using data between 1994 and 2005 and applying Stochastic Frontier Approach (SFA) to determine efficiency, Weill (2009), confirmed the appearance of a banking cost efficiency convergence and found a positive influence on banking efficiency lead by European integration for 10 EU countries by examining  $\beta$ -convergence and  $\alpha$ -convergence of cost efficiency of banks. Casu and Girardone (2010) found confirmatory instance for efficiency level convergence towards a European Union standard by utilizing data between the periods 1997-2003, for 15 EU nations and applying the similar conception of banking cost efficiency convergence to non-parametric Data Envelopment Analysis (DEA). From 10 newly joined European Union members, between the periods from 1998 to 2003, Mamatzakis et al. (2008), confirmed convergence in cost efficiency, however no convergence occurs in terms of profit efficiency by examining convergence of banking cost and profit efficiency.

By utilizing SFA between the period 1993 and 2000, Margono et al., (2010) evaluate bank efficiency in Indonesia. The authors concluded that in compare with the pre-Asian crisis period, cost efficiency on average is approximately 30% less in the post-Asian crisis period for all banks. By applying DEA approach, and utilizing data from 1994 to 2000, Matthews and Ismail (2006) made a comparison between technical efficiencies and productivities of internal and international commercial banks in Malaysia. The authors concluded that international banks were more efficient. In recent application Manlagnit (2011), investigated Philippines commercial bank`s cost efficiency during the periods from 1990 to 2006 and applied SFA procedure. The author found substantial bank inefficiencies with a significant pattern of persistence of inefficiency between banks, demonstrating that comparatively ineffective (effective) banks tend to continue comparatively ineffective (productive) over the periods of time , and the outcomes is consistent with the poor convergence tendency for banks in Philippines. Over the period 1992-1996, for six Singaporean listed banks, Chu and Lim



(1998), studied banking cost and profit efficiency and they found profit efficiency was much lesser than cost efficiency and as well larger banks tend to have higher efficiency levels. By applying DEA technique and using data after the Asian crisis in between of 1999-2008, Sufian and Habibullah (2010a) investigated banking sector technical and scale efficiency in Thailand to determine effects of national and external environmental variables the authors established a negative impact on bank efficiencies exerted by recent global financial crisis, and unlike outcomes from other low income nation`s investigations, Thailand`s domestic banks actually showed higher technical efficiency than foreign owned banks.

Andries and Capraru (2014) made a few conclusions from their studies for convergence of Central and Eastern European banking sector in emerging markets. They concluded that cross-country differences in banking efficiency decreases in certain period after EU recession. However, the discrepancies increase because of global financial crisis. Results from convergence tests show that the beta and sigma is no and significant. This implies there is convergence in cost efficiency among banks in sample countries. In addition, convergence in EU banking sector is because of both catching-up and lagging behind processes. From the observation, this catching-up might be due to increase in banking competition across EU countries. Whereas the lagging-behind process increases in cost due to investment in a large branch network to dominate bigger market share. Alhassan and Kwaku (2016), investigated Ghana banks competition and convergence from year 2004 to 2011. From the results, they found that there is an improvement in cost efficiency and competition in Ghana banking sector. In addition, the competition has an effect on cost efficiency. The test for efficiency convergence shows banks that are inefficient at the beginning are able to catch-up with efficient banks within the study period. But, the rate of convergence for technical efficient frontier happens at a faster phase relative to cost frontier due to high absolute values of technical efficiency beta. As for convergence in cost efficiency, Ghanaians banks are unable to allocate resources effectively. Lapteacru (2016) investigated competition convergence of central and eastern countries banking sector. The findings show that the convergence levels of all banks for all countries and types of ownership are different. In addition, results suggest there is a poor convergence across countries for both domestic and foreign banks. Furthermore, there is no efforts from domestic and foreign banks to converge towards competitive behaviour despite banking market integration and the existence of major foreign banks. On the other hand,  $\beta$  convergence test found that less competitive banks, especially foreign banks are faster in increasing their competitiveness behaviour. Also,  $\sigma$  convergence test showed that there is a reduction for competition diversion with different speed for foreign and domestic banks. Thus, this study concluded that bank ownership does matter in convergence of bank competition.

## METHODOLOGY

The purpose of this study is to investigate ASEAN banking sector efficiency and its convergence club by using Data Envelopment Analysis (DEA) approach and the innovative method recommended by Phillips and Sul (2007a, 2007b, 2007c), in which will cluster banks convergence or divergence according to their efficiency. The vital issue that requires to be focused in this investigation, whether these ASEAN-5 countries are possibly to be applicable candidates for the AEC by ensuring that there remains productivity convergence in banking sectors and therefore shocks will be symmetrical between the participant members participated. The methodology by Phillips and Sul (2007a), which is on the basis of a general nonlinear time-varying factor model permits to identify convergence even in situation of transitional heterogeneity or transitional divergence, where alternative mechanisms such as stationary tests fail. The particular choice for this investigation was accustomed by the uniqueness's of the applied region. In our study, we examined the clubs convergence for ASEAN-5 countries, in which some of the counties in transition. Thus with individual heterogeneity and probable time path (components of countries in transition), the most convenient approach for this situation is the method of Phillips and Sul (2007) which a regression commencing from a convergence test. This technique is preferred due to the following purposes (i) no exact expectations regarding the involved variable's stationarity and/or the presence of common factors are required although this analysis of convergence could be explained as an asymptotic co-integration analysis that does not rely on the inadequate sample issues of unit root and co-integration testing. (ii) This technique is on the basis of on a relatively common type of a nonlinear time varying factor model which has taken into account that nations experience transitional dynamics, while it withholds from the homogeneous technological progress hypothesis, an expectation broadly applied in the majority of growth investigation (Apergis et al., 2010).

### Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a linear programming technique which constructs the set of frontier of the input-output ratios. It is an analytical tool and was introduced by Charnes et al. (1978) to measure comparative efficiency of firms throughout the process of transforming inputs into outputs. DEA approach is considered as modern efficiency measurement and this approach was initiated by Farrell (1957). A straightforward method of firm efficiency has been defined by the author in his work, which could take into consideration to multiple inputs. Allocative Efficiency (AE) and Technical Efficiency (TE) are the two components of firm efficiency. By providing their respective prices, AE shows the firm capability to utilize optimal inputs in optimal proportions, on the other hand, TE implies, the capacity of firm to achieve

maximum output from a particular value of inputs. Another two components that can be used to measure efficiency are Scale Efficiency (SE) and Cost Efficiency (CE), SE is a measure of performance maximize the proportion of the linear aggregate of outputs to the linear aggregate of inputs. Meanwhile, CE measures bank possible cost reductions that can be achieved from its technical and allocative efficiency. Thus, in order to measure ASEAN banking efficiency, this study will adopt DEA approach. Charnes et al. (1978) establish CCR-Model in which the efficiency of each Decision Making Units (DMU) is measured by this model, which collected as a maximum ratio of overall sum of weighted outputs to overall sum of weighted inputs. By utilizing DEA technique, Emrouznejad et al. (2008) assess efficiency and productivity for 30 years and evidence that there are 1621 studies produced in 20 journals. Thus, Efficiency can be defined as,

$$\text{Efficiency} = \frac{\text{Weighted Sum of Outputs}}{\text{Weghted Sum of Inputs}}, \text{ which can be considered as Productivity as well.}$$

By considering the maximum proportion of weighted outputs to weighted inputs, the efficiency score is estimated. DEA technique provides to be reduced to individual virtual input ( $x_i$ ) and individual virtual output ( $y_i$ ) by optimal weighs from multiple outputs and inputs. Thus If there are N firms and where I=1.....N, forming q outputs vector  $y_i = (y_{i1}, \dots, y_{iq})$ , selling prices  $r_i = (r_{i1}, \dots, r_{iq})$ , utilizing p inputs vector  $x_i = (x_{i1}, \dots, x_{ip})$  and the paying prices  $w_i = (w_{i1}, \dots, w_{ip})$ . In order to account for cost efficiency, then input prices vector,  $w_i$  is applied in equation. Therefore, by determining the regarding linear equation, firm j`s cost efficiency can be estimated as follows:

$$\begin{aligned} & \text{Minimize } \sum_p w_{pj} x_{pj} \\ & \text{s.t } \sum_i \lambda_i y_{iq} \geq y_{jq} \quad \forall q \\ & \quad \sum_i \lambda_i x_{ip} \leq x_{jp} \quad \forall p \\ & \sum_i \lambda_i = 1, \text{ where } \lambda_i \geq 0; \quad i = 1, \dots, N \quad (1) \end{aligned}$$

From the model (1), the input prices  $w_i$  and the output levels  $y_i$  is gathered from a linear combination of firms that use the same or less amount of inputs to produce at least as much of each of the outputs. Meanwhile,  $x_j^w$  denotes the cost minimizing vector of input quantities for the jth Decision Making Unit (DMU). The cost efficiency of firm j is measured, after determining the resolution to the problem as follow:

$$CE_j = \frac{C_j^*}{C_j} = \frac{\sum_p w_{pj} w_{pj}^*}{\sum_p w_{pj} x_{pj}} \quad (2)$$

In which,  $CE_j \leq 1$  illustrates the proportion between minimum costs associated in connection with the performance of vector of the input that reduces costs and the adopted costs for firms'  $j$ . Through the technique of linear programming, the estimation of standard profit efficiency can be achieved.

$$\begin{aligned}
 & \text{Maximize } \sum_q r_{qj} y_{qj} - \sum_p w_{pj} x_{pj} \\
 & \text{s. t. } \sum_i \lambda_i y_{iq} \geq y_{jq} \quad \forall q \\
 & \quad \sum_i \lambda_i x_{ip} \leq x_{jp} \quad \forall p \\
 & \quad \sum_i \lambda_i = 1 \text{ where } \lambda_i \geq 0; \quad i \\
 & \quad \quad = 1, \dots, N \quad (3)
 \end{aligned}$$

This model (3) is identical to outputs vector  $y_j^* = (y_{j1}^*, \dots, x_{jq}^*)$ , and the vector of input demand  $x_j^* = (x_{ji}^*, \dots, x_{jp}^*)$  that maximize the benefits by the prices given for outputs  $r$  and  $w$ . Therefore, hypothetical firm profit can be defined as  $P_j^* = \sum r_{qj} \cdot y_{qj}^* - \sum w_{pj} \cdot x_{pj}^*$  that is  $\geq$  firm  $j$ ,  $P_j = \sum r_{qj} \cdot Y_{qj} - \sum w_{pj} \cdot x_{pj}$ . Consequently, firm  $j$ 's achievement of profit efficiency can be defined as:

$$PE_j = \frac{P_j}{P_j^*} = \frac{\sum r_{qj} \cdot Y_{qj} - \sum w_{pj} \cdot x_{pj}}{\sum r_{qj} \cdot y_{qj}^* - \sum w_{pj} \cdot x_{pj}^*} \quad (4)$$

The proportion between the observed profits  $p_j$  and the maximum profits  $P_j^*$  is denoted by  $PE_j$  that is associated the vector of output  $y_j^*$  and with inputs demand  $x_j^*$  which maximize firm  $j$ 's profit.

### The Nonlinear Factor Model:

This study applies nonlinear time varying factor model by Phillips and Sul (2007) as it has few advantages in order to study the transitional behavior of banking sector efficiency in ASEAN. Since, it includes simple linear regression and one-sided regression coefficient test with standard normal critical values. Additionally, results from convergence test gives empirical estimation regarding the speed of convergence. This is to say, it captures how fast or how slow for one to converge to steady-state equilibrium. Furthermore, this method also provides a basis for a clustering algorithm. As a result, it allows formation of convergence clubs and observes transition behavior between clusters too. Apart from that, Phillips and Sul (2007) convergence test is a nonlinear model which contains time varying components. Therefore, this nonlinear

model is very crucial as it investigates the possible growth convergence or divergence over time and study the heterogeneous transition paths across economies. In other words, this method identifies the convergence clubs behavior among time varying idiosyncratic transition coefficients that permits one to locate the sources of divergence in a panel. Hence, this method is useful in order to observe and measure transition toward a long run growth path as well as individual transitions over time period in relation with common trends, representative or aggregate variable. Thus, in order to investigate the convergence of banking sector in ASEAN Phillips and Sul convergence method is adopted.

