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EMPIRICAL STUDIES OF CONVERGENCE IN INCOME, PRODUCTIVITY AND COMPETITIVENESS: THE EXPERIENCE OF ASIAN ECONOMIES

By

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ABSTRACT

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EMPIRICAL STUDIES OF CONVERGENCE IN INCOME, PRODUCTIVITY AND COMPETITIVENESS: THE EXPERIENCE OF ASIAN ECONOMIES

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This thesis comprises three essays on convergence issues in selected Asian countries, focusing on both macro and micro perspectives. These papers encompass issues on convergence testing from time series and panel perspectives, with in-depth coverage on convergence in aggregate and structural (inter sectors and sub sectors convergence) of the Asian economies.

The first essay examines the convergence hypothesis using both time series and panel frameworks, from a macro perspective. Utilizing the concepts of stochastic convergence, the study tests the income convergence hypothesis by using both linear and nonlinear unit root tests. The present study emphasizes the usefulness of the nonlinear unit root tests due to Kapetanios, Shin and Snell (2003) and extended by Chong, Hinich, Liew and Lim (2008) to permit the test of long-run convergence and catching-up hypothesis. Next, the study utilized the recent panel unit root test for the nonlinear heterogeneous panel model proposed by Ucar and Omay (2009). In the present study, despite using the univariate and panel nonlinear tests for convergence, the results suggest strong evidence of divergence among the Asian countries with Japan. Further analysis was undertaken using tests for convergence with two robust tests that do not require stationarity in the data generating process suggested by Nahar and Inder (2002) and recently proposed by Phillips and Sul (2007a). On the one hand, the Nahar-Inder test indicates divergence between the Asian economies with Japan (except for Singapore), however, on the other hand, the Phillips-Sul test suggests that, all the other Asian economies converge towards Japan. The study suggests that since the Asian economies are in

various stages of development, the Phillips-Sul test for convergence is more appropriate for such transition economies. Thus, testing for convergence using the unit root and cointegration test for transitional dynamics in the data may not be appropriate. Bernard and Durlauf (1996: p.172) have cautioned that "the (time-series) test may therefore be invalid if the data are largely driven by transition dynamics" and in this study, this found support.

The second paper tries to bridge the gap between the macroeconomic issue of productivity convergence at the aggregate level and the microeconomic issues of convergence at the industry level. The study investigates structural convergence in selected Asian countries over the period of 1970-2005 using the non-linear time-varying coefficients factor model proposed by Phillips and Sul (2007a). This model has the flexibility to model a large number of transition paths to convergence, and allows for convergence clubs as well. Structural convergence exists if the convergence progress in income is accompanied by convergence at a sectoral or disaggregated level. The study finds strong divergence in income convergence at the aggregate level, and the clustering shows four clubs. To be robust, the study presents three measures of structural convergence, namely productivity, labour shares and value added. Convergence tests on productivity and value added shares indicate divergence in all sectors that leads to possible creation of club convergence. On the other hand, the labour share shows convergence in aggregate in three sectors (manufacturing, mining and construction). Also, the paper reveals that there is strong sectoral club convergence within the manufacturing sector in Asian whereas the evidence of convergence club for services, agriculture, and construction as well as for mining is rather weak. While the integration process is actively geared in Asian, the question of candidates' suitability for the AEC (Asian Economic Community), as proposed in this study JAKITH (Japan, Korea, India, Taiwan, Hong Kong, and ASEAN) is still a debatable issue.

Utilizing the concept of sub-sectoral convergence, the third study tests the convergence in competitiveness for 13 Asian countries for medium/high technology manufacturing sub-industries in three decades. This paper focuses on the issue of competitiveness measured in terms of productivity and labour input efficiency at the industry level within the manufacturing sector of Asian countries. The study applies the non-linear time-varying coefficients factor model that allows for large transition path to converge and also convergence clubs (Phillips and Sul, 2007a). The results indicate that in general Asian countries have a constant increase in its competitiveness yet no aggregate convergence is achieved. Club convergence indicates that labour productivity is likely to

be driven by high income countries, as opposed to labor input efficiency. However, the low income countries show significant increase of productivity and high labour input efficiency as compared to richer countries. The high labour input efficiency indicates low wages paid to workers, significantly correlated with high density population countries as India and Indonesia. Based on comparative advantage theory, focusing on the industry level, the study also utilized the Krugman specialized index to show the clustering of concentrated industries among countries in Asia. The study found no trace of close to convergence situation, which indicates that the economic activity of Asia is focused or concentrated in specific activities, explaining the divergence in the sub-industries. The growing similarity of Asian economies in terms of overall productivity masks a continued high degree of specialization in particular industries. These findings should help policy makers for both target groups in designing appropriate growth-oriented programme as well as in setting priorities in their implementation.

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List of Abbreviations

ULC	Unit Labour Cost
HAC	Heteroskedasticity Consistent Coefficient Covariance
GGDC	Groningen Growth and Development Centre
ADB	Asian Development Bank
UNIDO	United Nations Industrial Development Organization
ISIC	International Standard of Industrial Classification
ARMA	Autoregressive Moving Average
GNP	Gross National Product
ASEAN	Association of Southeast Nations
AEC	ASEAN Economic Community
GDP	Gross Domestic Product
ADF	Augmented Dickey Fuller
ESTAR	Exponential Smooth Transition Autoregressive Model
PESTAR	Panel Exponential Smooth Transition Autoregressive Model
NAFTA	North American Free Trade Area
EU	European Union
OCA	Optimum Currency Area
OECD	Organization for Economic Co-operation and Development
NMS	New Member States
HP	Hodrick and Prescott
EBA	Extreme Bound Analysis

Declaration of Authorship

I, **Dayang Affizzah Awang Marikan,**

Declare that the thesis entitled

EMPIRICAL STUDIES OF CONVERGENCE IN INCOME, PRODUCTIVITY AND COMPETITIVENESS: THE EXPERIENCE OF ASIAN ECONOMIES

and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- this work was done wholly or mainly in candidature for a research degree at this university;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this university or any other institutions, this has been clearly stated;
- where I have consulted the published work of other, this is always clearly attributed;
- where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
- I have acknowledged all main sources of help;
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- none of this work has been published before submission.

Signed: ……

Date: ……

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CHAPTER 1

1.0 Introduction

The notion of economic convergence refers to a process by which national economies display increasing similarities in the patterns of their performances. The convergence hypothesis states that poor countries, those with relatively low initial per capita income, grow faster than rich ones so that over time income levels converge across countries. For policy coordination between Asian economies to be a net benefit, it is necessary that there be some degree of "convergence" between the participating countries. A successful cooperation and integration of these economies requires some degree of "convergence" between the participating countries and that they fulfill certain criteria in terms of both the domestic policy and the structure of domestic institutions, or that there is some supranational body which has sufficient authority to enforce compliance.

Most countries in South-East Asia have experienced substantial economic growth, with the pace of growth having varied substantially across countries. Recent empirical studies have found evidence of several convergence clubs, in which per capita incomes have converged for selected groupings of countries and regions. As Asian countries are at various stages of development, the path of transition in economic performance may be very different across nations. However, explaining why some countries differ whilst others converge towards each other requires a lengthy and thorough discussion subject to many technical and theoretical arguments in terms of methods, income, structure and indicators of competitiveness.

This dissertation contributes to the empirical literature on convergence by deepening our understanding of the in depth study of convergence theory and testing on Asian economies. In Chapter 2, convergence of income per capita for the Asian economies was tested using both linear and nonlinear unit root test procedures, and using Nahar-Inder and Phillips-Sul approaches that do not require stationarity in the data generating process. The nonlinear time varying factor model is shown to be a robust testing for convergence theory. Chapter 3 examines the structural (inter-sectoral) convergence of five sub-sectors, namely; Agriculture, Mining, Construction, Manufacturing and Services in Asian countries. In Chapter 4, we investigate the competitiveness

measures and the convergence in medium/high technology manufacturing industries for selected Asian economies.

Chapter 2 emphasizes the test for convergence using time series data. Time series studies on the long run behaviour of the differential in per capita output between countries have relied on unit root and cointegration techniques to test for the existence or non-existence of convergence among countries. The constant parameter of cointegration model, which essentially tests if the linear combination of two series is stationary, is based on the strong assumption that the long run relationship between two series is time invariant and linear. However, Bernard and Durlauf (1996) emphasize that time series models may have poor power properties when applied to data from economies in transition. With regards to different level of economic performance, the distribution of income across nations moves over time, often in ways that cannot be anticipated.

Nevertheless, there are three new developments that emerge in the research related to convergence. First, in a time series framework, unit root testing of income differentials has been the most popular method for testing convergence. Since it has been recognized that unit root testing in a single equation framework has low power, panel unit root techniques solve the low power issue of unit root tests; and furthermore, panel unit root tests based on a heterogeneous specification take into account individuals with heterogeneous dynamics. Secondly, the economic growth literature has illustrated that growth is nonlinear. Subsequently, estimating income convergence assuming linearity in income is subject to mis-specification error and spurious policy conclusions. Finally, whether stationarity matters for testing for convergence has been questioned recently. The method proposed by Nahar and Inder (2002) and Phillips and Sul (2007a) has provided a solution to the prerequisite of unit root and cointegration for the testing of convergence.

This study has taken into account all the above three issues when testing for income convergence between Japan, as the leader country, with China, South Korea, Indonesia, Malaysia, Philippines, Singapore and Thailand. Interestingly, the results using Phillips and Sul (2007a) $\log t$ test clearly indicate that all countries, namely; China, South Korea, Indonesia, Malaysia, Philippines, Singapore and Thailand converge to the leading country, Japan. It concludes that as Asian economies experience various stages of development, the path of transition in economic performance may be very different across nations. Thus, testing for convergence using the standard

time series framework may not be appropriate to detect convergence in transitional dynamic economies such as the Asian nations.

Our study suggests that nonlinearity is an important feature of the growth process. Growth is nonlinear in nature, and being analyzed using a linearity test would somehow lead to misleading results. The study argued also that stationarity is not a necessary condition for the existence of convergence. This is a crucial point to note, since under technological heterogeneity, the examination of either growth convergence or growth determinants by standard panel stationarity tests is not valid. In line with this view, a nonlinear time varying model suggested by Phillips and Sul (2007a) is appropriate. It interprets the model as an asymptotic cointegration test without suffering from the small sample problems of unit root and cointegration testing. Moreover, the methodology is robust to the stationarity properties of the series under scrutiny, i.e. it does not rely on any particular assumptions concerning trend stationarity or stochastic nonstationarity. More importantly, in the context of this methodology, countries can merge into clusters by means of a simple empirical algorithm, based on a quite general form of a nonlinear time varying factor model. Thus, not finding convergence does not merely indicate a total divergence, it could lead to club convergence.

The main objective for this chapter is:

i. To investigate the existence of income convergence among ASEAN5+3 by applying the non linear framework,
ii. To investigate the applicability and suitability of standard time series in convergence testing taking into account the heterogeneity, nonlinearity and nonstationarity aspects factors.

First, the novelty of this paper stems from the in-depth research of appropriate methods in testing convergence based on important key developments in the area. It attempts to answer the debatable issues of nonlinearity, stationary and considers the heterogeneity specification testing for a more robust and accurate result. With the evidence of divergence of income in most previous studies, the study exploits some recent developments in the econometric literature which provide a more flexible framework for the analysis. Upon this background, an important issue to be added is that even the non existence of convergence would then indicate the possibility of convergence

clubs. Clearly, any evidence of multiple regimes due to the nonlinearities in growth raises questions about misspecification in empirical studies that assume that all countries follow the same growth process, (Solow's setting) and casts doubt on inferences and policy recommendations that are drawn from these studies. Thus, this study attempts resolve the issues.

Chapter 3 examines empirically the convergence issues in more detail for the Asian countries. Despite Asia's long integration process, there is still a wide variation between the member countries in terms of economic and social development. It is hypothesized that there exists structural convergence within JAKITH (Japan, ASEAN, Korea, India, Taiwan and Hong Kong) which are the proposed countries to participate in the Asian Economic Community. Structural convergence is defined as a situation in which there exists convergence of per capita income levels supplemented with the convergence of their inter-sectoral productivity or employment shares. Analysis at the disaggregated level is important as it shows the true scenario of similarity or dissimilarity of sectoral structure of the economy; ultimately to determine whether the shock is symmetric or asymmetric. In other words, the external shocks are also symmetrical, such that, in the occurrence of a negative demand shock, all the member countries are affected in roughly the same way (Martin, 2001). This would suggest that a monetary union is feasible among that group of countries. Thus, the existence of sectoral convergence in the sample is crucial to enhance the economic integration between Asian economies, thus contributing to the objective of the Asian Economic Community (AEC). The five sub-sectors are chosen based on their major contribution to overall economic growth in Asia namely manufacturing, construction, mining, agriculture and services. Specifically, the objectives of this paper are,

i. To determine whether all sectors of JAKITH show similar converging process by testing the structural convergence in terms of productivity
ii. To measure the robustness of structural convergence testing using labour productivity, value added share and labour shares.
iii. To ensure that JAKITH might be possible candidates for the AEC (ASEAN Economic Community)

This paper contributes to the literature in several ways. First, the novelty of this paper stems from the implementation of the new methodology of panel convergence tests by Phillips and Sul on the structural convergence testing in JAKITH sectors. In particular, JAKITH consists of developed

and developing countries, resembles the integration process that proceeds at different speeds and to different extents. However, as these countries are in the same region, they may share a similar sectoral economic structure. This methodology caters for the heterogeneity that exists within these countries. Secondly, the study is able to group countries into convergence clubs by means of a simple algorithm. In other words, JAKITH countries are clustered into their strong and weak convergence clubs, indicating the core and the catching up countries, even allowing countries to diverge from the groups individually. Thus different policy measures can be adopted to cope with the different level of convergence process. Thirdly, it provides a comprehensive view on intersectoral convergence on Asian industry level in which there have been very few studies.

Chapter 4 examines the convergence issues in term of competitiveness in high/medium technology in manufacturing industries in selected Asian countries. In order to understand the economic structure of Asian economies, both macroeconomic issues on the income at the aggregate level and the microeconomic issues on convergence at the industry level are detailed. The study hypothesizes that convergence is likely to exist in the labour competitiveness throughout the sub-sectors of manufacturing industry in Asian countries. In this study, two measurements of competitiveness, labour productivity and labour input efficiency are explored. Questions are raised of whether, how and when poor or low productivity countries will catch up with rich or highly productive countries, which are of great interest to economic theorists and policymakers alike. There are two reasons why the aggregate productivity of nations may differ; first, one country may have higher productivity at the industry and sub-industry level; second, one country may have its work force concentrated in high-productivity industries and sub-industries. In this study, we focus on the latter. Based on the competitive advantage theory, Michael Porter states that competitiveness can be defined through firm, industries, nations and regions and cities. Precisely, he suggests the substitution of the notion of national competitiveness with that of firms and/or sectors. Based on this view, he claims that a country is competitive when a concentration of competitive firms and sectors exists on its territory.

