# STRUCTURAL HOMOGENIZATION AMONG ASEAN-5 ECONOMIES

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## ABSTRACT

*A successful economic integration shall result to real income convergence within a region. It helps the poorer countries within the region to catch-up with the richer counterparts. Hence, poorer countries shall undergo extensive development and move from an agriculture-dominant economy towards industrial and then the service-dominant economy according to the famous three-sector hypothesis. Therefore, these countries within the region tend to have their economic structure become more similar over time and it is defined as structural homogenization (convergence). Such convergence in productive structures is also essential for a sustainable region in order to overcome the asymmetry of shocks. Empirical studies showed that ASEAN-5 has achieved certain degree of income convergence over the years. However, limited studies focused on the adjustment of sector structures among ASEAN-5 countries. Therefore, this paper would like to perform a more comprehensive convergence study among ASEAN-5 countries in terms of homogenization in their production structures. Output shares of five categorized sectors over 1970 to 2012 was examined using heterogeneity index proposed by Palan and Schmiedeberg (2010). Our results revealed that the heterogeneity index has decreased over time implying that ASEAN-5 has experienced convergence in their production structures as well. Hence, this finding provides new evidence of further real convergence among ASEAN-5 countries that strengthen the sustainability as a successful region.*

Key Words: ASEAN-5, homogenization, sectoral structures, time series

## Introduction

By definition, structural homogenization refers to the tendency of countries to have their production structure becoming more similar over time. It is contributed by structural change which is best to be explained by the famous three-sector-hypothesis in Fourastie's theory (1949). The hypothesis claimed that the production and employment of a country will shift from agricultural sector to industrial sector followed by the service sector in the development path. Through economic integration, backward countries within a region gain assistance from more developed member countries. Supports provided in terms of knowledge flow and technological diffusion help to accelerate their economic development and hence their income as well. As such, these backward countries are expected to undergo the said transition process and their production structures shall be more similar to the more developed countries in the region over time. Meanwhile, extensive catch-up by the backward countries in income will leads to regional income convergence as well.

It is known that regional income convergence is essential for a region like ASEAN to maintain their sustainability and political stability (Molle & Boeckhout, 1995; Bunyaratavej & Hahn, 2003). Therefore, the study on structural homogenization is important due to the fact that income convergence can be improved if countries within a region have similar productive structures (Marelli, 2004). On top of that, degree of symmetry of macroeconomic shocks within the region concerns primarily on the sector structure of these countries. Such criteria served as one of the preconditions for a successful monetary union.

Considerable number of studies was conducted investigating whether ASEAN is ready for common currency union. However, huge development gap between the founder countries and late comers (especially the CLMV countries) becomes the stumbling block for such aim. Therefore, a more pratical approach would be forming a common currency union with a smaller local (subgroup) currency area. In respect to criteria of optimum currency area (OCA), a few subgroups within ASEAN were proposed to take the lead (Cho & Kwek, 2004; Falianty, 2005; Xu et al., 2007; Thong et al., 2010; Liu, 2012). Studies recommended three to five of ASEAN-5 countries as potential candidates. In addition, certain degree of income convergence has been achieved among the ASEAN-5 countries. Hence, this study attempts to make yet another contribution by examining whether structural homogenization can be detected among these founder countries. In other word, the results hope to determine whether ASEAN-5

countries undergo similar economic development resulting to similarity in production structures. It provides important implications for understanding their business cycles and long run development patterns.

The rest of this paper is organized as follow: next section discusses relevant theoretical framework and related literature reviews. Data and methodology adopted in this study are described after that. The last section will be covering the results along with the concluding remarks.


**Theoretical Framework And Literature Reviews**

Structural homogenization (or convergence) indicates that economies which follow similar stages of development and converge to a structural "steady-state" producing more uniform sectoral mix of output. On one hand, it explains the narrowing variation in structure of economic production between countries over time (Imbs, 2001; Wacziarg, 2001; Hohenberger & Schmiedeberg, 2008). On the other hand, it tend to investigate whether the backward countries were able to catch-up with the more developed countries in the region by transforming their production structures (Palan & Schmiedeberg, 2010).