As Model Factor analysis provides the series decomposing into common and country-specific factors in a particularly frugal manner, it is an essential mechanism for investigating data sets with considerable time series and cross-section measurements. Panel data are usually decomposed by:

$$X_{it} = g_{it} + a_{it} \quad (5)$$

In equation (5),  $X_{it}$  defined as log income per capita for nation  $I$  and at time  $t$ , where  $i=1 \dots N$  and  $t=1 \dots T$ . It is common that  $X_{it}$  can be decomposed as systematic,  $g_{it}$  and transitory,  $a_{it}$  into two components. In equation (1),  $g_{it}$  and  $a_{it}$  may contain both common and idiosyncratic factors

$$X_{it} = \left( \frac{g_{it} + a_{it}}{\mu_t} \right) \mu_t = \delta_{it} \mu_t \quad \text{for all country, } i \text{ and time, } t \quad (6)^\dagger$$

By using Equation (6), the common and idiosyncratic factors in the panel can be separated by Phillips and Sul through factorising the common stochastic trend component. Equation (2) specifies that two time varying components; common,  $\mu_t$  and idiosyncratic  $\delta_{it}$  is created by decomposing  $X_{it}$ . Between  $X_{it}$  and the common component,  $\mu_t$ , the factor  $\delta_{it}$  represents a measurement of distance by which the error term and the unit specific component is dissolves and hence serves as the idiosyncratic component which is changing over time.  $\mu_{it}$  represents as common trend component in panel and considered to possess various deterministic or stochastic trend attitude that influences the transitory element  $a_{it}$ , as  $t \rightarrow \infty$ .

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<sup>†</sup> In standard neoclassical growth model, for heterogenous technology development, log income per capita,  $\log y_{it}$  can be written as:  $\log y_{it} = \log y_{it}^* + (\log y_{i0} - \log y_i^*) e^{-\beta it} + \log A_{it} = a_{it} + \log A_{it}$  (Phillip and Sul, 2007).  $\log A_{it}$  can be further decomposed by,  $\log A_{it} = \log A_{i0} + \gamma_{it} \log A_t$ . Where, in terms initial technology accumulation,  $A_{i0}$  is current technology for country  $I$  and from available advance technology  $\log A_t$ .  $\gamma_{it} \log A_t$  capture distance of country  $i$  technology. If advance technology  $\log A_t$  assume to grow a constant rate  $a$ :

$$\log y_{it} = \left( \frac{a_{it} + \log A_{i0} + \gamma_{it} A_t}{a_t} \right) = \delta_{it} \mu_t.$$

The non-stationary transitional nature of factor loadings is suggested in semi-parametric form for specifying the null hypothesis of convergence wherein every coefficient converges to some factor of certain constant:

$$\delta_{it} = \delta_i + \frac{\sigma_i \xi_{it}}{L(t)t^\alpha} \quad (7)$$

Where  $\delta_i$  is fixed, across  $I$ ,  $\xi_{it}$  is iid  $(1, 0)$ , idiosyncratic scale parameters is denoted by  $\sigma_i$ , slowly varying function is represented by  $L(t)$ , and  $L(t) = \log t$  that is why  $L(t) \rightarrow \infty$  as  $t \rightarrow \infty$ .

### The Transition Path

Since the time-varying factor loadings  $\delta_{it}$ , estimation provide fact about transition behaviour of specific panel units so that it is a necessary concern of the strategy recommended by Phillips and Sul (2007).

By applying its corresponding form, a smooth and effective method to obtain fact about  $\delta$  it is as regard:

$$h_{it} = \frac{x_{it}}{\frac{1}{N} \sum_{i=1}^N x_{it}} = \frac{\delta_{it}}{\frac{1}{N} \sum_{i=1}^N \delta_{it}} \quad (8)$$

The loading coefficient  $\delta_{it}$  is measured from equation (8), which is in association to the panel average. For the economy  $i$ , alike  $\delta_{it}$ ,  $h_{it}$  even traces out transition path though presently produces one is in association to panel average. Over time, corresponding to the average, a particular path for every  $i$  is traced by variable  $h_{it}$  for this reason it is denominated as path of transition. Together, from the common steady state growth path  $\mu_t$  of country  $i$ 's relevant deviation is as well measured by  $h_{it}$ .

Therefore, path of transition  $h_{it}$  reflect divergences from  $\mu_t$  by forming, the average of cross-section of the corresponding path of transition of economy  $i$  equalize unity (Figure 1 Transition Path of per capita GDP). Moreover, the corresponding transition path,  $h_{it}$  converges to unity and the cross-sectional variation ( $H_t$ ) of the corresponding transition path converges to zero, if panel units converge and all the factor loading  $\delta_{it}$  approximate to a fixed  $\delta$ . Which is as follows:

$$H_t = \frac{1}{N} \sum_{i=1}^N (h_{it} - 1)^2 \rightarrow 0 \quad \text{and } t \rightarrow \infty \quad (9)$$

When testing convergence approaches, it suggests that the application is according with long run behavior in the macroeconomic phenomena. Thus, it is usually desirable to eliminate business cycle factor using smoothing technique to obtain hit from  $X_{it}$ . Accordingly, by incorporating a business cycle influence kit equation (8) can be written as:

$$X_{it} = \delta_{it} \mu_t + k_{it} \quad (10)$$

Due to the adaptability and the point that Hodrick and Prescott (1997) smoothing filter quest simply the addition of smoothing series and not looking for preceding particularization of the characteristics of the common trend  $\mu_t$  in  $X_{it}$ , in this analysis, Hodrick and Prescott (1997) smoothing filter is adopted. Having computed the HP estimate:

Expanding the above, the cross sectional averages in (48) show to the assessed transition path computed as:

$$\hat{h}_{it} = \frac{\hat{X}_{it}}{\frac{1}{N} \sum_{i=0}^N \hat{X}_{it}} \quad (11)$$

Where  $\hat{X}_{it}$  are the filtered income per capita series. Within the expectation, in small samples, the panel average  $N^{-1} \sum_{i=1}^N \hat{X}_{it}$  is positive also asymptotical that is performed for many related economic time series for instance, prices, GDP or different gross.

### The Log t test

By taking into consideration the time varying factor statement from equation (6) and depending on the log t convergence test that is depend on a simplistic time series regression, Phillips and Sul (2007a, 2007b, 2007c) proposed a unique convergence test and clustering algorithm. The null and alternative hypothesis can presently be established.

Null hypothesis,  $H_0: \delta_i = \delta$ , where, for all  $i$ ,  $\alpha \geq 0$ , which indicates convergence for all nations.

Alternative hypothesis  $H_a: \delta \neq \delta$  here, for some  $i$  and/or  $\alpha < .0$  indicating that no convergence for some nation.