This paper focuses on the dynamics and convergence of the competitiveness of labour in Asian countries over the last three decades considering the specific medium and high technology sector in manufacturing industry using several measurements of competitiveness. This study comprises an in-depth investigation into the process of convergence in labour competitiveness both in aggregate and sectoral measures. The study considers patterns of labour productivity and

effective unit of labour input convergence across medium/high technology manufacturing sectors in 13 countries during 1971-2001 both in aggregate and clubs. The convergence analysis on the disaggregated data of sub-sectoral level namely printing and publishing, manufacture of industrial chemicals, manufacture of plastic products and manufacture of transport equipment, should thus show a better scenario of similar economic structures.

Thus, the objective of the present study is:

i. To examine the competitiveness of labour in manufacturing industry in Asia in terms of two indicators, labour productivity and labour input efficiency

ii. To analyse empirically labour competitiveness of intra-sectoral convergence among the medium/high technology industries in the selected Asian countries.

This study makes important contributions to the literature in several aspects. First, the novelty of this paper stems from the in-depth research of intra-sectoral medium/high technology industry in Asia in the context of labour competitiveness. It attempts to answer whether there exists a statistically significant movement towards structural homogeneity in competitiveness within the manufacturing sub-sectors. Secondly, in order to analyze the transitional behaviour of labour cost and productivity in Asian countries, a test of non linear time varying factor model developed by Phillips and Sul (2007a) is applied. The methodology is chosen as it is based on a nonlinear time-varying factor model that incorporates the possibility of transitional heterogeneity or even transitional divergence. Thirdly, the Krugman specialization index is used in the hope of explaining in depth the pattern of labour competitiveness convergence/divergence in the manufacturing industry.

CHAPTER 2

NONLINEAR GROWTH AND CONVERGENCE IN ASEAN5+3 ECONOMIES: DOES STATIONARITY MATTER FOR INCOME CONVERGENCE?

2.1. Introduction

The income convergence hypothesis says that poorer and richer economies may eventually converge in term of their economic growth rates even though there are differences in the initial condition (income). This interesting issue of income convergence where poor countries grew faster than the richer ones has drawn the attention of many researchers and policy makers. Numerous studies have been conducted for both the developed and developing countries using both cross-section and time-series approaches for testing convergence, however, with mixed results. Even though, the voluminous literature on testing for income convergence hypothesis has previously been scrutinized using the linear regression framework, however, the effort from the nonlinear perspective is lacking.

The validity of convergence hypothesis based on linear regression framework could be tested using stationary test of time series of income differential between poorer and richer countries. If there is evidence of stationary (stable long-run movement) between two countries' incomes, this implies income convergence over time. Otherwise, the result would be interpreted as income divergence. Time-series studies, which focus on the long run behavior of differences in per capita output across countries, have relied on unit root and cointegration techniques to test for the existence or nonexistence of convergence among a group of countries. Using this framework time-series tests generally reject convergence for a range of countries. The cointegration modeling approach, which essentially tests if the linear combination of two series is stationary, is based on the strong assumption that the long-run relationship between two series is time-invariant and linear. Such an assumption is more apt to test for steady state behavior, as pointed out in Bernard and Durlauf (1995). The impetus of this study is embedded on the proposition that linearity may well encrypt nonlinearity, which cannot be detected by the traditional linear causality tests. If it is observed that non-linear causality exists, it would imply a far more complex relationship exists

between these two variables than has previously been documented. Furthermore, instead taking an aggregative approach this study looks at pairwise convergence which allows accounting for heterogeneity in country specific behavior.

In broad, several nonlinear growth models are being discussed in the previous literatures. These nonlinear growths models/approaches are being characterized by a country's performance being very much dependant upon its initial condition. To elaborate more, among it is the structural change (or 'stages of development') models, that focus on the (internal) transformations of an economy as it transits through critical phases or 'stages' (Lewis, 1956) leading to industrialization. Another view from Peretto (1999) says that a nonlinear growth process is the result of the transition from growth generated by capital accumulation, subject to decreasing returns to scale, to growth based on knowledge accumulation. Besides, nonlinear economic growth can also be derived as a result of gradual reform strategy. According to Lai (2006), China has entered a convergent growth path since 1978 that is driven by its market-oriented reform and opening to the outside world. The mechanism that works in the East Asian model (the flying geese pattern) is basically similar to the main mechanism that works via market and opening drive convergence. Aside from China, 'reformed' is a predominant feature in the 1970s and 1980s in the transition East Asian countries. To enhance growth in these countries, financial reform has been formulated by the government to liberalize the so-called 'financially repressed economy' (Habibullah and Smith, 1997). The liberalization of interest rates, the reduction of capital controls and the adoption of flexible exchange rates regime have greatly boosted the economy to some new high level of economic development. Japan has emerged into a developed nation followed by South Korea more particularly due to these reformation. Apart from that, the ASEAN5 countries have since been recognized by the world communities as the high performing Asian economies. Despite the shocks in the 1970s and 1980s, the success of these Asian nations was the consequences of macroeconomic stability, prudent fiscal and external borrowing policies, and the successful financial liberalization programs embarked by these countries. The reforms, the supply shocks and the crises experienced by the Asian countries have impacted the ups and down of the economy. In fact, Liew and Lim (2005) and Liew and Ahmad (2007) has demonstrated that the data generating process of the GDP per capita of the East Asian economies are nonlinear.

Another nonlinear growth model that heavily emphasized is on the role of technological progress in growth. According to Lucas (2000), the model focuses on the diffusion of technology

from countries which are technological leaders to less developed countries. Generally, rich and poor countries would gradually converge in per capita income provided if there is no barrier to the technological diffusion. However, if such barriers exist, then countries may differ in their ability to adopt technologies. As a result, this eventually creates 'clusters' of countries defined by a set of common barriers to technological adoption. With this, the issue of club convergence arises. As pointed by Fiaschi and Lavezzi (2003) since different countries have different speed of adoptions this will lead to nonlinear growth paths. Nevertheless, the per capita incomes across convergence clubs need never converge and the polarization of per capita incomes across countries may be permanent. The fact that global inequality may be persistent as suggested by the nonlinear growth models has sparked major advances in the area of cross-country growth empirics. Thrilled by such ideas, the central focus of growth empirics has been to evaluate the conditions under which poor countries catch up with rich ones or fail to do so.

Why consider nonlinear model? Many believe that linear model ought to be a relatively poor way of capturing certain types of economic behavior, or economic performance, at certain times. The obvious example would be a linear (e.g. Box–Jenkins ARMA) model of output growth in a developed economy subject to the business cycles, where the properties of output growth in recessions are in some ways quite different from expansions (Hamilton, 1989). In addition, Potter (1995) claims that univariate nonlinear model outperforms the standard linear models in examining the nonlinear behavior of U.S. GNP. In fact, the nonlinear model suggests that the post-1945 U.S. economy is significantly more stable than the pre-1945 U.S. economy. Upon the linear specification nature of the Solow model's growth predictions, Kalaitzidakis, Mamuneas and Stengos (2000) tested the linear specification of the auxiliary variable. Within this framework, they used these robust models to ascertain the significance of any variable in standard EBA fashion. Their findings confirmed that investment has a robust impact on growth, however, the omitted nonlinearities of Levine and Renelt (1992) showed that at least one variable from every major policy group was robust, contrary to their conclusions. Therefore, Kalaitzidakis et al. (2000) conclude that the use of a simple linear regression framework is inappropriate. Moreover, as Granger (1969) argues, univariate and multivariate nonlinear models represent the proper way to model a real world that is almost certainly nonlinear. Besides the predominance of nonlinear models in economics and finance is not inconsistent with the use of linear models by the applied practitioner; as such models can be viewed as reasonable approximations to the nonlinear phenomenon of interest. Nevertheless, while

an increasingly large body of work finds evidence that is suggestive of growth nonlinearities; many questions remain open and are the subject of current research.

Based on the fact that less study is explored in nonlinearity setting, especially in developing countries, thus, this study aims to investigate the existence of income convergence or divergence of Asean5+3 using the latest method of non-linear test of stationary to produce robust results. These economies include Indonesia, Malaysia, the Philippines, Singapore, and Thailand as the founding members of the Association of Southeast Asian Nations (ASEAN) and the East Asian counterpart – China, Japan and South Korea. Motivated by the argument that linear testing procedure may fail in non-linear context, the study adopts both linear and non linear setting of unit root test in showing empirically that non-linear stationary test of Kapetanios, Shin and Snell (2003) perform better than ADF in detecting stationarity in the presence of non-linearity. The reason for applying the latter is that linear unit root tests might suffer from lack of power in the presence of nonlinearities in the dynamics of the variables (Kapetanios et al., 2003) and, hence, they might not be able to distinguish between unit root and nonlinear stationary process. More model specification and further discussion on the nonlinear panel unit root is then discussed to have robust result. The study is extended into the debate of stationary as a necessary condition for convergence. Furthermore, motivated by mixed arguments on the relationship between income convergence/divergence, stationary, heterogeneity, the study attempts to show a more appropriate testing of convergence by applying Philips and Sul convergence testing which cater all the mentioned issues.

This study makes important contributions to the literature in several aspects. First, the novelty of this paper stems from the in-depth research of appropriate methods in testing convergence based on important key development in the area. It attempt to answer the debatable issues of nonlinearity, stationary and taking into account the heterogeneity specification matters in having a more robust and accurate testing. With the evidence of divergence of income in most of previous studies, the study exploits some recent development in the econometric literature which provides a more flexible framework for the analysis. Upon this background, an important issue to be added is that even the non existence of convergence would then indicates the possibilities of convergence clubs. Clearly, any evidence of multiple regimes due to the nonlinearities in growth raises questions about misspecification in empirical studies that assume that all countries follow the

same growth process, (Solow's setting) and casts doubt on inferences and policy recommendations that are drawn from these studies. Thus, this study is in hope is to resolve the issues.

The study is organized as follow. Section 2.2 presents some related literature on convergence testing in the East Asian region, followed by theoretical framework in section 2.3. The method for the testing of convergence is discussed in Section 2.4 and data description in section 2.5. We present the results in Section 2.6. The last section contains the conclusion.

2.2 Literature Review

ASEAN continuous effort to foster closer political ties as well as to strengthen economic co-operation are justified from its huge market opportunities, its democratic political belief (except Myanmar), and its closer proximity within the Southeast Asian region. In 1997, the ASEAN leaders adopted the "ASEAN Vision 2020" which envisaged a "concert of Southeast Asian nations, living in peace, stability and prosperity, bonded together in a partnership of dynamic development and in a community of caring societies" (ASEAN Secretariat, 2005; Economic Analytical Unit, 2006). Based on foundations laid in 1997 in the "ASEAN Vision 2020", the ASEAN leaders agreed to transform ASEAN's ten member countries into an ASEAN Community. This include an ASEAN Economic Community (AEC) – "a single market and production base with free flow of goods, services and skilled labor and freer flow of capital by 2020". In the same year, the efforts towards regionalism has been further stepped up in East Asia with the formation of the ASEAN+3 grouping, comprising of ASEAN member countries and China, Japan and South Korea, the three major economies in East Asia. This has been widely observed as a move towards achieving an East Asia-wide Free Trade Area and furthermore, this formation does become an important building block for a wider pan-Asian Economic Community in the future. Nevertheless, ASEAN+3 is fundamentally a heterogeneous group of countries, ranging from low income (such as Laos) to high income (such as Japan) economies. The significant heterogeneity among these Asian countries would present significant challenges in achieving AEC.

Thus, whether these countries are converging over time in terms of per capita income is of great importance and is a basic question and of considerable interest for economic integration. It

addresses the concerns of policymakers analyzing inequality and brings to the analysis, ideas and insights into the economics of income distribution and redistributive policy. However, according to Lloyd and Smith (2004) if the advanced ASEAN countries maintain their rapid growth rates, convergence will be difficult because it is quite impossible for the newer member to catch-up with such high rates of growth. As a result of this, Hew (2003) points out the possibility of the presence of two club convergence – the advanced ASEAN economies and the newer ASEAN member countries. Nevertheless, it has been recognized that the fast growing East Asian economies and the new development in ASEAN to form an ASEAN Economic Community and the establishment of the ASEAN+3 framework for economic co-operation should be an ideal group of countries for which to empirically test the convergence hypothesis.

The question of whether East Asian economies can catch-up with Japan has been examined by Zhang (2003). Using the model for testing club convergence proposed by Chatterji and Dewhurst (1996), Zhang found out that there is strong and robust evidence of the existence of multiple convergence equilibria across the ASEAN5, China, Korea, Hong Kong and Taiwan economies for the period 1960-1997. Zhang found two club convergences – "rich" club comprising Japan, Hong Kong, Singapore, Malaysia, Taiwan and the Philippines. The "poor" club consists of China, Indonesia, Korea and Thailand. On the other hand, using the logistic model (nonlinear function) to test for convergence between Japan, Korea and Taiwan for the period as early as 1900s to 1992; Hsiao and Hsiao (2004) indicate that real GDP per capita of Taiwan and Korea are converging to that of Japan and the United States. Similarly, Japan's GDP per capita also converges to that of the United States.

Lim and McAleer (2004) examine club convergence for ASEAN5 as well as convergence with the technological leader, the United States. Despite the varieties of methods employed, generally, the results do not support convergence between the ASEAN5 with the United States. However, there is strong evidence of technological catching-up by Singapore to the technological leader.

In another study, using σ-convergence and β-convergence approaches, Moon (2006) show that the East Asian region comprises of Japan, Korea, China, Taiwan, Hong Kong and the ASEAN5 economies as a whole tends to converge to each other in terms of per capita income. However, when considering the Northeast Asian region and the ASEAN5 region, the result indicates that

strong evidence in favor of real growth convergence for the Northeast Asian region, while for the ASEAN5 economies, is not conclusive. However, similar conclusions are found by Carmignani (2007) and Alavi and Ramadan (2008). By using the Im, Pesaran and Shin (2003) panel unit root test, Carmignani (2007) found out that the ASEAN5 nations diverge from the regional mean for the period 1977-2004. On the other hand, using the Johansen multivariate cointegration test, Alavi and Ramadan (2008) failed to detect income convergence between any of the ASEAN10 member countries for the period 1970-2003. Nevertheless, a recent study conducted by Ismail (2008) for the ASEAN5 economies using the Pooled Mean Group Estimator found empirical evidence that supports both the unconditional and conditional convergence hypotheses in the region for the period 1960-2004. Ismail estimates that the ASEAN5 economies tend to converge to a steady state growth rate of per capita GDP with a speed of convergence of between 1.6% and 16.6%.