Structural convergence can be further distinguished into 2 types, namely the inter-sectoral convergence and inter-industry (or equivalent to intra-sectoral) convergence. Inter-sectoral convergence explained about the convergence between three aggregate sectors across economies which relies on the three-sector hypothesis. It is argued that countries within a region should undergo same path of development and reach to the structural steady state where service sector become the dominant sector of the economies. In particular, the convergence of production structures within one aggregate sector is referred as inter-industry convergence. However, the latter type of convergence was not included as part of this study.

Inter-sectoral convergence can as well be explained via the Engel Curve where convergence in income per capita leads to convergence of consumption pattern and hence to convergence of productive structures. Empirically, Imbs (2001) and Wacziarg (2001) revealed that countries with convergence in per capita income tend to detect income convergence in their sectoral structure as well. Longhi and Musolesi (2007) further evidenced that greater similarity in sectoral structures is associated with the decrease in income gap among forty European cities under their investigation. In separate work, Cuadrado-Roura et al. (1999) produced an index of inequality in productive structure for the Spanish region while performing convergence study on aggregate productivity. They found that the gradual homogenization of productive structure in Spain to be the main reason for the aggregate convergence in productivity. Meanwhile, Palan and Schmiedeberg (2010) analysed the development of economic structures among fourteen Western European countries using inter-sectoral heterogeneity index calculated from employment data. A strong and persistent inter-sectoral convergence detected among these countries due to the shifting in economic structures of lagging countries from industrial to service economies. Besides, Crespo and Simões (2012) conducted an investigation on the degree of structural similarity in exports from Germany and France to four important markets, i.e. USA, China, UK and Japan. Utilizing Krugman specialization index, they found that German and French to show higher level of structural similarity in British markets and lowest in the exports to Japanese market.

Back to the history of ASEAN, ASEAN-5 was established in 1967 comprising the founder members of Malaysia, Indonesia, Thailand, Singapore and the Philippines. The complete formation of ASEAN with full membership including Brunei and CLMV (i.e. Cambodia, Lao, Myanmar and Viet Nam) took place in 1999. These 10 member countries from different economic background results to huge disparities in income within ASEAN as documented in many studies (Alavi & Ramadan, 2008; Bunyaratavej & Hahn, 2003; Chowdhury, 2005; Park & Rahman, 2001). Teulon (2011) pointed out one lesson learned from the Euro crisis is that highly disparate countries having single currency could lead to great problem. Besides, Reyes (2012) further recommended such huge development gap within ASEAN must be narrowed in order to unite 10 member states as a single market and production base.

Though, mixing results were found on income convergence when the scope were limited to ASEAN-5 countries. Such conclusions are not suprising as these founder countries are more developed as compared to the newer members. Studies conducted by Bunyaratavej and Hahn (2003), Lim and McAleer (2004) along with Park and Rahman (2001) did not support the fact of income convergence among ASEAN-5 countries. On the contrary, Ong and Habibullah (2008) documented gradual convergence among these countries. Yet, some evidences on income convergence within ASEAN-5 still can be found (Ismail, 2008; Jayanthakumaran & Verma, 2008).

On top of the investigation regarding income convergence in ASEAN or ASEAN-5, research on structural homogeneity has yet received much attention. Though, homogeneity in trade structures among them can be found in Loke (2009). The net export similarity index analysed in the paper revealed high similarity in trade (export) structure among ASEAN-5 countries. Such finding also indicated increasing competition among ASEAN-5 countries as well.