After estimating transition path, the variation ratio of cross section  $H_1 / H_t$  is to be computed by acknowledging  $H_t$  as:

$$H_t = \frac{1}{N} \sum_{i=1}^N (\hat{h}_{it} - 1)^2$$

The transition distance  $H_t$  has a limiting form which is showed by Phillips and Sul (2007):

$$H_t \sim \frac{A}{L(t)^2 t^{2\alpha}} \text{ as } t \rightarrow \infty \quad (12)$$

Where, positive constant is denoted by  $A$ , slowly varying function is explained by  $L(t) = \log(t + 1)$ , and the speed of convergence is  $\alpha$ . Usually, after removing a fraction ( $r$ ) of the sample, equation (13) is run. Phillips and Sul suggest at some point,  $t$  become  $(rT)$ , where  $(rT)$  represents the integer part of  $(rT)$ , and  $r = 0.3$ . For examining the convergence null hypothesis discussed above, log  $t$  test is carried out as regards:

$$\text{Log}(H_t/H_1) - 2\log L(t) = \hat{c} + \hat{b} \log t + \hat{\mu}_t \quad (13)$$

Here, variation of cross-section is  $H_t$ , at the beginning of the sample, variation ratio of cross-section is explained by  $H_1/H_t$ , over the corresponding difference for each stage of period  $t$ ,  $H_1$  (i.e.  $H_t$  at  $t = 1$ ), which means,  $H_t (t, \dots, T)$ , from the common limit the distance of the panel is measured by  $H_t / H_1$ .

At the same time,  $L(t) = \log(t)$  and  $r > 0$ . The regression presented in equation (10) is regarded as log  $t$  regression due to the log  $t$  regressor.

By applying the traditional  $t$ -statistic, if,  $t_b < -1.65$ , we reject the  $H_0$  of convergence. It can be concluded panel convergence, when the  $t$ -statistic,  $t_b$  recommends that  $\hat{b}$  is else positive otherwise equals to 0. On another side, we reject the  $H_0$  of convergence, when  $t$ -statistic,  $t_b$  recommends that  $\hat{b}$  is negative and significant.

## Data

In this investigation, we concentrate on ASEAN-5 economies, specially; Indonesia, Malaysia, Philippines, Singapore and Thailand. Data that being used is based on Bank scope –Bureau van Dijk. We used annual data from 2005 to 2010. A non-parametric method is employed in the estimation of production functions which is known as Data Envelopment Analysis (DEA). For individual banks on each ASEAN-5 countries, the measures of technical, pure technical, and scale efficiencies are computed through DEA technique. Usually, Data Envelopment Analysis is a linear programming procedure in which each decision making unit (DMU) is transformed from multiple incommensurable inputs and outputs into a scalar measure of operational efficiency. According to Kumar & Gulati (2008) Data Envelopment Analysis includes resolving a linear programming technique for each DMU.



## EMPIRICAL RESULTS AND DISCUSSIONS

The empirical findings of this study will be presented in this section. In order to test the efficiency of banking by using data envelopment analysis (DEA), the test is analysed. The results of DEA show technical, pure and scale efficiency. Each bank in every country is listed according to the last technical efficiency based on their highest efficiency to lowest efficiency value. Next, all results regarding technical efficiency been selected in order to analyse the convergence and then select the first commercial bank based on highest ranking as a base. Then run the log t regressing and convergence test statistics is computed for each sub group of size k. From the remaining commercial bank, add one bank at a time to core club and test for convergence hypothesis through log t test. If the t-statistics is greater than the critical value -1.65 at 5% significant level, add another commercial bank in the convergence club. Stop the process when the t-statistics is less than critical value -1.65. Then, the next cluster is form. If there is no subgroup detected it means divergence manner. Repeat the process for each country and lastly proceed all over again with all first convergence club from every country in order to identify convergence club for commercial banks in ASEAN region.

Table1 Transition Path

Banking Sector	Cross-Sectional Variation
ASEAN-5	The prospect of clusters convergence existence across the different stages of equilibria has shown in the Figures. From the figure-1, it is clear that Panin bank (Indonesia), Citibank (Singapore), AG bank (Indonesia), CIMB bank (Malaysia) and BDO bank (Philippines) shown an increasing trend, on the other hand, DBS bank (Singapore), OCBC bank (Singapore), Kasikorn bank (Thailand), Communications bank (Thailand) and ABC bank (Philippines) are observed to have a decreasing trend.
Malaysia	From Figure-2 Affin bank (HIT_AC), Alliance bank (HIT_AH) and CIMB bank (HIT_AA) have showed an increasing trend, whereas, Hong Leong bank (HIT_AF), May bank (HIT_AG) and RHB bank (HIT_AD) shows a decreasing trend of transition parameter path.
Singapore	From Figure-3, Rabo bank (HIT_BB) and Citibank (HIT_BF) both have showed an increasing trend whereas, DBS bank (HIT_BA) and Bank of Singapore (HIT_BC) show a decreasing trend and lastly, OCBC bank (HIT_BD) shows the lowest of parameter transition path.
Thailand	It can be concluded from Figure-4 is a cross sectional variation of Thailand commercial banks. Bangkok bank (HIT_DD) has an increasing trend of transition path and is the highest as compared to the other banks. Additionally, Krungthai bank (HIT_DH) and Communications bank (HIT_DC) also demonstrate an increasing in trend of transition parameter path. On the other hand, Ayudhya bank (HIT_DF) and TMB bank (HIT_DB) are among the lowest of transition parameter path in terms of banking efficiency.
Philippines	Figure-5 demonstrates cross sectional variation for banking efficiency in Philippines among 8 selected commercial banks. PBCOM bank (HIT_CD) and BPI bank (HIT_CC) are among the highest of transition parameter path in terms of efficiency. Meanwhile, BDO bank (HIT_CF) and CBC bank (HIT_CH) are among the lowest of transition parameter path.

Table 1 Cont.

Indonesia Figure-6, ICBC bank (HIT\_FS) and Panin bank (HIT\_FO) have an increasing trend and among the highest of transition parameter path in regards of efficiency. On the other hand, Mizuho bank (HIT\_FAH) and BNP bank (HIT\_FN) are showing a decreasing trend as well as among the lowest of efficiency in transition parameter path.