Other studies by Ghosh (2007), Liew and Lim (2005), Lee, Lim and Azali (2005) and Liew and Ahmad (2007) show interesting results. Ghosh (2007) examines the income convergence between ASEAN5, China, India and South Korea with the technological leader, Japan for the period 1960-2000. The convergence hypothesis is tested by investigating the unit root properties of the income differential between each country with Japan. Generally, the results suggest that only South Korea and Singapore support convergence, while the remaining six countries show divergence with the technological leader, Japan. Lee et al. (2005) also study the income convergence between Japan and ASEAN5 economies but imposes structural break when testing for unit root on the income differential. Lee et al. found out that long run income convergence is presence between Singapore and Japan. The remaining four ASEAN economies indicate divergence with Japan.

On the other hand, Liew and Lim (2005), and Liew and Ahmad (2007) question the standard ADF unit root test for income convergence in the presence of nonlinearity in the data. Liew and Lim (2005) and Liew and Ahmad (2007) demonstrate that the data generating process of income differentials between Japan and all East Asian economies are nonlinear. Thus, the appropriate testing procedure in the presence of nonlinear income differentials is by using the nonlinear unit root test proposed by Kapetanios, Shin and Snell (2003; KSS, hereafter). Liew and Lim (2005) found out that Hong Kong, Korea, and Taiwan and Singapore exhibit convergence with Japan, while China, Indonesia, Malaysia, Thailand and the Philippines showing divergence. On the other hand, by modifying the KSS test with the inclusion of nonlinear trend in the unit root testing procedure, the study by Liew and Ahmad (2007) found out that Hong Kong, Korea and Singapore

show long-run convergence with Japan, while Taiwan, on the other hand, showing catching-up with Japan.

2.3. Theoretical Framework

The neoclassical growth models states that there is negative relation between initial income levels and growth rates of income of a certain period. This means that rich countries tend to grow less faster than poor countries, once some conditions are settled and this is known as conditional convergence. The economy will eventually arrive at an equilibrium called steady state, where it cannot grow anymore. If the economy is approaching its steady state, there is convergence but if it is moving away from steady state, there is divergence. Meanwhile absolute convergence exists when poor economies grow faster than rich ones, regardless whether they have a common steady state or not. Thus poor countries tend to catch up when time passes.

The work of Barro and Sala-i-Martin (1991, 1992) has generated renewed interest in the testing of output convergence among countries in the growth literature. Barro and Sala-i-Martin has proposed two types of convergence – beta (β) and sigma (σ) convergence. On one hand, β convergence considers whether the growth rates of countries exhibit a negative correlation with the initial level of real GDP per worker, that is, β-convergence implies that countries with low real GDP per worker possess more potential for faster growth rates than countries with high real GDP per worker. On the other hand, σ-convergence measure the dispersion of real per capita income whether it is falling over time.

Quah (1995) and Sala-i-Martin (1996) show that a necessary condition for the existence of σ-convergence is the existence of β-convergence. For the dispersion of per capita GDP to decline between two countries, the initially poorer countries should grow faster than the initially richer ones, so that the existence of β-convergence generates σ-convergence. The former is necessary but not sufficient for the latter, since there may be economic shocks that push countries or regions apart even as β-convergence works to bring them together.

According to Bernard and Durlauf (1996), there are two categories of testing for convergence – the cross-section and time-series approaches. The cross-section approach investigates the correlation between initial per capita GDP levels with growth rates of a group of countries. Convergence is said to occur if a negative correlation is found between the average growth rate and the initial income. However, Quah (1993) criticizes the cross-country growth regression on the basis of Galton's fallacy.[1] Friedman (1992) and Quah (1993) argue that sigma convergence is the only valid measure of convergence.

Quah (1997) extend the cross country inequality by studying the dynamics of cross section distribution of country incomes. In the literature it is referred to as polarization, stratification or clustering models. In the distribution dynamics model, each economy has multiple locally stable steady states. Transitory shocks may have permanent effects whereas the Neoclassical Growth model assume that economies have a unique, globally steady state equilibrium and that transitory shocks affect the income ranking of an economy in the short run but do not have lasting effects (Galor,1996). The 'emerging twin peaks' idea is that at the beginning time t_0, there are one peak of income distribution while at later time, say time t_1, there are two peaks; one for countries with high levels of income and another is low. The middle income countries have disappeared. The number of groups at time t_1 can be more than two, and this process is called as stratification and each group is known as 'club'.

Nevertheless, the empirical evidence on the issue of income convergence is mixed, depending upon model characteristics, underlying assumptions, and the nature of data (e.g. cross section or time series). In a time series framework, a definition of convergence is to determine whether there exists a common deterministic and/or stochastic trend for different countries. In other words, convergence for a group of countries means that each country has an identical long run trend. Time series focus on the permanence of shocks to relative per-capita incomes by employing a stochastic definition of convergence. That is, per-capita income disparities between economies should follow a stationary process. Without stationary, relative per capita income shocks could lead to permanent deviations in any tendency toward convergence Bernard and Durlauf (1995, 1996). In a time-series perspective according to Bernard and Durlauf (1995), the so-called stochastic convergence asks whether

[1]Bernard and Durlauf (1996) show that the cross-section growth regressions cannot identify groupings of countries which are converging, in other words, it cannot discriminate between global (new growth models) or local (neoclassical growth models) convergence.

permanent movements in one country's per capita income are associated with permanent movements in another countries' income, that is, it examines, whether common stochastic elements matter, and how persistent the differences among countries are. Thus, stochastic convergence implies that income differences among countries cannot contain unit roots. In this respect, Bernard and Durlauf (1995, 1996) proposed a test for convergence that relies on the notion of unit root and cointegration in time-series.

Bernard and Durlauf (1995: p. 99) proposed the following three practical definition of convergence:

Definition 2.1. Convergence in output

Countries i and j converge if the long-term forecasts of output for both countries are equal at a fixed time t:

$$\lim_{k\Rightarrow\infty} E\left(y_{i,t+k} - y_{j,t+k} \middle| I_t\right) = 0$$

where I_t represent the information set at time t.

Definition 2.2. Convergence in multivariate output

Countries $\rho = 1,..,n$ converge if the long-term forecasts of output for all countries are equal at fixed time t:

$$\lim_{k\Rightarrow\infty} E\left(y_{1,t+k} - y_{p,t+k} \middle| I_t\right) = \mu_\rho \qquad \forall_\rho \neq 1$$

The above definition of convergence asks whether the long-run forecasts of output differences tend to zero as the forecasting horizon approaches infinity. The definition of convergence will be satisfied if $y_{1,t+k} - y_{\rho,t+k}$ is a mean zero stationary process (i.e. $\mu_\rho = 0$). This definition is called absolute convergence, but, if $\mu_\rho \neq 0$, we have the conditional

convergence. For Definition 2.1, if countries i and j to converge, their outputs must be cointegrated with cointegrating vector $[1,-1]$.

Definition 2.3. Convergence as catching-up

Countries i and j converge between dates t and $t+T$ if the deviation in output between country i and country j is expected to decrease. If $y_{i,t} > y_{j,t}$,

$$\lim_{k \Rightarrow \infty} E(y_{i,t+T} - y_{j,t+T} | I_t) < y_{i,t} - y_{j,t}$$

where t refers to the present and T to some year in the future. According to this definition, the difference between the two outputs should also be stationary, but now the time trend can be deterministic. Once again, the only cointegrating vector between the two countries can be $[1,-1]$.

Under a time-series framework, convergence requires real per capita cross-country output differentials to be stationary, that is, the levels of per capita national output are not diverging over time. This definition of convergence has a testable counterpart in the unit root literature. Since the testing procedure is by using the standard ADF unit root test, there are two alternative definitions of income convergence, depending on whether the test contain a constant, or a constant and a time trend. If a constant is included in the unit root regression, then income convergence is called deterministic convergence (Li and Papell, 1999) or asymptotically perfect income convergence (Bernard and Durlauf, 1995; Hobijn and Franses, 2000). If a constant and a time trend are included in the fitted regression, income convergence is called stochastic convergence (Carlino and Mills, 1993) or asymptotically relative convergence (Hobijn and Franses, 2000) or β-convergence or catching-up (Jungmittag, 2006; Greasley and Oxley, 1997)

2.4 Methodology

The following analysis is based on the Bernard and Durlauf (1996) definitions of convergence. With this backdrop, Oxley and Greasley (1995) proposed the following conventional augmented Dickey-Fuller (ADF) regression to test for convergence and distinguished between long-run convergence and catching-up.

$$\Delta y_{iqt} = \alpha + \gamma t + \beta y_{iqt-1} + \sum_{j=1}^{m} \theta_{ij} \Delta y_{iqt-j} + \varepsilon_t \qquad (2.1)$$

For $i = 1,...,N$ countries, and $j = 1, ..., m$ ADF lags and $y_{iqt} = \log Y_{it} - \log Y_{qt}$, and Y_{it} is the log of real per capita GDP for country i, and Y_{qt} is log of real per capita GDP of a leader country, and both series are $I(1)$. In a time series framework, a distinction is made between long-run convergence and convergence as catching-up (see Oxley and Greasley, 1995). The statistical tests are interpreted as follows. First, if y_{iqt} contains a unit root (i.e. $\beta = 0$), real GDP per capita for country i and q diverge over time. Second, if y_{iqt} is stationary (i.e. no stochastic trend, or $\beta < 0$) and (a) $\gamma = 0$ (i.e. the absence of a deterministic trend) indicates long-run convergence between countries i and q; (b) $\gamma \neq 0$ indicates catching-up (or narrowing of output differences) between countries i and q. Although such definition may be open to critisms as the presence of a time trend allows for permanent per capita differences, it might be appropriate in a context in which converging is an on going process (Bernard and Durlauf,1995; Oxley and Greasly,1995).[2]

Equation (2.1) has been applied to test for stochastic convergence in numerous studies. Main criticism of using the standard ADF as specified in Equation (2.1) is it may not be able to detect convergence if y_{iqt} is nonlinear. The probability of failing to reject nonstationarity maybe due to the inability of the linear unit root test being low power when nonlinearity is presence in the data generating process. To add, ADF widely reported that empirical evidence based on the ADF test is biased towards non rejection of stationarity thereby producing result that favor income

[2]Carlino and Mills (1993) for example, use this methodology in order to allow initially low income countries to grow faster than higher income countries.)

divergence. As pointed earlier nonlinearity is an important feature of the growth process and therefore the application of unit roots that account for nonlinear structure in the data-generating process is more appropriate in testing for convergence.

Kapetanios et al. (2003, KSS hereafter) address this issue by extending the augmented Dicker Fuller (ADF) unit root test to incorporate nonlinearity as characterized by the Smooth Transition Autoregressive (STAR) process. This method is particularly useful in the context in which time series maybe mean-reverting in the nonlinear sense but not in the linear sense. Furthermore, there is evidence to suggest that conventional unit root test such as ADF have low power in such cases (Kapetanios et al., 2003; Liew et al., 2004). In order to understand the basis of the nonlinear unit root test, a model for univariate exponential smooth transition autoregressive of order 1, ESTAR (1) is considered,

$$y_{iqt} = y_{iqt-1} + \gamma y_{iqt-1}\left[1-\exp(-\theta y_{iqt-1}^2)\right]+\varepsilon_{t,} \qquad t = 1,..,T$$

Equivalently, the above equation can be rewritten as follows,

$$y_{iqt} = \{1+\gamma[\left[1-\exp(-\theta y_{iqt-1}^2)\right]y_{iqt-1}+\varepsilon_{t,}$$

The nonlinear unit root test of KSS transformed the above equation of exponential smooth transition autoregressive (ESTAR) models as follows,

$$\Delta y_{iqt} = \gamma y_{iqt-1}\left[1-\exp\left(-\theta y_{iqt-1}^2\right)\right]+\varepsilon_t \qquad (2.2)$$

Where Δ_{iqt} is the non linear time series of income, ε_t denotes the random errors that are independently and identically distributed (i.i.d) with zero mean and finite variance and $\left[1-\exp(-\theta y_{t-1}^2)\right]$ is the exponential transition function in the KSS to portray the nonlinear adjustment. The null hypothesis of the KSS test is that $H_0:\theta=0$ against the alternative $H_1:\theta>0$. Since γ is not identified under the joint null hypothesis of linearity and a unit root, it become impossible to test the null hypothesis directly. However, following Luukkonen et al.

(1988), the problem can be overcome by taking a first-order Taylor series approximation of the exponential function around zero ($\theta = 0$), to derive a *t*-type statistics, to account for the testing of unit root in the presence of non linearity,[3] by obtaining the following auxiliary regression,[4]

$$\Delta\tilde{y}_{iqt} = \delta\tilde{y}^{3}_{iqt-1} + \varepsilon_t \tag{2.3}$$

where ε_t is a stochastic error term and y_t is a de-meaned and de-trended time series.

As above, to accommodate stochastic processes with nonzero means and/or linear deterministic trends, some modifications is necessary. In the case where the data has nonzero mean, i.e. $x_t = \mu + y_t$, one must replace the raw data with de-meaned data $y_t = x_t - \bar{x}$ where $\bar{x}$ is the sample mean. In the case where the data has a nonzero mean and a nonzero linear trend, i.e $x_t = \mu + \alpha_t + y_t$, one must instead de-meaned and de-trended data $y_t = x_t + \hat{\mu} + \hat{\alpha}_t$ where $\hat{\mu}$ and $\hat{\alpha}$ are OLS estimators of μ and α.

Anticipating that errors term in Equation (2.3) are serially correlated, KSS (2003) also proposed the following augmented specification to circumvent the problem mentioned.

$$\Delta\tilde{y}_{iqt} = \delta\tilde{y}^{3}_{iqt-1} + \sum_{i=1}^{k} \rho_i \Delta\tilde{y}_{iqt-i} + \varepsilon_t \tag{2.4}$$

where $\tilde{y}_t = z_t - \hat{\alpha} - \hat{\beta}_t$ and q is the number of augmentation that can be specified using any standard lag length selection criteria.These are the de-meaned and de-trended series with both $\hat{\alpha}$ and $\hat{\beta}$ being the least squares estimators obtained from regressing z_t on a constant and a trend

[3]The test is obtained using the first difference approximation of the ESTAR model.

[4]Given: 1- $e^{-\theta y_{t-1}^2}$. 1- $e^{-\theta y_{t-1}^2}$ =1-(1-(- θy_{t-1}^2) = θy_{t-1}^2 . $\Delta y_t = \gamma y_{t-1}\theta y_{t-1}^2 = \delta y_{t-1}^3$. The test statistics for $\delta = 0$ against $\delta < 0$ is obtained as follows; $t_{NL} = \hat{\delta} / s.e(\hat{\delta})$, where $\hat{\delta}$ is the OLS estimate and s.e $(\hat{\delta})$ is the standard error of $\hat{\delta}$.

terms. With this, the null hypothesis is now that nonstationarity to be tested is $H_0 : \delta = 0$ against the alternative $H_1 : \delta < 0$. The acceptance of the null hypothesis implies that the time series as non-mean reverting. However, the rejection of the null hypothesis in favor of alternative indicates that time series is nonlinear mean reverting. The *t*-statistic (KSS statistic) can be tested using the critical values simulated by Kapetanios et al. (2003).