**Methodolody & Data**

This present paper attempt to examine whether the productive structures have become homogenous across countries, hence the inter-sectoral heterogeneity index introduced by Palan and Schmiedeberg (2010) will be adopted in this context. The index of

inter-sectoral heterogeneity (SHE) is calculated as the sum of the N countries absolute deviations from the average employment share of each sector $s$ on total employment, in such:

$$SHE = \frac{1}{N}\frac{1}{S}\sum_{n=1}^{N}\sum_{s=1}^{S}|b_n^s - \overline{b^s}|$$

The employment share $b_n^s$ of sector $s$ in country $n$ is calculated by dividing employment $l$ in sector $s$ by total employment in country $n$, i.e. $b_n^s = l_n^s \Big/ \sum_{s=1}^{S} l_n^s$. Similarly, the average employment share is the ratio of employment in sector s in all N countries and total employment in the N countries, i.e. $\overline{b^s} = \sum_{n=1}^{N} l_n^s \Big/ \sum_{n=1}^{N}\sum_{s=1}^{S} l_n^s$. The index has a lower boundary at zero which indicates perfect homogeneity, implying all countries produce the same sectoral mixture of products.

Subsequently, the index for each year over the observation period will be calculated. σ-convergence can be analysed by modelling the development of the heterogeneity index as an autoregressive integrated moving average process (ARIMA(p,d,q)) with d = 1, according to the following equation:

$$\Delta \log SHE_t = \varphi + \sum_{i=1}^{p} \mu_i \Delta \log SHE_{t-i} + \varepsilon_t - \sum_{j=1}^{q} \theta_j \varepsilon_{t-j}$$

The estimation results of the constant $\varphi$ which in the case of d = 1 indicates the (deterministic) time trend of the time-series. If the value of $\varphi$ found significantly greater than zero, it is interpreted as a sign that heterogeneity increases over time, implying inter-sectoral divergence. Otherwise, a significant negative value of $\varphi$ indicates a decrease of SHE and suggesting inter-sectoral convergence.

Our annual data from year 1970 to 2012 were retrieved from the database in United Nations Statistics Division (UNSD) for ASEAN-5 members namely Malaysia, Singapore, Thailand, Indonesia and the Philippines. These data are then breakdown to five main sectors under investigation according to the classifications in UNSD as follows:

Sector 1: Agriculture, hunting, forestry and fishing (ISIC A-B)
Sector 2: Mining and utilities (ISIC C & E)
Sector 3: Manufacturing (ISIC D)
Sector 4: Construction (ISIC F)
Sector 5: Service (including ISIC G-H: wholesale, retail trade, restaurants and hotels; ISIC I: transport, storage and
communication; ISIC J-P: Others)

The empirical analysis of this study is based on output measured in gross domestic product (GDP) per capita in U.S. Dollar (at the constant price of year 2005) for each sector rather than employment, mainly due to the shortage of employment data among ASEAN-5 countries. Therefore, the calculation of SHE index will be using sectoral share in terms of GDP per capita accordingly.


**Empirical Results & Some Concluding Remarks**

The SHE indexes among ASEAN-5 countries were calculated over 43 years and it is presented in Figure 1. Obviously, the trend of the index shows a decreasing trend. This implies that the sectoral mix of output among the ASEAN-5 countries do become more similar. In order to ascertain the trend seen from Figure 1, further test need to be conducted.

Two conventional unit root tests i.e. the Augmented Dickey Fuller (ADF) test and Philips-Perron (PP) test were performed on the SHE indices in logarithm term. Both of these tests examine on the null hypothesis of containing unit root and the results are documented in Table 1. Regardless to the test with or without trend, all the results found that log (SHE) to be stationary at its first difference with the significance level of 1%. Hence, the first difference series of log (SHE) will be estimated using the ARIMA (p,1,q) model. Correlogram helps to decide the appropriate lag order for p and q while the best ARIMA model will be selected based on the Akaike information criterion (AIC).