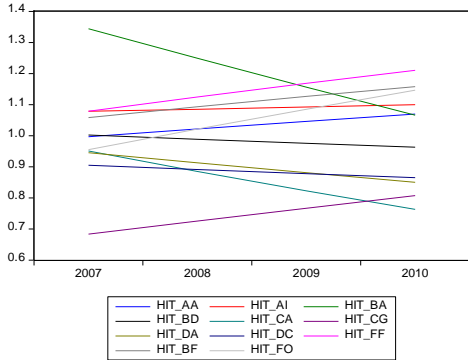


Figure 1 ASEAN-5 Cross Sectional Variation for Banking Efficiency

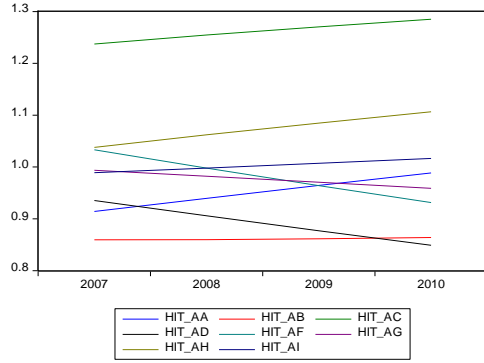


Figure 2 Malaysia Cross Sectional Variation for Banking Efficiency

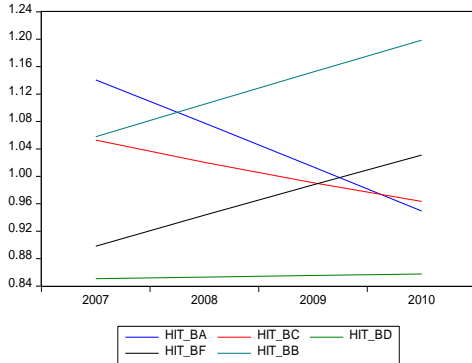


Figure 3 Singapore Cross Sectional Variation for Banking Efficiency

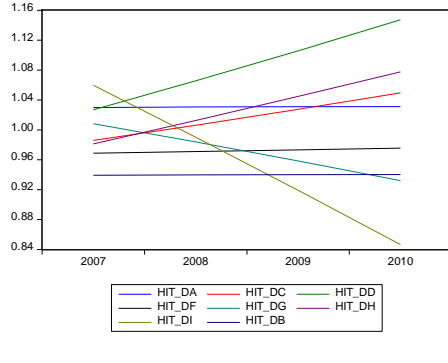


Figure 4 Thailand Cross Sectional Variation for Banking Efficiency

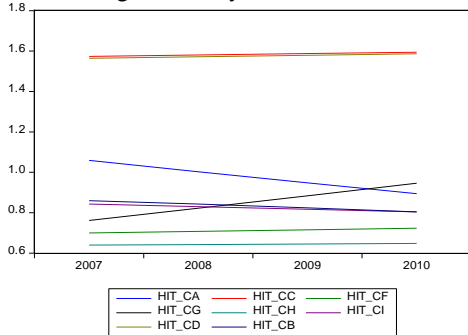


Figure 5 Philippines Cross Sectional Variation for Banking Efficiency

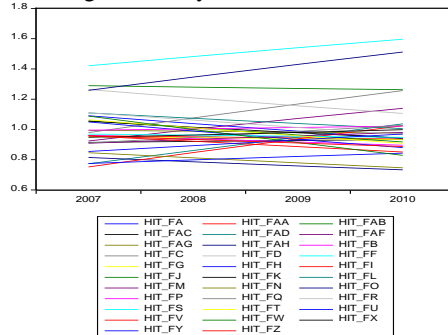


Figure 6 Indonesia Cross Sectional Variation for Banking Efficiency

## Efficiency

By applying a DEA technique, the mean efficiency scores of banks were calculated with inputs and outputs in each of the nation comprised in the sample. As specified by Coelli (1996), applying the BCC model three figures of scores; technical, pure and scale efficiency were produced. The national frontier shows high efficiency scores. Even though it seem to be highly effective bank at the internal frontier, it may not continue when cross-country frontiers are produced.

From table 3, Technical Efficiency and Pure Technical Efficiency scores for two countries appear to be lower than the mean of the region, on the other hand, one country appears to be the SE lower than the regional score. The highest Technical Efficiency among the large banks are appeared in Singapore and Malaysia and it appeared lowest in Indonesia and Philippines.

Table 2 Ranking of the Bank based on higher efficiency to lower efficiency

Country	Ranking
ASEAN 5	Panin Bank (Indonesia), AG bank (Indonesia), AM bank (Malaysia), Citi bank (Singapore), CIMB bank (Malaysia), DBS bank (Singapore), OCBC bank (Singapore), BDO bank (Philippines), Communications(Thailand), ABC bank(Philippines), Kasikorn bank(Thailand)
Malaysia	Affin Bank, Alliance Bank, AM bank, CIMB bank, Hong Leong bank, May bank, Public bank, RHB bank
Singapore	Bank of Singapore, Rabo bank, Citibank, DBS bank, OCBC bank
Philippines	PBCOM bank, BPI bank, BDO bank, ABC bank, Philtrust bank, BDO unibank, AUB bank, CBC bank
Thailand	Bangkok bank, Krung thai bank, Communication bank, Kasikorn bank, Ayudhya bank, SCB bank, Thanachart bank, TMB bank
Indonesia	Panin bank, AG bank, DBS bank, Rabo bank, Mega bank, BNI bank, Agris bank, QNB bank, PPBI bank, Permata bank, Maybank, ICBB bank, Sumitomo bank, ANZ bank, BCA bank, Danamon ba, Deutsche bank, Mandiri bank, BRI bank, OCBC bank, ICBC bank, Mayapada bank, Sinarmas bank, BBA bank, Commonwealth bank, CTBC bank, BOI Bank, Raharja bank, Mizuho bank, UOB bank, CIMB bank, BNP bank

Table 3 Mean Efficiency Scores by Country under National Frontier

Country	No. Of Banks	National Frontier		
		TE	PTE	SE
MALAYSIA	8	0.7670	0.8562	0.8965
SINGAPORE	5	0.8228	0.9146	0.8980
PHILIPPINES	8	0.6269	0.6561	0.9507
THAILAND	8	0.6349	0.8532	0.7497
INDONESIA	31	0.5342	0.6709	0.8099

Sources: Dataset from Bankscope – Bureau van Dijk (2016)

## Full Panel Convergence

Table 4, shows the results of overall panel convergence in terms of banking efficiency in ASEAN 5 economies. Philips and Sul (2007) convergence methodology stated that the null hypothesis of convergence is rejected if the log t-test result is smaller than critical value -1.65. From the analysis, the t-statistics is -6.5048 which is smaller than -1.65 at 5% significant level. Thus, null hypothesis is rejected for the period 2005-2010 and there is no full panel convergence. Even though the results of convergence on aggregate variables in ASEAN 5 indicate divergence but there is possibility of convergence to exist in the sub group. Therefore, this leads to further trimmed observation.