Although the KSS nonlinear unit root test can detect nonlinear stationary in the series, however the KSS test using either Equation (2.3) or Equation (2.4) cannot tell the significance of the deterministic trend. In other words, it is not possible within this framework to distinguish between the long-run converging and catching-up process (Liew and Ahmad, 2007; Chong, Hinich, Liew and Lim, 2008), even when nonlinearity stationary is found. To circumvent this problem, Chong Hinich, Liew and Lim (2008; CHLL, hereafter) modified Equation (2.4) by including an additive intercept μ_t and trend component [*G* (trend)] as follows

$$\Delta y_{iqt} = \mu_t + \phi G(trend) + \delta y_{iqt-1}^3 + \sum_{i=1}^{k} \varphi_i \Delta y_{iqt-i} + \xi_t \qquad (2.5)$$

Where the Δy_{iqt} is the original series under study and not the de-meaned and de-trended series of $\tilde{y}_t$. $G(trend)$ is the trend component of specific functional form and ε_t is the error term. From Equation (2.5), the absence of nonlinear unit root $(\delta < 0)$ in the income differential, implies either nonlinear catching-up, given the presence of deterministic trend $(\phi \neq 0)$, or nonlinear long-run converging if deterministic trend is absent $(\phi = 0)$. However, if y_{iqt} indicates the income differential is to contains a nonlinear unit root $(\delta = 0)$, the income between country i and country q is said to diverge over time. This statistical interpretation of Equation (2.5) is analogous to that Oxley and Greasly (1995) in defining convergence, divergence and catching up. In the case of KSS (2003), the statistical significance of δ and ϕ is tested using t-statistics. Yet, for this framework, the asymptotic distribution of the t statistics is unknown. The critical value for this framework is tabulated in Chong et al. (2008) that shows in the simulated critical values from 5000 replications for various sample sizes. As shown above, Kapetanios *et al*. (2003) have developed a unit root test procedure in an ESTAR framework, which has a better power than conventional Dickey-Fuller test.

It is a known fact that single equation suffer from low power (Phillips and Peron, 1988) thus to address the low power problem of the univariate unit root test, Ucar and Omay (2009) extended the KSS (2003) nonlinear unit root testing to a panel context. Ucar and Omay (2009) have developed a panel unit root test procedure in an ESTAR framework, which has a better power than the conventional Im, Pesaran and Shin (2003) (IPS, hereafter) test. However, this study will not discuss on the panel unit root test on IPS. In order to arrived at the testable equation, Ucar and Omay (2009) used the following specific PESTAR(1) model to arrive at the following specification.

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$$\Delta y_{niqt} = \alpha_i + \gamma_i y_{niqt-1}\left[1 - \exp\left(-\theta_i y_{niqt-1}^2\right)\right] + \varepsilon_{niqt} \tag{2.6}$$

Where n is the number of sample or countries in the panel. $\theta_i \geq 0$ represents the speed of mean reversion for all units; ε_{niqt} is a serially and cross sectionally uncorrelated disturbance with zero mean and variance σ_i^2. The parameter α_i may vary across units, thereby allowing for various degrees of heterogeneity in the individual serial correlation structures. Nonlinear panel unit root test based on Equation (2.6) is to test the null hypothesis $\theta_i = 0$ for all i against $\theta_i \geq 0$ for some i under alternative. Equation (2.6) can be seen as a panel extension of the model used on KSS (2003). Nevertheless, direct testing of the $\theta_i = 0$ is somehow problematic because γ_i is not identified under the null hypothesis. By applying a first-order Taylor series approximation to the PESTAR(1) model around $\theta_i = 0$; thus, we obtain the auxiliary regression as the following

$$\Delta y_{niqt} = \alpha_i + \delta_i y_{niqt-1}^3 + \varepsilon_{niqt} \tag{2.7}$$

where $\delta_i = \theta_i \gamma_i$.

To correct for plausible serial correlation in the error term, the following auxiliary regression is proposed,

$$\Delta y_{niqt} = \alpha_i + \delta_i y_{niqt-1}^3 + \sum_{j=1}^{p} \beta_i \Delta y_{niqt-j} + \varepsilon_{niqt} \tag{2.8}$$

where $\delta_i = \theta_i \gamma_i$. The hypothesis for unit root testing is based on Equation (2.8) as follows:

$H_0 : \delta_i = 0$, for all i (linear nonstationarity)

$H_1 : \delta_i < 0$, for some i (nonlinear stationary).

The method of Ucar and Omay is constructed by standardizing the average of individual KSS statistics across the whole panel. The KSS test for the *i-a*th individual is the t-statistics for testing $\delta_i = 0$ in Equation (2.7)[5]. In testing for unit root in panel, Ucar and Omay (2009) proposed two test statistics;

$$\bar{t}_{NL} = \frac{1}{N}\sum_{i=1}^{N} t_{i,NL} \quad \text{and} \quad \overline{Z}_{NL} = \frac{\sqrt{N}\left(\bar{t}_{NL} - E\left(t_{i,NL}\right)\right)}{\sqrt{\text{var}\left(t_{i,NL}\right)}} \xrightarrow{d} N(0,1) \tag{2.9}$$

The simulated values for both $E\left(t_{i,NL}\right)$ and $Var\left(t_{i,NL}\right)$ are tabulated in Table 1 in Ucar and Omay (2009). The critical values for both $\bar{t}_{NL}$ and $\overline{Z}_{NL}$ are tabulated, respectively in Table 2 and Table 3 in Ucar and Omay (2009).Under the assumption of cross sectional independence, the test shows that Z_{NL} is asymptotically standard normal distributed.

2.4.1 Does Stationary Matters for Income Convergence? Further Analysis

The debates on the reliability of convergence testing continue into the stationary perspectives. All the discussions above argue about the linear versus nonlinearity stationary processes in univariate and panel unit root setting. On the other hand, Nahar and Inder (2002) question the 'stationary' as conditions for convergence. According to Nahar and Inder, output gap between countries will approach to zero as time progresses and this should be taken as indication of convergence. Furthermore, Nahar and Inder have demonstrated that even nonstationary output gap process can

[5] Defined by, $t_{i,NL} = \dfrac{\Delta z_i^{'} M_t z_{i,-1}^3}{\hat{\sigma}_{i,NL}\left(z_{i,-1}^{'} M_t z_{i,-1}\right)^{3/2}}$

meet their definition of convergence. Thus, they strongly argue that, stationarity is not a necessary condition for the existence of convergence.

According to Nahar and Inder (2002), to test for convergence between a country i and a leader country j, the following equation is specify,

$$y_{it} - y_{jt} = d_{it} = \theta_0 + \theta_1 t + \theta_2 t^2 + ... + \theta_{k-1} t^{k-1} + \theta_k t^k + \mu_{it} \quad (2.10)$$

The convergence condition requires that the output gap decline through time. The average slope of Equation (2.10) is therefore positive, i.e.

$$\frac{1}{T}\sum_{t=1}^{T}\frac{\partial d_{it}}{\partial_t} > 0 \quad (2.11)$$

The average slope can be obtained from Equation (2.10) as follows

$$\frac{1}{T}\sum_{t=1}^{T}\frac{\partial_{d_{it}}}{\partial_t} = \theta_1 + \theta_2 r_2 + ... + \theta_{k-1} r_{k-1} + \theta_k r_k = \theta r^{'} \quad (2.12)$$

where $r_2 = \frac{2}{T}\sum_{t=1}^{T} t, ... r_{k-1} = \frac{(k-1)}{T}\sum_{t=1}^{T} t^{k-2}$, $r_k = \frac{k}{T}\sum_{t=1}^{T} t^{k-1}$. Defining $r = [0,1, r_2, ..., r_k]$, and $\theta = [\theta_0, \theta_1, ..., \theta_k]$, we can test the null hypothesis of no convergence, $H_0 : \theta r^{'} \leq 0$ while the alternative is $H_1 : \theta r^{'} > 0$. A rejection of the null hypothesis implies convergence to the leader country.

Nevertheless, more recently, Phillips and Sul (2007a, 2007b, 2007c) has proposed a new method for the testing of convergence. The method by Phillips and Sul (2007a) is based on a general nonlinear time-varying factor model enables to detect convergence even in case of transitional heterogeneity or transitional divergence, where other methods such as stationary tests fail. Phillips and Sul (2007a), allow for time variation in the loading coefficients as follow

$$X_{it} = \delta_{it} \mu_t \quad (2.13)$$

Where both δ_{it} and μ_t are time varying factor. While μ_t represents common trend component in panel and δ_{it} measures the relative share in μ_t of individual i at time *t*. In other word, it measures the distance between X_{it} and common component of μ_t.The non-stationary transitional behaviour of factor loading is proposed, so that each coefficient converges to some specific constant.

$$\delta_{it} = \delta_i + \sigma_{it}\varepsilon_{it}L(t)^{-1}t^{-\alpha} \tag{2.14}$$

Where *L(t)* is a slowly varying factor, and ε_{it} is assumed to be independent across i and weakly dependant over t. The null hypothesis is formulated as $H_0 : \delta_{it} \to \delta$ and $\alpha \geq 0$.

Phillip and Sul (2007a) suggests a simple non parametric way to extract information about δ_{it} by using the relative transition parameters/path as follow,

$$h_{it} = \frac{\delta_{it}}{1/N\sum_{i=1}^{N}\delta_{it}} \tag{2.15}$$

Like δ_{it}, h_{it} still traces out transition path for eco *i,* but now does so in relation to panel average. Based on this property, the following test of convergence procedure was proposed, constructing the cross sectional variance ratio H_1/H_t for a country i, where:

$$H_t = \frac{1}{N}\sum_{i=1}^{N}(h_{it}-1)^2 \tag{2.16}$$

Next the following regression is estimated and an autocorrelation and heteroskedasticity robust one-sided t-test is applied on $\hat{b}$.

$$\log\left(\frac{H_2}{H_t}\right) - 2\log L(t) = \hat{\alpha} + \hat{b}\log t + \mu_t \tag{2.17}$$

where $L(t) = \log(t+1)$. By employing the conventional t-statistic, t_b the null hypothesis of convergence is rejected if $t_b < -1.65$. Usually, Equation (15) is run after a fraction (r) of the sample is removed. Phillips and Sul recommend at some point, $t = (rT)$, where (rT) is the integer part of (rT), and $r = 0.3$. However, before we estimate Equation (2.17) to test for convergence, we first remove the business cycle component of y_{it} by employing the Hodrick and Prescott (1997) filter. Having extracted the trend component from the series denoted as $\hat{y}_{it}$, we calculate the estimated transition paths as $\hat{h}_{it} = \dfrac{\hat{y}_{it}}{N^{-1}\sum_{i=1}^{N}\hat{y}_{it}}$. The cross-sectional variance ratio is then constructed as

$$H_1 \Big/ H_t \text{ given } H_t = \frac{1}{N}\sum_{i=1}^{N}(\hat{h}_{it} - 1)^2 \qquad (2.18)$$

2.5 Data

In this study, due to data unavailability for some countries, we focus on ASEAN5 countries, namely; Indonesia, Malaysia, Philippines, Singapore and Thailand and three Northeast Asian countries comprising Japan, China and South Korea. Data for real GDP per capita for each country are compiled from the Penn World Table version 6.2. Summers and Heston (1991) provide a comprehensive explanation of this data set. Since all the variables in the Penn World Table are denominated in a common set of prices and in a common currency, international comparisons of income is appropriate. In this study, we used annual data from 1960 to 2004 since Penn World Data set provide data until 2004. We have extended the data until 2007, using sources from International Financial Statistics published by International Monetary Fund. All variables were transformed into logarithm for analysis. The quarterly data is not available for most of developing countries, as in this case not for all Asean5+3. Furthermore, quarterly data are subject to seasonality that will bear some problem such as the need to de-seasonalised the data, test for seasonal unit root or seasonal cointegration test.

2.6. Discussion on Empirical Results

In this study, Japan has been chosen as the technological leader for several reasons. First, Japan is a global economic superpower with one of the world's highest per capita income (Li and Xu, 2007). Second, Japan has been a major contributor of foreign direct investment in this region. Third, Japan is one of the major trading partners for the ASEAN region. Finally, the close economic relationship has contributed to the transfer of foreign technology and knowledge from Japan to these countries (Lee et al., 2005; Ghosh, 2007). In their study, Zhang (2003), Lee et al. (2005), and Ghosh (2007) have considered Japan as the benchmark country in the testing for convergence in the East Asian region.

Figure 2.1 display the trend in the logarithm of real GDP per capita for the ASEAN5+3 economies for the period 1960-2007. As seen from Figure 2.1, real per capita incomes differ substantially across East Asia for three decades, during the 1970s, 1980s and 1990s. The narrowing of real per capita income seems beginning to happen after the 1997 Asian Financial crisis. Nevertheless, one interesting feature shown in Figure 2.1 is that Japan's growth has been slowing down since mid 1970s. The other Asian countries are rapidly growing and thus are catching up with Japan. Notably, Singapore reaches the steady state as Japan in mid 1990s, while South Korea matches Japan's steady state before 2005.

The narrowing down of income differences or output gap between countries is best seen in Figure 2.2. For convergence we would expect that the output gap equals zero. Figure 2.2 demonstrate the output gap between Japan and the other Asian countries. As seen in Figure 2.2, Singapore converges to Japan in mid 1990s, while South Korea converges to Japan in early 2000. The narrowing of income for Singapore begins in the 1960s while South Korea begins in early 1970s. However, the majority of the Asian countries start to narrow their income with Japan after 1980, except for the Philippines, catching up only begins from mid 1990s. Nevertheless, whether the Asian economies have converged or diverged to Japan is an empirical question.

In this study, we endeavor to test convergence using the standard unit root test as per Equation (2.1), assuming linearity in the output gap. The results are presented in Table 2.1. Clearly we can observe that the null of unit root cannot be rejected for all the Asian countries, thus suggest

divergence with the technological leader, Japan. As mentioned earlier, Liew and Lim (2005) and Liew and Ahmad (2007) have demonstrated that the output gap between Japan and the other Asian countries are nonlinear. Thus, does the failure to find convergence in Table 2.1 implies the inappropriate use of the standard ADF test on the data generating process which is nonlinear? Table 2.2 and Table 2.3 present the results of using nonlinear unit root tests on the output gap[6]. For Table 2.2, before running the nonlinear unit root test as per Equation (2.4) the output gap are first transformed into de-meaned and de-trended series. For the de-meaned series, we use the de-meaned data $\tilde{y}_{iqt} = y_{iqt} - \bar{y}_{iqt}$, where $\bar{y}_{iqt}$ is the sample mean. For the de-trended series, we use the de-meaned and de-trended data $\tilde{y}_{iqt} = y_{iqt} - \hat{\alpha} - \hat{\beta}t,$ where $\hat{\alpha}$ and $\hat{\beta}$ are the OLS estimators of α and β.[7] So in the above regression, the derived KSS *t*-statistics is then compare to the critical value tabulated in KSS paper.