Figure 1: Index of Inter-Sectoral Heterogeneity (SHE) among ASEAN-5 Countries, 1970 – 2012
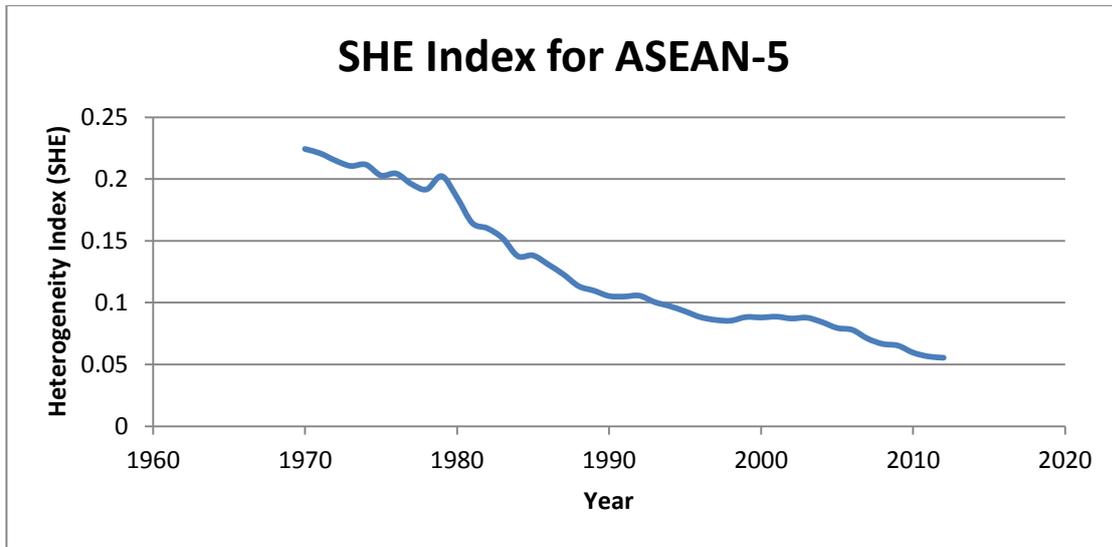


Source: United Nations Statistics Division (UNSD) Database

Table 1: Results of Unit Root Test on Logarithm of SHE Index

| Test | Level | | First Difference | |
|------|-------|--|------------------|--|
|      | Intercept | Intercept & Trend | Intercept | Intercept & Trend |
| Augmented Dickey Fuller test | 0.2126 | -2.7047 | - 5.5366 *** | - 5.4754*** |
| Philip & Perron Test | 0.0777 | -1.9271 | - 5.6139 *** | - 5.5624 *** |

Source: United Nations Statistics Division (UNSD)
Note: *, ** and *** denote significance at the 10%, 5% and 1% level respectively.

The best fit ARIMA model with the minimum AIC value is selected and the result is presented in Table 2. Necessary diagnostic check through various tests were conducted including the invertibility test, independent test (Ljung-Box Test), autocorrelation test (Breusch-Godfrey LM Test) and normality test (Jarque-Bera test) in order to validate the estimated model. The result from all these tests demonstrated that our estimated model do not violate any of the assumptions required.

Table 2: Results of ARIMA Estimation for Logarithm of SHE Index at First Difference

| Variable | Coefficient | t-statistics |
|----------|-------------|--------------|
| Constant ($\varphi$) | – 0.016216 | – 4.859410 *** |
| AR (2) | – 0.406202 | – 2.790518 *** |
| MA (2) | 0.652795 | 12.11514 *** |
| MA (3) | 0.524040 | 10.73161 *** |

Note: *, ** and *** denote significance at the 10%, 5% and 1% level respectively.

Referring to Table 2, it is found that the constant $\varphi$ to be significant at 1% level. The negative sign of the $\varphi$ indicated that heterogeneity in productive structures within ASEAN-5 decreases over time implying σ-convergence in their productive structures. Hence, we found structural homogeneity (convergence) among ASEAN-5 countries in terms of output (income).

Therefore, the findings presented in this study allow us to provide new evidence of convergence among ASEAN-5 countries in their productive structures, complementary to the mixing results found in literatures regarding income convergence within the

region. As such, we may disclose that the founder member of ASEAN has been developed following similar path and gradually converge towards their structural "steady-state". On the other hand, it also implies that certain degree of symmetry in shocks has been achieved, shading more insight on the feasibility of ASEAN-5 as a common currency union.

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