Table 4 Results of Overall Convergence (ASEAN-5)

Country	$\hat{b}$	Remarks
All Countries (ASEAN-5)	-6.5048*	Divergence

Note: At 5% level, asterisk (\*) indicates statistically significance. -1.65 is the critical value at 5%.

## Club Convergence

Table 5, is the illustration of group, club convergence of commercial banks in the ASEAN banking sector. From the ranking, Panin bank is the base bank and it is the core group, Club 1 and AG bank is added to the base bank to compute t-statistics. From the result, it can be implied that AG bank is converging on the same path as Panin bank since t-statistics 2.5138 is higher than -1.65. Next, we add AM bank to get a new t-statistics, the t-statistics is -0.5012 which is lower than -1.65. However, since the new t-statistic is lower than previous t-statistic, AM bank become the base bank and need to need to add another bank from the next ranking list, which is Citibank. From the result, it implies that Citibank is diverging as the t-statistics -1.6708. Therefore, Citibank now is the base bank and CIMB bank is added. The result insinuates that CIMB bank is diverging with t-statistics -23.7782. With that, CIMB bank becomes the base and following by DBS bank and the accumulated t-statistics of 1.9533 postulates that the bank is converging. Based on t-statistics, DBS bank and OCBC bank are converging. Since the OCBC bank is converging now it acts as the base bank and BDO bank have added to it. However, even though t-statistics imply that BDO bank is converging, as the current t-statistics for OCBC bank and BDO bank have resulted in smaller value than the previous result, so based on Philips and Saul (2007), BDO bank becomes the base bank and club 2 is formed by CIMB bank, DBS bank and OCBC bank. Finally, Club 3 is formed by BDO bank, Communications bank, ABC bank and Kasikorn bank.

Table 5 Results of Convergence Club in ASEAN

Last T Banks order		Step1	Step2	Step1	Step2	Step1	Club	Remarks
1.	Panin bank (Indonesia)	Bas					1	Converge
2.	AG bank (Indonesia)	2.513					1	Converge
3.	AM bank (Malaysia)	-0.501	Base					Divergence
4.	Citi bank (Singapore)		-1.670	Base				Divergence
5.	CIMB bank (Malaysia)			-23.77	Base		2	Converge
6.	DBS bank (Singapore)				1.9533		2	Convergence
7.	OCBC bank (Singapore)				4.3034		2	Convergence
8.	BDO bank (Philippines)				2.3910	Base	3	Convergence
9.	Communications(Thailand					2.896	3	Convergence
10.	ABC bank(Philippines)					3.988	3	Convergence
11.	Kasikorn bank(Thailand)					5.356	4	Convergence

From the findings, the most efficient banks are from Indonesia, which is Panin bank and AG bank. It can be concluded that these two banks are converging towards the same state of equilibrium in terms of efficiency performance. This outcome might be due to the banking structural reformation program by the government of Indonesia after the Asian Financial Crisis in 1997 (Zhang and Matthews, 2011). Additionally, the government had re-privatized its formerly nationalized banks by selling government shares to local and foreign investors in which increase the present foreign subsidiary banks. As a result, banking sector in Indonesia became more competitive, stronger and had a better capitalized banking system as the competitiveness in Indonesian banking sector rise (McCawley, 2009). Besides, Ataulloh et al. (2004) mentioned that liberalization reduce efficiency gap of different size of groups. On the other hand, in Club 2 there are two banks from Singapore and one commercial bank from Malaysia. The result indicates that these three banks namely Affin bank, DBS bank as well as OCBC bank are converging on the same efficiency path. Since Singapore and Malaysia is a neighbouring country thus the prosperity of Singaporean and Malaysian banking sectors somehow depends on each other. In other words, Malaysia and Singapore are countries that are closely interlinked and economically interdependent with each other as they have a common strategic outlook (Thayer, 2008). Lastly, Club 3 consists of commercial banks from Philippines and Thailand. Commercial banks from the Philippines and Thailand are converging with each other towards the same equilibrium state of efficiency performance. This outcome might be due to their political instability in these past few years. Among other commercial banks in ASEAN, banks from the Philippines and Thailand have the lowest efficiency level.

Table 6, reports the results of the overall panel convergence for commercial banks of Malaysia, Singapore, Philippines Thailand and Indonesia. According to Phillips and Sul (2007), the log t-result for 8 Malaysian banks is -108.8330 is smaller than the

critical value, at 5% significance level. Thus, null hypothesis of convergence is rejected for the period 2005-2010. We conclude that there is no aggregate level convergence in terms of efficiency in Malaysian banking sector for commercial banks. The results of overall panel convergence for banking efficiency of 5 commercial banks in Singapore shown the log t-test result -3.6024 therefore, overall, banking sector in Singapore specifically commercial banks are diverging in regards of efficiency. For Philippines the log t-result is -28.7146, therefore, it can be postulated that there is no full panel convergence For Thailand, the log t-test result of -5.1306, therefore, there is no overall panel convergence. Finally, For Indonesia, Commercial bank is diverging at aggregate level, since the log t-test result is -10.2835. However, Philips and Sul (2007) stated that there is possibility of convergence in the sub group. The later part of the results will show the trimmed observation of efficiency in the separate country`s (Malaysia, Singapore, Indonesia, Thailand and Philippines) banking sector specifically commercial banks.