As seen in Table 2.2, the de-meaned series for all the Asian countries show that the null hypothesis of nonstationarity cannot be rejected at the 5 percent level of significance. Thus, this implies divergence of each of these countries with Japan. On the other hand, for the de-trended series, in all cases, except for Singapore, the non-convergence of the Asian economies with the technological leader Japan is implied by the nonstationarity of the series. Thus, the KSS test is able to detect convergence with Japan only for the Singapore case.

On the other hand, Table 2.3 shows the results of the KSS-CHLL nonlinear unit root test for convergence by estimating Equation (2.5). Using the KSS-CHLL test, we can distinguish between nonlinear long-run convergence and nonlinear catching up by observing the significant of the trend variable. If $\delta < 0$ and $\phi \neq 0$, we have nonlinear catching up and if $\delta < 0$ and $\phi = 0$ we have nonlinear long-run convergence. However, if $\delta = 0$, the income between the two countries is diverging. Nonetheless, this is what has been portrayed by the results of the KSS-CHLL nonlinear unit root test in Table 2.3. In all cases, either using the linear trend or nonlinear trend, the null hypothesis of nonstationarity of the output gap series cannot be rejected. The results thus imply that all the Asian countries diverge from their technological leader, Japan.

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[6]In the case of non zero mean and non zero linear trend, i.e., where $x_t = \hat{\mu} - \hat{\delta}t$ where $\hat{\mu}$ and $\hat{\delta}$ are the OLS estimator of μ and δ. See KSS (2003).

[7]Refer to KSS (2003), Appendix A.1 for the derivation of t_{NL}.

The study expands further in exploring the panel setting of unit root. Recently, Ucar and Omay (2009) have provided such setting – nonlinear unit root test in heterogeneous panel. The results of the nonlinear unit root test in the context of heterogeneous panel by estimating Equation (2.7) is presented in Table 2.4. To compute $\bar{t}_{NL}$ we first estimate Equation (2.7) separately for each of the Asian country and derive, $t_{i,NL}$ of the parameter δ. The t-statistic, $\bar{t}_{NL}$ is then computed as the average of $t_{i,NL}$. On the other hand, $\overline{Z}_{NL}$ is computed using $E(t_{i,NL})$ equals -1.625762974 and $Var(t_{i,NL})$ equals 0.727220464 for sample size T equals 50. We have estimated Equation (2.7) with both; intercept only, and intercept with trend. Our results suggest that both the $\bar{t}_{NL}$ and $\overline{Z}_{NL}$ test statistics are not statistically significant at the 5 percent level. This implies that both tests, either with intercept only or with intercept and trend, failed to reject the null hypothesis of no stochastic income convergence between all the Asian economies with their technological leader, Japan.

Generally, the above results suggest strong evidence of divergence between Japan and the rest of the Asian countries despite testing by using univariate nonlinear or nonlinear panel unit root tests. Given the heterogeneity of the Asian countries with different stages of development, it has been pointed out by Bernard and Durlauf (1995, 1996) that in such countries undergoing transitional development in the economy, and if national income have not yet reached a level close to steady state conditions of the leading country, then the null of no convergence tend to be accepted erroneously.

In the discussion of stationary, Table 2.5 reports the average slopes obtained from estimation of Equation (2.8). The results suggest that in all cases, except for Singapore, the negative sign and significant of the average slopes indicate the presence of divergence of the Asian countries from the leader, Japan. Thus, this result is consistent with earlier findings using the KSS test where we find Singapore as the only country that show convergence with Japan. This implies that the remaining output gap of the Asian countries are not approaching zero as does Singapore.

Our question is: does Japan a 'true' leader among the ASEAN5+3 regions? Is Japan a suitable proxy for the steady state value for the region? According to Giles and Feng (2005) it is

common to encounter situations where there is no true leader in the sense that in a group of economies, there are country that leads the other in some years and some other country leads in some other years. In other words, time-series for output "cross". Figure 2.1 clearly depicts this situation where incomes of Singapore and South Korea crosses Japan in later years. In another instances, Malaysia's income crosses South Korea several times in the 1970s. On the other hand, Philippine crosses South Korea, Malaysia, Thailand, Indonesia and China. In this respect, Giles and Feng (2005) suggest using a nominal leader by using squared output gap as the dependent variable, that is, $v_{it} = (d_{it})^2$. In this case, for convergence to hold, v_{it} should decline and approaching zero, and the average slope would be negative. Thus, the test for the null hypothesis of no convergence is, $H_0 : \theta r' \geq 0$ against the alternative $H_1 : \theta r' < 0$.

In Figure 2.3, we plot the squared output gap between Japan and the other Asian economies. Clearly we observe that only the squared output gap for Singapore has been approaching zero since the 1980s. Nevertheless, Table 2.6 presents the results of the average slopes by estimating Equation (2.10) with v_{it} as the dependent variable. Again we found that Singapore converges to the nominal leader. Other Asian countries indicate divergence since the average slope is positive and significant.

Thus, it seems that the convergence test using KSS specification and Nahar-Inder approach, support for convergence only in the case of Singapore, except for all countries exhibits divergence in Ucar Omay test. The new method, the nonlinear time varying factor model by Phillips and Sull (2007) allows for quite general heterogeneity across individuals and over time which gives a new outlook into convergence testing literature.The results of estimating the $\log t$ regression is presented in Table 2.7 using the sample period 1973-2007. The results of the Phillips-Sul test (with n=2) for convergence suggest that China, Indonesia, South Korea, Malaysia, Singapore and Thailand converge to Japan. However, Philippine diverges from Japan as parameter $\hat{b}$ is statistically significant at the 5 percent level. The relative transition curves for each of the Asian countries with respect to Japan real per capita income is displayed in Figure 2.4. According to the theory, under the assumption of convergence, the relative transition path tends to unity for the country. As seen in Figure 2.4, from early 1970s, except for the Philippine, all other Asian countries converging or closer to unity. For the Philippines, its transition path diverge from unity for most of the years, and

only in late 1990s its start to approach unity. This could be the reason why we found no convergence for the Philippines using the $\log t$ test. In the 1960s, the Philippines was one of the richest country in Asia, has fallen behind many developing Asian nations. The supply shocks in mid-1970s and early 1980s; the confidence crisis as a result of the Dewey See scandal in 1981; political turmoil as a result of the assassination of Benigno Aquino in 1983; major devaluations, capital flight and a foreign exchange crisis in 1984; and an economic recession in 1985; hamper Philippine's economic growth for several years (Habibullah and Smith, 1997). Interestingly, the $\log t$ test for the full sample of the ASEAN5+3 countries indicate convergence. The parameter b is statistically insignificant at the 5 percent level. Despite the earlier findings that Japan and the Philippines are diverging, the method by Phillips and Sul $\log t$ test enable to detect convergence with Philippines as one of the group in the ASEAN5+3 in a panel setting.

2.7 Conclusion

Convergence has been the most popular economic concept being tested by economists and researchers for the last two decades, however, with mixed results. Government around the world is concern about the widening disparity in income between the developing and the developed countries. Thus, the question of how fast poor countries converge to the richer countries has important policy implications. What policy prescription is appropriate to bring the poor provinces or regions or countries to the level of the richer ones? Studies propagated by Barro and Sala-i-Martin using cross-sectional data; and Bernard and Durlauf using time series data has, however, created more questions than answers. Numerous studies using different sample countries, varying time period and various estimating techniques provide useful contribution to the convergence debate. However, it remains the case that no single approach provides a conclusive answer to the question of convergence.

At least there are three new development emerges in the researches related to convergence. First, in a time series framework, unit root testing of income differential has been the most popular method for testing convergence. Since it has been recognized that unit root testing in a single

equation framework has low power, panel unit root techniques solve the low power issue of unit root tests; and furthermore, panel unit root tests based on a heterogeneous specification take into account individuals with heterogeneous dynamics. Secondly, the economic growth literature has illustrated that growth is nonlinear. Subsequently, estimating income convergence assuming linearity in income is subject to mis-specification error and spurious policy conclusions. Finally, does stationarity matters for testing for convergence has been question recently. The method proposed by Nahar and Inder (2002) and Phillips and Sul (2007) has provide solution to the prerequisite of unit root and cointegration for the testing of convergence.

In this study we have taken into account all the above three issues when testing for income convergence between Japan, as the leader country, with China, South Korea, Indonesia, Malaysia, Philippines, Singapore and Thailand. Our results from the standard ADF unit root tests, KSS-CHLL nonlinear unit root tests and panel unit root test due to Ucar and Omay (2009) suggest divergence between Japan and the rest of the ASEAN5+3 economies. On the other hand, the KSS nonlinear unit root test and Nahar-Inder method suggest that only Japan and Singapore converge, while the remaining countries diverge from Japan. Interestingly, our results using Phillips and Sul (2007) $\log t$ test clearly indicate that all countries, namely; China, South Korea, Indonesia, Malaysia, Philippines, Singapore and Thailand converge to the leading country, Japan. We conclude that as Asian economies experiences various stages of development, the path of transition in economic performance may be very different across nations. Thus, testing for convergence using the standard time series framework may not be appropriate to detect convergence in transitional dynamic economies such as the Asian nations.

An important implication of this study is that the finding of convergence indicates promising prospects for deepening economic cooperation and integration among the ASEAN5 economies and their counterpart, the Northeast Asian nations for their long-run sustainable economic growth. The ASEAN5+3 economies had experienced different phases of economic development and suggest that economic integration process faced by the Asian nation is a long and winding road. While the Asian Economic Community (AEC) will take much more than extensive commitment and political will, ideas and insights into the economics of income distribution and redistributive policy should be strengthened.