Table 6 Results of Convergence on Aggregate: Full Sample of Banks within each country

Country	No of banks	$\hat{b}$	Remarks
Malaysia	8	-108.8330*	Divergence
Thailand	8	-5.130571*	Divergence
Singapore	5	-3.602386*	Divergence
Indonesia	32	-10.28352*	Divergence
Philippines	8	-28.71462	Divergence

Firstly, the table 7, shows the clubs of Malaysian bank. Based on the ranking, Affin bank is the base bank. As can be seen, the t-statistics for Affin bank and Alliance bank is -8.9977 which is less than -1.65. Therefore, Alliance bank becomes an outlier. In order to identify the Club, take Alliance bank as a base bank and add AM bank. The computed t-statistics for Alliance bank and AM bank is -23.8187. The result indicates Alliance bank as well becomes the outlier. Thus, log t-test is performed by adding CIMB bank and AM bank is now base. The t-statistics result obtained is 2.9147 which greater than the critical value. This implies that CIMB bank is converging. Since the t-statistics for Hong Leong bank is lower than previous t-statistics, Hong Leong bank become base. Thus club-1 is created by AM bank and CIMB bank. Next, May bank is added with Hong Leong bank. The t-statistics result is 0.1527 which also means Mabank is converging. Between Public bank and Maybank, t-statistic is 0.9413 and it signals Public bank is converging. Thu club 2 is formed by Hong Leong bank, May bank and Public bank. Finally RHB bank`s t-statistic shown -9.7389 and diverging but since there is no more bank to add we assume Public bank efficiency is converging same as other banks in Club 2. Table 8 shown, convergence clubs of commercial banks in Singapore. Based on t-statistics, Bank of Singapore and Rabobank become outliers (t-statistics-4.2804 and -15.1648, which is less than -1.65). Therefore, Club 1 is taken by

Citibank as a base and DBS bank is added to get t-statistics. Computed t-statistics for Citibank and DBS bank imply convergence (since t-statistics is 0.9765). Thus, the last bank, which is OCBC bank is added to DBS bank and found that the DBS bank is converging with the OCBC bank in regards of efficiency and belongs to Club 1. Table 9 shows, the club convergence of 8 commercial banks in Philippines. Based on this ranking, PBCOM bank is the base bank. Based on log t-statistics PBCOM bank and BPI bank become the outliers. Club 1 is created through BDO bank and ABC bank and club 2 is identified by Philtrust bank and BDO uni bank. Lastly, CBC bank is added to the base bank AUB bank. The computed t-statistics is -2.3257 which imply divergence. Table 10 is the result of convergence club in Thailand that focuses on 8 selected commercial banks. Bangkok bank is the base bank and Bangkok Bank and Krungthai bank become the outliers. Club 1 is opened with Communications bank, Kasikorn bank. From the results, Communication bank is converging with Kasikorn bank but diverging from Ayudhya bank. However, since the resulted t-statistics between Kasikorn bank and Ayudhya bank is smaller than the critical value, Club 2 is identified from Ayudhya bank and SCB bank. Lastly, Thanachart bank becomes the base and TMB bank is added to it. The t-statistics result is 4.36561 which postulate TMB bank is converging and created club-3.

Table 7 Malaysia: Intra banking sector technical efficiency convergence

Last T order	Banks	Step 1	Step 2	Step 1	Step 2	Clubs	Remarks
1	Affin Bank	Base	Outlier				Diverge
2	Alliance Bank	-8.9977	Bas	Outlier			Diverge
3	AM bank		-23.8187	Bas		1	Converge
4	CIMB bank			2.9147		1	Converge
5	Hong Leong			-0.0613	Base	2	Converge
6	May bank				0.1527	2	Converge
7	Public bank				0.9413	2	Converge
8	RHB bank				-9.7389		Diverge

Table 8 Singapore: Intra banking sector technical efficiency convergence

Last T order	Banks	Step 1	Step 2		Clubs	Remarks
1	Bank of Singapore	Base	Outlier			Divergence
2	Rabo bank	-4.2804	Base	Outlier		Divergence
3	Citibank		-15.1648	Base	1	Convergence
4	DBS bank			0.9765	1	Convergence
5	OCBC bank			1.0405	1	Convergence

Table 9 Philippines: Intra banking sector technical efficiency convergence

Last T order	Banks	Step1	Step2	Step1	Clubs	Remarks
1	PBCOM bank	-5.419	Outliers			Diverge
2	BPI bank	-3.467	Outlier			Divergence
3	BDO bank		Bas		1	Convergence
4	ABC bank		4.5784		1	Convergence
5	Philtrust bank		1.7138	Bas	2	Converge
6	BDO unibank		0.5900		2	Converge
7	AUB bank		-0.395	Base		Divergence
8	CBC bank			-2.325		Divergence

Table 10 Thailand: Intra banking sector technical efficiency convergence

Last T order	Banks	Step1	Step2	Step1	Step2	Step1	Step2	Clubs	Remarks
1	Bangkok bank	-86.42	Outlier						Divergence
2	Krung thai bank	-7.53	Outlier						Divergence
3	Communication			Base				1	Convergence
4	Kasikorn bank			0.7356					Divergence
5	Ayudhya bank		-7.0077	Base				2	Convergence
6	SCB bank			-0.795				2	Convergence
7	Thanachart bank			-0.809	Base			3	Convergence
8	TMB bank					4.35		3	Convergence

Table 11 (Appendix) shows the convergence clubs of commercial banks in Indonesia. Based on this ranking, Panin bank is the base bank and it is also the core group, Club 1. Based on Philips & sul (207) technique and the t-statistics Panin bank converging with AG bank. While, DBS bank is diverging from the base bank. Thus, Club 2 is taken by DBS bank following by adding Rabo bank. Mega bank is diverging from BNI bank and BNI bank become base bank. BNI bank converging with Agris and QNB bank formed club-3. PPBI bank is diverging from Permata bank and now Permata bank become the base bank and created Club 4 together with May bank. Since the t-statistics of ICBB bank is lower than the t-statistics of May bank, ICBB bank now become the base bank and club 5 is identified by ICBB bank and following Sumitomo bank. Club 6 is taken by ANZ bank, BCA bank and Danamon bank. By adding Deutsche bank, t-statistics shows that this bank is converging but Club 7 is opened because current t-statistics is lower than previous result. Now, Deutsche bank becomes the base and Mandiri bank is added and based on t-statistics Deutsche bank, Mandiri bank, BRI bank postulate club 7. OCBC bank is the base bank for Club 8 and ICBC bank is added to it and then, Mayapada bank, Sinarmas bank, BBA bank and Commonwealth bank is added to Club 8 respectively. Club 9 is taken by CTBC bank, BOI bank and Raharja bank. Now, Mizuho bank diverging Lastly, Club 10 is taken by



UOB bank and both CIMB bank and BNP bank is added respectively. The results indicate that both banks are converging in terms of efficiency.