Figure 2:1 Logarithms of Real GDP Per Capita, 1960-2007

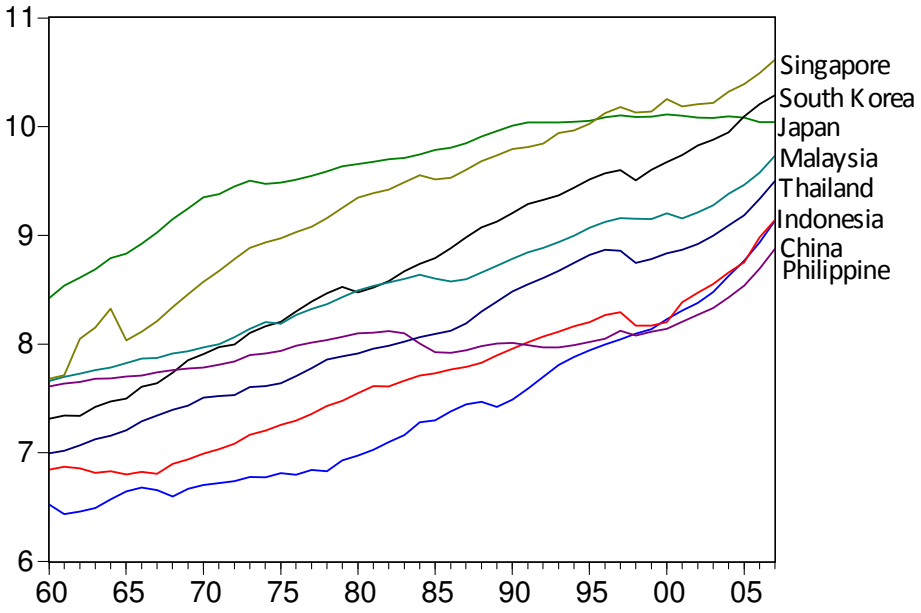


Figure 2:2 Output Gap between Japan and Other Asian Countries

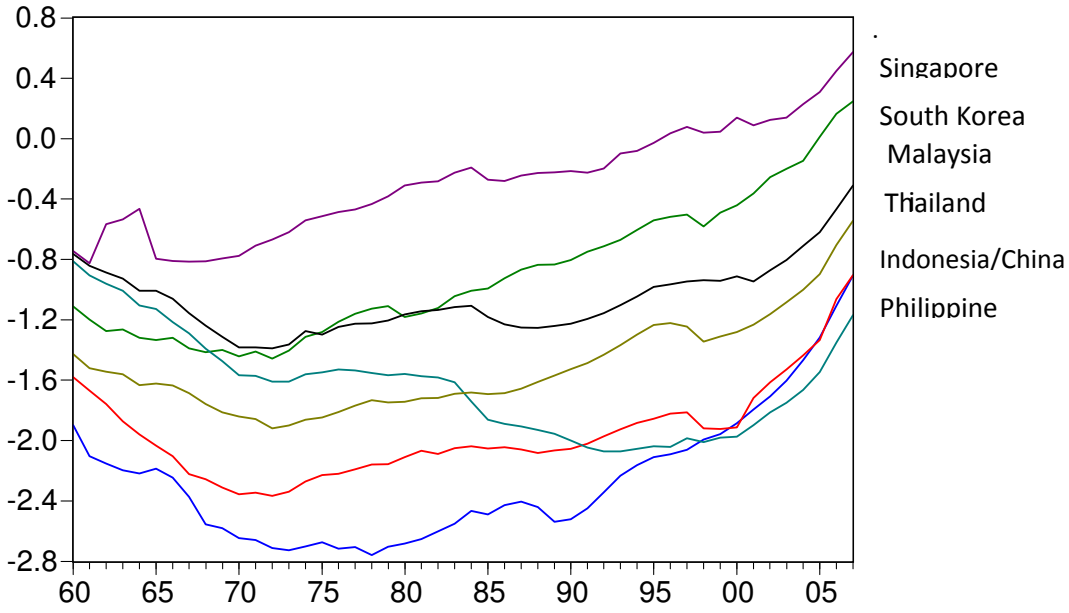


Figure 2:3Squared Output Gap between Japan and Other Asian Countries

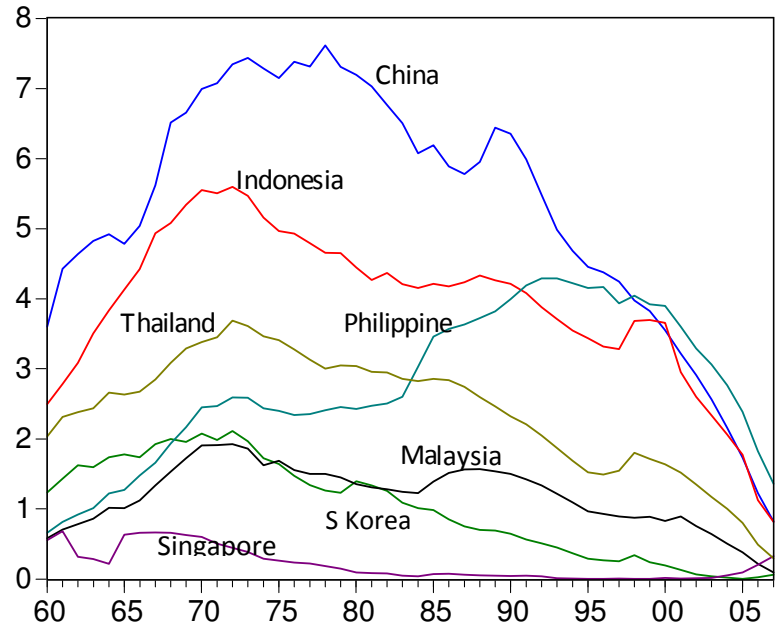


Figure 2:4Relative Transition Curves with Respect to Japan Real GDP Per Capita

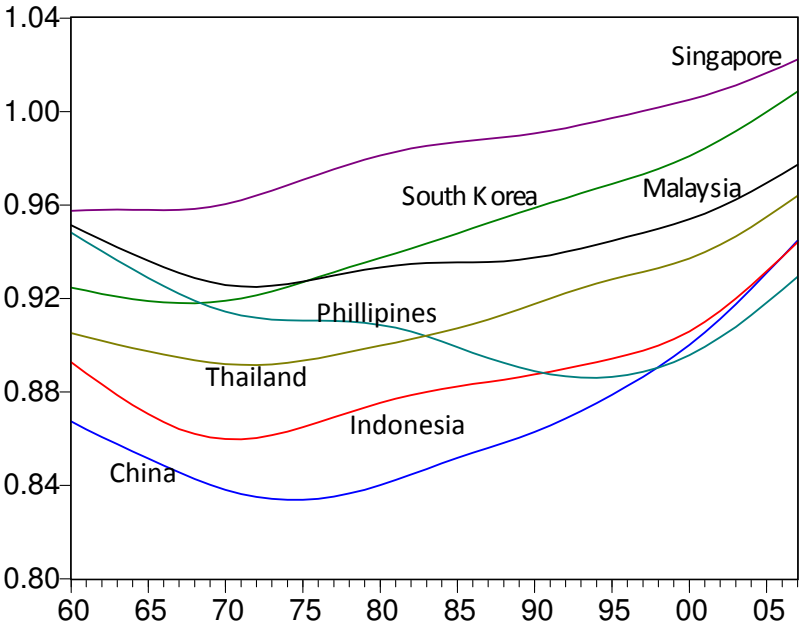


Table 2.1: Result of Bernard-Durlauf Test for Convergence

Output gap (Japan as leader)	DF/ADF *t*-statistic β	Lag	Remarks
China	0.9199	1	Divergence
Indonesia	-0.2004	0	Divergence
Korea	-1.5036	0	Divergence
Malaysia	-0.0967	1	Divergence
Philippine	1.5335	1	Divergence
Singapore	-1.8668	0	Divergence
Thailand	0.2501	1	Divergence

Notes: All unit root estimations were done using EViews6.1. EViews6.1 automatically select lag length based on SIC as default and was used throughout the analysis. Critical values for unit root test are tabulated by MacKinnon (1996) and at 5% level is -3.51.

Table 2.2: Result of KSS Test for Convergence

Output gap (Japan as leader)	De-meaned series, t_{NL}	Lag	Remarks	De-trended series, t_{NL}	Lag	Remarks
China	2.32	1	Divergence	1.17	1	Divergence
Indonesia	0.65	2	Divergence	-0.92	1	Divergence
Korea	1.38	1	Divergence	-0.97	1	Divergence
Malaysia	1.48	4	Divergence	0.86	4	Divergence
Philippine	-0.63	1	Divergence	0.85	2	Divergence
Singapore	1.57	3	Divergence	-5.00**	2	Convergence
Thailand	1.64	1	Divergence	0.55	1	Divergence

Notes: All unit root estimations were done using EViews6.1. Lag length selected based on paring down from lag 5 until the last lag significant at 10% level. Asterisk (**) denotes statistically significant at 5% level. Critical values at 5% level for t_{NL} are: de-meaned -2.93 and de-trended -3.40. See Table 1 in Kapetanios et al. (2003).

Table 2.3: Results of KSS-CHLL Test for Convergence

Output gap (Japan as leader)	δ coefficient	*t*-statistic	ϕ coefficient	*t*-statistic	Lag	Remarks
A. Linear trend						
China	-0.001053	-0.5728	0.003990	3.6309**	3	Divergence
Indonesia	-0.003852	-1.1655	0.002702	3.0568**	1	Divergence
Korea	-0.040790	-3.0800	0.005288	5.3964**	0	Divergence
Malaysia	-0.013649	-1.1046	0.001871	2.5547	4	Divergence
Philippine	0.006970	1.6392	0.002774	2.6415	1	Divergence
Singapore	-0.203500	-2.2356	0.003388	2.6445	0	Divergence
Thailand	-0.001851	-0.3961	0.001498	2.0762	1	Divergence
B. Nonlinear trend						
China	-0.004809	-2.2400	1.04×10^{-4}	4.4074**	3	Divergence
Indonesia	-0.008411	-2.2209	7.29×10^{-5}	3.7029**	1	Divergence
Korea	-0.030568	-2.1818	9.03×10^{-5}	4.3104**	0	Divergence
Malaysia	-0.028185	-2.0650	4.23×10^{-5}	3.3251**	4	Divergence
Philippine	0.004365	1.3765	5.11×10^{-5}	3.8021**	1	Divergence
Singapore	-0.066866	-0.7513	4.48×10^{-5}	2.1279	3	Divergence
Thailand	-0.009522	-1.6378	5.19×10^{-5}	2.9647	1	Divergence

Notes: Asterisk (*) denotes statistically significant at the 5% level. Lag length selected based on pairing down from lag 5 until the last lag significant at 10% level. Critical values are tabulated by Chong et al. (2008). For T=50, critical value at 5% level for δ is -3.38 (with linear trend) and -3.44 (with nonlinear trend). Critical value at 5 % level for ϕ is -3.07 and 3.02 for linear trend, and -3.02 and 2.99 for nonlinear trend. See Table 1a and Table 1b in Chong et al. (2008).

Table 2.4: Result of Ucar-Omay Test for Convergence

Output gap (Japan as leader)	$t_{i,NL}$	Lag	Remarks
A. Only intercept			
China	1.50	1	-
Indonesia	0.43	1	-
Korea	1.72	1	-
Malaysia	-0.43	2	-
Philippine	-0.94	2	-
Singapore	0.92	3	-
Thailand	1.26	1	-
Ucar-Omay, $tbar_{NL}$	0.63		Divergence
Ucar-Omay, $Zbar_{NL}$	6.99		Divergence
B. Intercept and trend			
China	-0.57	3	-
Indonesia	-1.16	1	-
Korea	-3.08	0	-
Malaysia	-0.94	1	-
Philippine	1.63	1	-
Singapore	-2.23	0	-
Thailand	-0.39	1	-
Ucar-Omay, $tbar_{NL}$	-0.96		Divergence
Ucar-Omay, $Zbar_{NL}$	2.06		Divergence

Notes: All unit root estimations were done using EViews6.1. EViews6.1 automatically select lag length based on SIC as default and was used throughout the analysis. Asterisk (**) denotes statistically significant at 5% level. Critical values for $tbar_{NL}$ and $Zbar_{NL}$, for T=50, N=7 are as follows (see Table 2 and Table 3 in Ucar and Omay, 2009):

Intercept	$tbar_{NL}$	-2.13
	$Zbar_{NL}$	-1.582
Intercept & trend	$tbar_{NL}$	-2.62
	$Zbar_{NL}$	-1.646

Table 2.5: Nahar-Inder Test for Convergence

Output gap (Japan as leader)	Polynomial order	Average slope	*t*-statistic	Remarks
China	9	-0.0184	-3.76**	Divergence
Indonesia	9	-0.0121	-3.25**	Divergence
Korea	9	-0.0086	-2.43**	Divergence
Malaysia	9	-0.0117	-4.67**	Divergence
Philippine	9	-0.0103	-4.07**	Divergence
Singapore	7	0.0208	4.62**	Convergence
Thailand	9	-0.0120	-4.50**	Divergence

Notes: Asterisk (**) denotes statistically significance at 5% level. Lag length selected based on Schwarz criterion.

Table 2.6: Nahar-Inder Test for Convergence-Squared Output Gap

Squared Output gap (Japan as leader)	Polynomial order	Average slope	*t*-statistic	Remarks
China	9	0.0764	3.22**	Divergence
Indonesia	9	0.0394	2.81**	Divergence
Korea	4	0.0440	10.51**	Divergence
Malaysia	9	0.0221	3.76**	Divergence
Philippine	9	0.0237	2.76**	Divergence
Singapore	8	-0.0288	-4.91**	Convergence
Thailand	9	0.0360	4.54**	Divergence

Notes: Asterisk (**) denotes statistically significance at 5% level. Lag length selected based on Schwarz criterion.

Table 2.7: Result of Phillips-Sul Test for Convergence

Country (Japan as leader)	*b* *t*-statistic	Remarks
Japan, China	2.6338	Convergence
Japan, Indonesia	1.9600	Convergence
Japan, Korea	2.9650	Convergence
Japan, Malaysia	2.2305	Convergence
Japan, Philippine	-3.2334**	Divergence
Japan, Singapore	1.8362	Convergence
Japan, Thailand	3.2262	Convergence
Japan, China, Korea, Indonesia, Malaysia, Singapore, Thailand, Philippine	1.6226	Convergence

Notes: Asterisk (**) denotes statistically significance at 5% level. The 5% critical value is -1.65 (see Phillips and Sul, 2007).

CHAPTER 3

STRUCTURAL CONVERGENCE OF ASIAN COUNTRIES: A NON-LINEAR FACTOR MODEL APPROACH

3.1 Introduction

The 1990s saw great economic challenges for the Asian economies. The rapid regional economic development and a number of international trends have shifted the nation's focus towards economic and financial integration in the East Asian region. The threat of regional integration in other parts of the world has increased the momentum for cooperation and given the region a sense of common destiny. The formation of the North American Free Trade Area (NAFTA) in 1994; the Asian financial crisis in 1997; the adoption of a single currency called Euro in the European Union (EU) in 1999 have made the East Asian economies very vulnerable to trade policies and protectionism in the developed countries.

Besides the increased protectionism due to the EU and NAFTA, the occurrence of the Asian financial crisis pointed out the severe vulnerability of the region to external factors especially the exchange rate fluctuations. In an effort to face such external challenges, the East Asian economies have sought to form their own regional groupings. In fact, one of the earliest regional groups in East Asia is the Association of Southeast Asian Nations (ASEAN) which was established in 1967 with the original founding members consisting of Indonesia, Malaysia, the Philippines, Singapore and Thailand. In extending the group, Brunei, Cambodia, Laos, Myanmar and Vietnam have been added to the association. Over a period of four decades, ASEAN has proved to be one of the most important regional groupings in Asia. ASEAN has shown significant experience and achievements in attaining closer cooperation among its members at all levels (Kesavapany, 2003).

In 1997, the ASEAN+3 grouping were formed that comprises the ASEAN member countries and the three major economies of the North East Asia that is, China, Japan and South Korea. A step further to foster closer economic cooperation and expedite the economic integration

process within ASEAN took place in 2002, when the ASEAN leaders agreed to explore the possibility of transforming ASEAN into an ASEAN Economic Community (AEC) by 2020. The goals of the AEC are to create a stable, prosperous and highly competitive ASEAN economic region. The success of ASEAN and ASEAN+3 has been observed as a building block for a wider regional grouping – the Asian Economic Community.

According to Kumar (2002, 2005), Kesavapany (2003), Mohanty and Pohit (2007) and Dutta (2002), the Asian Economic Community is a future possibility. Kumar (2002, 2005) and Kesavapany (2003) suggest that the formation of the Asian Economic Community should begin with Japan, ASEAN, India, China and Korea (JACIK), and ASEAN being the effective leader (Mohanty and Pohit, 2007). The JACIK economies being the core of the East Asian Community can be expanded later to include other Asian countries (i.e. other East Asia, South Asia and Central Asia) into an Asian Economic Community. According to Kumar (2005), the JACIK trade bloc is a potential pole of the world economy. In 2003, in terms of purchasing power parity, the JACIK grouping will have a gross national income of $16 trillion, much larger than either NAFTA or EU. JACIK's exports of $1.66 trillion are more than the $1.48 trillion of NAFTA. Further, the combined official reserves and total population of the JACIK economies are much larger than the EU and NAFTA. Dutta (2002), on the other hand, presented a profile of industrialization for the Asian economies. He pointed out that the JACIK, including Hong Kong and Taiwan have progressed to a higher level of industrialization at an accelerated rate since 1970s. These economies are no longer agriculture dominant, traditional economies but they have progressed beyond Japan. Generally, GDP shares from agriculture sector of all these economies are declining and shares of industrial and service sectors are moving upward (Table 3.1).

Nevertheless, although the economies of JACIK have been shown by Mohanty and Pohit (2007) to give the most welfare gain compared to ASEAN or ASEAN+3, an important issue that needs to be addressed is whether these countries are likely to be suitable candidates for the Asian Economic Community. In other words, does JACIK constitute an optimum currency area?

Thus, the purpose of the present study is to provide comprehensive view on intersecoral convergence of selected Asian countries. The development progress of manufacturing industry structures of different countries will be examined to find as to whether the industrial structure of economies show any similarities or are they persistently different. The intersectoral perspectives is

analysed on the Labour shares, Value Added shares and Labour productivity for five major contributors sectors, agriculture, manufacturing, services, construction and mining. This focus is entwined with the questions as to whether all sectors of the potential candidates of JAKITH show a similar converging process, i.e. to test for structural convergence for the Asian countries. In other words, as to determine whether Asian Economic Community (AEC) is feasible. For example, the study is to show the increased/decreased dissimilarity with regard to its labour productivity in individual industries over time. When shocks are completely symmetric across countries or countries have flexible responses to these shocks, there is no need for autonomous monetary policy. In other words, if two or more countries have shown a sufficient level of structural convergence, it can be beneficial to form an economic union. For example, given a scenario that the Indonesian unemployed workers move to Malaysia where there is excess demand for labor. This movement of labor eliminates the need to let wages decline in Indonesia (generally speaking) and increase in Malaysia. Thus, the Indonesia's unemployment problem disappears, whereas the inflationary wage pressures in Malaysia vanish. Following Krugman (1991) much recent work has been devoted in analyzing similarities and differences in industrial structures across countries. Differences in industrial structure mean the potential candidates of AEC would be more vulnerable to sectoral shocks in the absence of an exchange rate or monetary instrument. In addition to that, it remains an empirical questions which of these measurements are better a better measures of sectoral convergence, either Labour shares, Value Added shares or Labour productivity. This will determine which sectors play a central role in aggregate convergence/divergence that drives the overall economic growth.