Table 11 Indonesia: Intra banking sector technical efficiency convergence

Last T order	Banks	Step1	Step 2	Step 1	Step2	Step1	Step2	Step1	Step2
1	Panin bank	Bas							
2	AG bank	2.5134							
3	DBS bank	-18.325	Base						
4	Rabo bank		2.674						
5	Mega bank		2.229	Base					
6	BNI bank			-6.841	Base				
7	Agris bank				0.521				
8	QNB bank				0.6001				
9	PPBI bank				-0.0789	Base			
10	Permata bank					-3.3573	Base		
11	May bank						5.282		
12	ICBB bank						-0.5329	Base	
13	Sumitomo ba							-0.6262	
14	ANZ bank							-0.9925	Base
15	BCA bank								-0.5843
16	Danamon ba								0.7501
17	Deutsche ba								0.7492
18	Mandiri bank								
19	BRI bank								
20	OCBC bank								
21	ICBC bank								
22	Mayapada ba								
23	Sinarmas ba								
24	BBA bank								
25	Commonwlth								
26	CTBC bank								
27	BOI Bank								
28	Raharja bank								
29	Mizuho bank								
30	UOB bank								
31	CIMB bank								
32	BNP bank								

Table 11 Cont.

Last T order	Banks	Step1	Step2	Step1	Step2	Step2	Clubs	Remarks
1	Panin bank						1	Convergence
2	AG bank						1	Convergence
3	DBS bank						2	Convergence
4	Rabo bank						2	Convergence
5	Mega bank							Divergence
6	BNI bank						3	Convergence
7	Agris bank						3	Convergence
8	QNB bank						3	Convergence
9	PPBI bank							Divergence
10	Permata bank						4	Convergence
11	May bank						4	Convergence
12	ICBB bank						5	Convergence
13	Sumitomo ba						5	Convergence
14	ANZ bank						6	Convergence
15	BCA bank						6	Convergence
16	Danamon ba						6	Convergence
17	Deutsche ba	Base					7	Convergence
18	Mandiri bank	2.1316					7	Convergence
19	BRI bank	4.2806					7	Convergence
20	OCBC bank	2.2256	Base				8	Convergence
21	ICBC bank		0.5095				8	Convergence
22	Mayapada ba		0.54				8	Convergence
23	Sinarmas ba		2.2666				8	Convergence
24	BBA bank		3.0072				8	Convergence
25	Commonwlth		3.4366				8	Convergence
26	CTBC bank		1.9782	Base			9	Convergence
27	BOI Bank			2.8376			9	Convergence
28	Raharja bank			2.6261			9	Convergence
29	Mizuho bank			-7.2106	Base			Divergence
30	UOB bank				-9.4147	Base	10	Convergence
31	CIMB bank					3.9708	10	Convergence
32	BNP bank					1.8117	10	Convergence

## CONCLUSION

This study investigates, regional financial integration effectiveness and internal banking structural reforms and its convergence club among Southeast Asian countries, specifically ASEAN 5 economies in the aftermath of the 1997 Asian financial crisis. Banking efficiency was measured by using non-parametric method which is DEA approach. Later, the efficiency results of commercial banks in ASEAN 5 countries were applied by using Philip and Sul (2007) convergence methodology to identify the occurrence of convergence in terms of banking efficiency performance. Finally, this study concluded that there are 3 convergence clubs of commercial banks in ASEAN that are converging towards the same path in respect of efficiency with other banks within their respective clubs. From this study, several conclusions have emerged. Firstly, the results of the research indicate that commercial banks from Indonesia are converging among themselves. Indonesian government intervention to aid its banking sector leads to an increment in efficiency. As a result, the banking sector in Indonesia becomes more resilience to another financial shock in 2008 and makes the commercial banks efficiency

and performances sustainable. Secondly, observation from this study implies that neighbouring commercial banks tend to converge together. From the results, commercial banks from Malaysia and Singapore are converging towards the same efficiency path. Thus, diplomatic relation between these two countries is very important to each other in terms of economic performance especially in banking sector in order to attain high efficiency performance. Thirdly, commercial banks from Philippines and Thailand are also converging under the same efficiency performance. Political instability is assumed to affect banking efficiency performance in these two countries.

The concepts of convergence that are adopted from the literature of growth-convergence were employed to bank efficiency experiment. Analysing cross-nation and within a nation convergence properties of banking efficiency is fascinating, since a banking market with catching up behavior from laggards and increasing allocation of efficiencies, i.e. narrowing down diffusion of performance, could be claimed as an index of the degree of banking sector integration. All in all, it is crucial to see the efficiency performance of commercial banks in ASEAN economies whether they are converging or diverging towards a common path. This is because it allows for these countries namely Malaysia, Singapore, Indonesia, Thailand and Philippines to take a similar action to any economic and financial shock to avoid the action of one's country from jeopardizing stability of banking sector in other ASEAN countries. In this study, it can be concluded that ASEAN countries are inter-related and most of the banks were convergence between each other's although there is a different of club of convergence. In general, the results of the study exhibit engaging stylized actions on the convergence issues of banking convergence in the ASEAN-5 countries. Empirical assessments of bank efficiencies on country-level and their properties of convergence provide comparatively facilitative outcomes. The ASEAN 5 members were organized into three categories, with Indonesia on the leading categories, bearing the strongest average bank efficiency level, Malaysia and Singapore in the intermediate category, and Philippines and Thailand on the bottom, which are organized as poor performance nation. In terms of efficiency, the results shows that aggregate, the ASEAN countries are competitive between each other. This is shows that the policy implications that apply by all of the ASEAN countries are merely the same and due to that, the results shows that efficiency of ASEAN banks in terms of club are converging between each other's. The evaluations of this study is able to gain an overview regarding ASEAN countries able to catch-up between other countries in terms of banking sector thus it could lead to a successful to achieve ASEAN objectives creating a single currency within ASEAN countries. In order for ASEAN to continue sustain and compete with EU country, ASEAN community members need to implement a same fiscal policy management and it should be made more transparent thus could give benefits within members. Thus, these ASEAN countries could catch up between each other accordingly. Previous background has demonstrated us that economic integration is a particularly gradual and scrutinized procedure, for illustration, the formation of European Union took 50 years to materialise

with only 12 representatives as an initiate. Thus it advanced up by including each representative at a time as it fulfils the Maastricht Criteria. The development of ASEAN integration is under progress even though shows to be relatively slow. For the sub-group of ASEAN members that show weak convergence or divergence, further comprehensive policies are required to stimulate stronger financial integration with other participant. The outcomes are remarkably significant to the policy makers as to suggest the degree of banking sector similarity /dissimilarity across the participant nations.

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