It is hypothesized that there exist structural convergence within JAKITH (Japan, ASEAN, Korea, India, Taiwan, and Hong Kong). Structural convergence is defined as when there exists convergence in per capita income levels supplemented with the convergence of their inter-sectoral productivity or employment shares (Wacziarg,2004). The existence of structural convergence suggests that countries follow similar stages of development characterized by the rise and fall of similar types of sectors as income grows and that countries may converge to a structural 'steady state' in which the sectoral mix of output becomes uniform across countries (Imbs and Wacziarg, 2003). The existence of structural convergence among the country groupings would also suggest that economies at the national and regional/industrial level are roughly similar and synchronized. In other words, the external shocks are also symmetrical, such that, in the occurrence of a negative demand shock, all the member countries are affected in roughly the same way (Martin, 2001). This

would suggest that a monetary union is feasible among the potential group of JAKITH countries as in the study.

This study makes several important contributions to the literature. First, the novelty of this paper stems from the implementation of a new methodology of panel convergence testing recently proposed by Phillips and Sul (2007) on the structural convergence issues of the Asian countries. The methodology is chosen as it is based on a nonlinear time-varying factor model that incorporates the possibility of transitional heterogeneity or even transitional divergence. Phillips and Sul (2007a) propose a simple "log *t*" regression test, jointly with the development of a convincing clustering procedure. This new approach does not depend on stationarity assumptions and is encompassing because it covers a wide variety of possible transition paths towards convergence (including sub-group convergence). Furthermore, one and the same test is applied for the overall test and in the clustering procedure which strengthens the methodological coherence. The time varying formulation is particularly suitable for this analysis as the integration process proceeds at different speeds and to different extents in different countries of Asia. Asian countries, JAKITH, in particular, consist of developed and developing nations yet may share similar sectoral economic structure within the region. In the majority of past growth studies, hypothesis of homogenous technological progress is extensively applied in various studies. To the best of our knowledge, this paper is the first attempt to study convergence at the inter-sectoral level (productivity, value added and employment shares) within the Asian economies using the non linear factor model.

In this study, it takes into consideration that Asian countries experiences transitional dynamics. This is crucial, since under technological heterogeneity, the examination of either growth convergence or growth determinants by standard panel stationarity tests is not valid (Phillips and Sul, 2007b). The method can be interpreted as an asymptotic cointegration test without suffering from the small sample problems of unit root and cointegration testing. Moreover, the methodology is robust to the stationarity properties of the series under scrutiny, i.e. it does not rely on any particular assumption concerning trend stationarity or stochastic nonstationarity.

Second, and more importantly, in the context of this methodology the study are able to group countries into convergence clusters by means of a simple empirical algorithm, based on a quite general form of a nonlinear time varying factor model. In other words, we can identify groups of Asian countries that strongly converge into the core groups and catching up countries that

converge to different equilibria. To add more, the approach allows the individual countries to diverge from the groups. In this way, we can examine the strong and weak convergence clusters and various economic characteristics. Besides, within the clusters, their competitiveness is enhanced by the achievement of economies of scope and scale and better access to resources and markets.

From the start, it should be noted that measuring the convergence in production structures has important limitations and one should be careful with interpreting any particular indicator. It is a priori not clear what the relevant level of aggregation is. By definition, high levels of industry disaggregation reveal greater specialisation between countries. The implications for monetary policy, however, become limited as the impact of a particular industry on overall output falls with a rising level of disaggregation.

3.1.1 Optimum Currency Area (OCA) and Convergence

Mundell (1961) claim that two countries or regions will decide to adopt a common currency when the saving in transaction costs dominates the rise in adjustment costs. Large currency area will leads to lower transaction cost and these benefits are positively related to the size of the prospective union and the degree of openness of the participating countries (McKinnon, 1963). In saying that either monetary integration is a useful instrument, the benefits must be weight against the cost of losing its monetary policy instrument. The costs of monetary union are inversely related to the symmetry of economic disturbances and the ability to deal with such disturbances. When shocks are completely symmetric across countries or countries have flexible responses to these shocks, there is no need for autonomous monetary policy. In other words, if two or more countries have shown a sufficient level of structural convergence, it can be beneficial to adopt a common currency. Symmetry in shocks is determined by symmetry in economic structures. These in turn can be defined by a number of structural indicators; similarity in production structures and level of trade integration. This study focus on the former mentioned shocks, i.e production structures, by examining the different sectors in the economy particularly manufacturing, agriculture, mining, construction and services. When economic structure is sufficiently symmetrical, thus indicating structural convergence, will then can be said that monetary union is feasible and generally beneficial to its members.

How to tell whether cost or benefits of monetary union are feasible for certain region/countries? The OCA framework proposes criteria that help judge the costs and benefits of a monetary union. The criteria focus on the probability that countries face asymmetric economic shocks and on the ability of countries to adjust swiftly to economic shocks. If prospective members of a monetary union generally face similar economic shocks and have flexible adjustment mechanisms in place to deal with economic shocks, they could consider giving up monetary autonomy. In these circumstances they no longer need the exchange rate as an adjustment mechanism. The four often cited criteria by Mundell (1961) are the labour mobility across the region, openness with capital mobility and price and wage flexibility, a risk sharing system such as an automatic fiscal transfer mechanism and lastly participant countries should have similar business cycles. Having a high degree of synchronization of the business cycle across countries is essential for it to benefit from a common currency. This will indicate that the business cycle in each country is driven largely by common external shocks and that the economies of the countries involved are highly interdependent (Dorrucci et al., 2004).

Why convergence is important for monetary union? There are several reasons to expect convergence in production structure. First, we can expect the convergence in the factor. Study by Aiginger et al. (1999) find that factor endowments of European countries indeed became more similar during the 1980s and 1990s, especially with respect to R&D capital. Convergence in endowments maybe stimulated by factor mobility and faster factor accumulation of lagging countries. Higher returns on capital, for example motivate flows into countries which are not well endowed with capital. The role of multinational firms is also counted as to contribute to structural convergence by investing directly in those countries where marginal returns on capital are high. The next reason for convergence in structure is due to the knowledge spillovers. This will lead to convergence in productivity and a levelling-off of comparative (Ricardian) advantages and both productivity and structure will then converge. Technological diffusion, rising per capita income and expanding world trade also contributed in the increased homogenization of industrial structures across all but the poorest countries. This is the case despite significant inter-country variations in histories, factor endowments, financial systems, and industrial policies. This finding is, of course, not inconsistent with the observation that global integration of the less industrialized economies, given the multiplicity of initial conditions, can and does result in greater specialization at the level of specific products (Cimoli, Dosi, Nelson 2005).However, convergence might exhibit at a very slow pace or even divergence due to several reasons. In terms of factor mobility, which is motivated

by differences in productivity adds an additional factor endowment basis to trade, and thus induces production structures to diverge (Markusen 1983). Grossman and Helpman (1992) on the other hand, demonstrate that in case of perfect spillovers there exist states where countries share a common stock of knowledge and grow at the same rate. However, their production structure remains different, and in the steady state a stable trade pattern based on endowment differences as in the Heckscher-Ohlin model emerges. The endogenous growth model argue that to the extent that knowledge is a public good, prior experience in developing new products influences the allocation of research activities. In the extreme case of no spillovers across countries, typically one country inherits the lead and history determines the output pattern. Convergence in structure then never takes place. Hence, path dependency is a major source of slow or absent structural convergence.

The paper is organized as follows. Section 2 provides the related literature review of the issues. Theoretical framework is discussed in section 3. The method of Phillips and Sul (2007a, 2007b) is presented in Section 4. Section 5 presents the discussion on the empirical results. The last section contains conclusion

3.2 Literature Review

Previous studies suggest that the possibility for countries in Asia to form a monetary union in accordance to the OCA is mixed. [8] Depending on different numbers of country samples, the time period chosen and the method of analysis, the same country groupings can form or reject a currency union. Nevertheless, one thing in common is that the studies were conducted at the aggregate level. Studies in the developed countries have indicated that having detected convergence at the aggregate level does not meant that similar convergence process can be achieved at the regional or sectoral level. Fujita et al. (1999) have showed that income convergence does not necessarily imply structural convergence.

[8] See for example, Chow and Kim(2003), Kwack(2004), Huang and Guo(2006), Kim(2007), Tawadros(2008) and Sato et al (2009) among others.

Rowthorn (1992) found clear on evidence of aggregate productivity convergence but very little evidence of convergence at the sectoral level, with only one sector, in his study on the sectoral convergence (four sectors were distinguished) for 12 OECD countries between 1970 and 1985. According to Rowthorn, these results are ``paradoxical . . . [as] . . . a priori we should expect just the opposite, since the pace of technological diffusion should depend more on conditions in a particular sector than in the economy at large".

Dollar and Wolff (1993) also investigated sectoral convergence among 14 OECD countries from 1970 to 1985 (ten sectors are distinguished). They found that the rate of labour productivity convergence at the aggregate level was faster than for any of the sectors. The main finding in the their study is that seven of the ten sectors converged in terms of labour productivity, confirming the claim that convergence are more likely to be found in aggregate level rather than sectoral. Bernard and Jones (1996) investigate the degree of sectoral convergence (six sectors were distinguished) among the same 14 OECD countries from 1970 to 1987. Again, there was greater evidence of convergence at the aggregate than at the sectoral levels. Moreover, services exhibited the greatest degree of convergence whereas manufacturing shows little or no evidence of convergence.

Contradicting to assertiveness by researchers mentioned above, Hohenberger and Schmiedeberg (2007) hypothesized that intersectoral convergence is most likely to happen because most countries developed through stages of development, transiting from an economy dominated by agriculture into an industrial society and to the service economy. Their study indicates that strong intersectoral convergence is found for European countries as they shift from agrarian to industrialized and service economies. On the other hand, they found mixed results regarding intrasectoral (sub industries) convergence, in that, in the manufacturing sector, technology intensive industries tend to diverge while labour intensive industries rather show convergence trends.

In a study by Gouyette and Perelman (1997), the productivity performances of 13 OECD countries' service and manufacturing sectors were estimated for the period of 1970-1987. They found that convergence is not found for the manufacturing sector, while convergence was found for productivity levels in the services sector. Muller (2000) examines the presence of sectoral convergence of labour productivity between 14 OECD countries. His study suggests that there is strong sectoral convergence within most service sectors while the evidence of convergence for manufacturing as well as for communication sectors is rather weak. On a study on regional

convergence in Euroland, Martin (2001) analyzes the pattern of regional productivity trends and employment growth over the period 1975-1998. He found out that while regional employment growth has been sharply divergent, worker productivity shows only very weak convergence across the EU regions.

On the one hand, using the composition of output for assessing the degree of structural convergence for the New Member States (NMS) of the EU, Angeloni et al. (2005) suggest that the output composition of NMS is still significantly different from that of the other Member States. Nevertheless, they conclude that despite structural convergence is ongoing; the process is far from complete and needs to be better understood. On the other hand, Wong (2006) found out that while productivity growth in services and agriculture contributed significantly to convergence, the contributions from employment shift and productivity growth in manufacturing are statistically insignificant.

This analysis may help to justify the puzzling result found in Rowthorn (1992), Dollar and Wolff (1993) and Bernard and Jones (1996) in claiming that there is a greater degree of convergence at the aggregate than at the sectoral level.

3.3 Theoretical Framework

For the discussion of structural convergence, we have to distinguish between two types of structural change, i.e. inter- and intrasectoral change. The former refers to variations of employment shares between aggregate sectors of an economy and hence focuses on the transition from the agrarian to the industrial and finally to the service economy. The latter relates to changes of production structures within one of the aggregate sectors, for instance a change in the share of the textile industry in total manufacturing employment. Arguments for intersectoral convergence can be derived from the three-sector-hypothesis and the convergence hypothesis of Chenery (1960), which both assume that there is a strong correlation between the production structure of a country and its per-capita income level. According to these hypotheses, intersectoral convergence is expected to occur whenever poorer countries are able to close the income gap, since consumption patterns then converge towards those of richer countries. All countries should have undergone the same path of

economic development and should reached a stage at which tertiary sector is the largest in economy. Rising incomes therefore lead to a decline in the consumption of basic goods and a rise in the consumption of luxury goods. When the production side adapts to these changes in demand, employment in agriculture sector declines, whereas employment shares rise first in manufacturing; similarly, in later stages, manufacturing declines whereas service industries increase. The three-sector hypothesis also stresses supply-side convergence potentials. Among all is the knowledge transfer that enables technologically lagging countries to increase labour productivity and catch up to technologically leading countries. This process of productivity growth reduces employment in the agricultural and (in a later stage) the manufacturing sector and ultimately increases the share of the service sector. Thus, convergence of income levels and labour productivity is expected to lead to structural convergence (Pigliaru, 2003). Kuznets (1972) argues in line with Engel's law that the share of agricultural sector is inversely related with income and whereas other sectors share is positively related. As regard to this, the difference in per capita income is the major determinants of heterogeneity in production structures between countries. As the country developed ahead, the diffusion of mature products and standardised processes allow for the establishment of low technology and then medium high technology industries (Nelson, 2005). Imb and Waciarg(2003) and Aiginger (1999) summed up the relationship of between income and technological sophistication and to structural change by showing a bi-directional relationship as follow;

$$\{y\} \quad \Leftarrow A \Rightarrow \{I\} \quad \Leftarrow B \Rightarrow \quad \{SC\}$$

where y= per capita income, I-industrial development as indexed by value added as fraction of GDP and SC=structural change

"A" captures the relationship between real per capita income and industrial development. For industrializing economies, the shares of value added in national output rises steadily and the falls at higher per capita income levels as services industry began to prevail its dominancy. The link "B" as between the industrial development and structural change is to indicate interrelationship of structural convergence. Structural convergence can occur as a result of three effects: demand effect, supply effect and trade effect as explained below;

i. *Demand-side effects,* i.e., convergence of incomes among countries, by homogenizing preferences via Engel effects, induce convergence in the structures of industrial output.

ii. *Supply-side effects*, i.e., convergence of inter-sectoral productivities of labor across countries as technological diffusion, via product and process innovations, shapes demand (lower prices and fungible consumer taste), and allocational efficiency improves. This effect is accentuated by economies of scale and economies of scope which together induce greater similarities in output structure.

iii. *Trade effects,* i.e., greater similarity in relative factor abundance (due to dynamic comparative advantage) may complement Ricardian productivity-led convergence to induce rising homogeneity in product mixes. One manifestation is the growing importance of intra-industry trade among high-income economies.

Differential sectoral growth rates modify industrial structures, and inherited structures, in turn, help shape subsequent industrial growth prospects. The next section is hoped to shed some light on this issue.

3.4 Methodology

In this study, the possibility of the JAKITH countries to constitute an Asian Economic Community is tested using the new methodology proposed by Phillips and Sul (2007a). As to whether the countries of JAKITH are the right candidates for the Asian Economic Community, is by ensuring that there exists structural convergence within the sample. In other words, labour productivity or employment shares or value added shares (production structures) are similar across countries, the structural convergence will prevail, thus shocks will be symmetrical among the countries involved. [9] For example, say in the context of employment, effects on aggregate demand will reinforce the

[9] The symmetry of economic shocks is determined by the extent to which countries have similar economic structures. In one of the early contributions to the literature, Kenen (1969), put forward that countries with diversified economies are natural candidates for a currency union. In practice, countries do not need to be fully diversified as long as their production structures are similar enough.

equilibrating mechanism. The wage and price increases in India make China products more competitive. This leads to an upward shift in the China's aggregate demand curve. Similarly, the decline in China's costs and prices makes India products less competitive and shifts the India aggregate demand curve downwards. Upon this backdrop, this section is to shed a light on the issues of convergence within the countries by using the non linear time varying factor model by Phillip and Sul (2007).

3.4.1 The Nonlinear Factor Model

Model Factor analysis is an important tool for analysing datasets with large time series and cross-section dimensions, since it allows to decompose series into common and country-specific components in a very parsimonious way. Model factor analysis is important as it is used to find latent variables or factors among observed variables. Factor analysis can produce a small number of factors from a large number of variables which is capable of explaining the observed variance in the larger number of variables. Panel data are often decomposed as:

$$X_{it} = g_{it} + a_{it} \tag{3.1}$$

Where in Equation (3.1) X_{it} is a panel of log per capita income for country $i, (i = 1,..N)$. and at time, $t = 1,...,T$. It is common to decompose X_{it} into two components; systematic, g_{it} and transitory, a_{it}. At this point, we do not assume any particular parametric assumptions of g_{it} and a_{it}, meaning that the framework may include linear, nonlinear, stationary and non stationary processes. Equation (3.1) may contain both common and idiosyncratic components in g_{it} and a_{it}.

$$X_{it} = \left(\frac{g_{it} + a_{it}}{\mu_t} \right) \mu_t = \delta_{it} \mu_t \qquad \text{for all } i,t \tag{3.2}$$

Using Equation (3.2), Phillips and Sul are able to separate the common and idiosyncratic components in the panel by factoring out the common stochastic trend component. Equation (3.2) states that X_{it} is decomposed into two time varying components; common, μ_t and idiosyncratic

δ_{it} . The component δ_{it} is a measure of distance between X_{it} and the common component, μ_t. It absorbs the error term and the unit specific component and therefore represents the idiosyncratic part that is varying over time. The common trend component in panel denoted by μ_t is assumed to have some deterministic or stochastically trending behaviour that dominates the transitory component a_{it} as $t \to \infty$.[10]

In order to specify the null hypothesis of convergence, the non stationary transitional behaviour of factor loadings is proposed in semi parametric form, so that each coefficient converges to some unit specific constant;

$$\delta_{it} = \delta_i + \frac{\sigma_i \xi_{it}}{L(t)t^{\alpha}} \tag{3.3}$$

Where δ_i is fixed, ξ_{it} is iid $(0,1)$ across i , σ_i are idiosyncratic scale parameters, $L(t)$ is a slowly varying function, for example $L(t) = \log^t$, so that $L(t) \to \infty$ as $t \to \infty$. The parameter α denotes the rate at which the cross-sectional variation decays to zero. The formulation above ensures that δ_{it} converges to δ for all $\alpha \geq 0$.

The model still allow for various transitional patterns of economies of i and j in which $\delta_{it} \neq \delta_{jt}$ thereby incorporating possibility of transitional heterogeneity or even transitional divergence across i .Two important contribution noted here is that the model does not rely on the assumption of trend stationary or stochastic stationary in X_{it} or μ_t. In other words, it can detect convergence even in

[10] Ecxample of Parente and Presscot(1994),Howit and Mayer (2005) and Phillip and Sul(2007) allowing for heterogenous technology progress in standard neoclassical growth model, log per capita real income, log y_{it} can be written as: Log y_{it} = $\log y_{it}^{*} + (\log y_{io} - \log y_i^{*})e^{-\beta_{it}} + \log A_{it}$ $= a_{it} + \log A_{it}$ Phillip and Sul further decomposed $\log A_{it}$ as; $\log A_{it} = \log A_{io} + \gamma_{it} \log A_t$. A_{io} is current technology for country i in terms initial technology accumulation. $\gamma_{it} \log A_t$ capture distance of country i technology from available advance technology $\log A_t$. If advance technology log A_t ,assume to grow a constant rate a; $\log y_{it} = \left(\frac{a_{it} + \log A_{io} + \gamma_{it} \log A_t)at}{a_t} \right) = \delta_{it}\mu_t$

case of transitional divergence where the other stationary time series methods fail to detect the co movement of two time series; therefore falsely reject the convergence hypothesis. Another crucial point is that the model is sufficiently general to include a wider range of possibilities in terms of path for δ_{it} and their heterogeneity over i.

3.4.2 The Transition Path

Estimation of the time-varying factor loadings δ_{it} is a central issue of the approach proposed by Phillips and Sul (2007,P&S hereafter), since the estimates deliver information about transition behaviour of particular panel units. A simple and practical way to extract information about δ_{it} is suggested by using its relative version as follow

$$h_{it} = \frac{X_{it}}{\frac{1}{N}\sum_{i=1}^{N} X_{it}} = \frac{\delta_{it}}{\frac{1}{N}\sum_{i=1}^{N} \delta_{it}} \tag{3.4}$$

Equation (3.4) measures the loading coefficient δ_{it} in relation to the panel average. Like δ_{it}, h_{it} still traces out transition path for the economy i, but now does so in relation to panel average. Over time, variable h_{it}, traces out an individual trajectory for each i relative to the average, that's why it is called as transition path. At the same time, h_{it} measures economy i's relative departure from the common steady state growth path μ_t. Thus any divergences from μ_t are reflected from transition path h_{it} .By construction, the cross-sectional mean of the relative transition path of country i equals unity (Refer to Figure 3.1 Transition Path of GDP per capita).

Furthermore, if panel units converge and all the factor loading δ_{it} approach to a fixed δ, the relative transition path, h_{it} converges to unity and the cross-sectional variation (H_t) of the relative transition path converges to zero as $t \to \infty$, as follows

$$H_t = \frac{1}{N}\sum_{i=1}^{N}(h_{it} - 1)^2 \to 0, \quad t \to \infty \tag{3.5}$$

i.e; $\delta_{it} \to \infty$, $h_{it} \to 1$, $H_t \to 0$ as $t \to \infty$.

These properties are employed to test the null hypothesis of convergence. Thus, the null hypothesis can now be specified as: $H_0: \delta_i = \delta$ and $\alpha \geq 0$ for all i, against the alternative: $H_A: \delta_i \neq \delta$ for some i and/or $\alpha < 0$. The null hypothesis implies convergence for all countries, while the alternative hypothesis implies no convergence for some countries.

When analyzing convergence concepts, it indicates that the study is dealing with long run behavior in the macroeconomic data. Fitting the h_{it} from the data using the regression approach is inevitably encounter difficulties because the number of unknowns is the same as the number of observations. Thus, it is often preferable to remove business cycle component using smoothing method to extract h_{it} from X_{it}. Accordingly, by extending (3.2) to incorporate a business cycle effect κ_{it} it can be written as

$$X_{it} = \delta_{it}\mu_{it} + \kappa_{it} \tag{3.6}$$

Smoothing methods offer a convenient mechanism for separating out the cycle κ_{it} and we can employ filtering, smoothing, and regression methods to achieve this. At this stage some smoothing technique is required to estimate the trend component $\delta_{it}\mu_{it}$.

In this analysis, Hodrick and Prescott (1997) smoothing filter is adopted due to its flexibility and the fact that it requires only the input of smoothing parameter and does not require prior specification of the nature of the common trend μ_t in X_{it}. Hodrick-Prescot (HP) filter using the smoothing parameter set equals to 100 for annual data is to extract the long run component $\delta_{it}\mu_t$, so that the estimated transition coefficient unit can be calculated. Having computed the HP estimate;

$$\hat{X}_{it} = \hat{\delta}_{it}\hat{\mu}_t \tag{3.7}$$

Extending the above, the cross sectional averages in (3.4) lead to the estimated transition path computed as;

$$\hat{h}_{it} = \frac{\hat{X}_{it}}{\frac{1}{N}\sum_{i=1}^{N} \hat{X}_{it}} \tag{3.8}$$

Where $\hat{X}_{it}$ are the filtered per capita income series. Under the assumption that the panel average $N^{-1}\sum_{i=1}^{N} X_{it}$ is positive in small samples as well as asymptotically, which is satisfied for many relevant economic time series like prices, gross domestic product or other aggregates.

3.4.3 The Log t test

Base on the time varying factor presentation in equation (3.2) P&S proposed a new convergence test and clustering algorithm based on the log *t* convergence test that is based on a simple time series regression, which involves a one sided *t*-test. The test is known as *t*-test as the *t*-statistic refers to the coefficient of log *t* regression in the equation. In that framework, the null hypothesis is formulated as below;

H_0: convergence for all i $H_0 : \delta_i = \delta$ and $\alpha \geq 0$.

H_A: No convergence for some i $H_A : \delta_i \neq \delta$ and $\alpha < 0$.

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

$$H_t = \frac{1}{N}\sum_{i=1}^{N} \left(\hat{h}_{i1} - 1\right)^2 \tag{3.9}$$

Phillips and Sul (2007) show that the transition distance H_t has a limiting form of;

$$H_t \sim \frac{A}{L(t)^2 t^{2\alpha}} \text{ as } t \to \infty \qquad (3.10)$$

Where A is a positive constant, $L(t) = \log(t+1)$ is a slowly varying function, and α denotes the speed of convergence.

In order to test for the null hypothesis of convergence mentioned above, the following log *t* regression is performed:

$$\log\left(H_1 / H_t\right) - 2\log L(t) = \hat{c} + \hat{b}\log t + \hat{\mu}_t \qquad t = [rT],...,T \qquad (3.11)$$

Where H_t is the cross-sectional variation. H_1 / H_t is the ratio of the cross-sectional variation at the beginning of the sample, H_1 (i.e. H_t at $t = 1$) over the respective variation for every point in time t, that is $H_t(t,...,T)$. The ratio, H_1 / H_t measures the distance of the panel from the common limit. On the other hand, $L(t) = \log(t)$ and $r > 0$. The regression presented in equation (3.11) is called as log t regression because of the log t regressor.

In estimating Equation (3.11), $\hat{b}$ is tested under one sided null hypothesis $\alpha \geq 0$ and converges to the speed of convergence parameter 2α where α is the estimate of $\hat{\alpha}$ in H_0. Under some regularity conditions stated in Phillips and Sul (2007) the test statistic $\hat{b}$ is asymptotically standard normally distributed, so that standard critical values can be employed. The standard error of the estimates is calculated using a HAC estimator for the long-run variance of the residuals. By employing the conventional t-statistic, t_b the null hypothesis of convergence is rejected if $t_b < -1.65$. If the t-statistic, t_b suggests that $\hat{b}$ is either positive or equal to zero, we conclude that the panel converges. On the other hand, if *t*-statistic, t_b suggests that *b* is negative and significant, we reject the null hypothesis of convergence. The fraction, *r* is imposed to remove the earlier sample used in the study. According to P&S, *r* should be set equal to 0.3 and the remaining

two-thirds (latter part) of the sample should be able to identify whether there is convergence or not. Discarding some small fraction r of the time series data helps to focus attention in the test on what happens as the sample size gets larger. The limit distribution and power properties of the test depend on the value of r. The higher the simulated value of r, the test power declines because the effective sample size is smaller, which reduces discriminatory power. Thus, since α is unknown, practical considerations suggest choosing a value of r for which size will be accurate when α is close to zero, for which size is not too conservative when α is larger, and for which power is not substantially reduced by the effective sample size reduction.

Briefly, the null hypothesis of convergence is accepted by testing factor loading δ_i converge to a fixed δ ,relative transition of h_{it} converge to unity, and cross section variance of H_t of relative transition path converges to zero as $t \to \infty$ .The convergence within a sample can consist of one that includes the whole countries or *2* or more clubs as well as single divergent units. The bias is dependent on the size of *T* and *α* rather than *N*, just as the asymptotic theory predicts, when *α* is small. This downward bias quickly disappears for larger *T* or as *α* increase. The log *t* test does not depend on *N* but rather on sample fraction *r* and varying function $L(t)$. In other words the number of countries examined in the study of convergence club can be as low as N=*2*.

3.4.4 The Club Convergence Algorithm

An important issue in the empirical convergence literature is the possible existence of multiple equilibrium. In this case, rejecting the null hypothesis that all countries in the sample converge does not imply the absence of different convergence clubs in the panel. Rejection of the null hypothesis H_0 does not rule out the possibility of club convergence. In fact, the regression t-test in (3.11) may be used as the basis of an algorithm for assessing club convergence and clustering. With the methodology proposed by Phillips and Sul (2007a), countries are allowed to achieve their own steady state.

Step 1 (Ordering):

The first step in clustering is to rank the members of the panel according to the last observation. When there might exist multiple convergence club within the sample, as when $T \to \infty$, the panel is then clustered via two methods; using the last observation of the final time series X_{it} or using some average of the final observations. In this analysis, the former approach is used.

Step2 (Core Group formation):

Select the base country (the highest rank) in the list to form the subgroup G_k for some $N > k \geq 2$ and run the log t regression and the convergence test statistic $t_b(k)$ is calculated for each k .The core group size k^* is chosen by maximizing $t_{b,}$ over k according to the criteria of minimum $\{t_{\hat{b}}(k)\} > -1.65.$ If the core group, $k^* = N$ thus there is only one large sample of panel convergent countries, no clusters and no individual divergent. Thus convergence is exhibited in aggregate. Yet if the condition min $t_{b,}$ >-1.65 does not hold for $k = 2$, then the first unit is drop and proceed with the same procedure for forming the next clusters.

Step 3 (Club Membership):

After forming the core group, the remaining unit is added separately to the core group and run the log t regression for each addition. The new country is included in the convergence club if the associated t-statistics is greater than some chosen critical value c. If the corresponding test statistics $\hat{t}_b$ exceeds some chosen critical value c, then the unit is included in the current subgroup. If $\hat{t}_b$ <-1.65, the forming the subgroup is finished, and the procedure is repeated to form the next group.

Step 4 (Recursion and Stopping):

The next group is form from these countries that fail to meet the condition in step 3. The log t regression is carried out for the remaining countries, i.e. to see if $\hat{t}_b$ >-1.65. If the null hypothesis is not rejected, thus these countries will form a second cluster. Otherwise, step 1-3 is to be repeated on

the remaining countries to see if the group itself can be subdivided into convergence clusters. On the other hand, if there is no other sub group detected, and then these countries display a divergent behavior.

3.5 Data

In testing the degree of similarity in sectoral structure in this study, the inter-sectoral convergence is tested by computing labour productivity at each point in time. In measuring the robustness of the sectoral measures, output shares and employment shares are also computed in the study. Convergence is first examined at the aggregate level, and then sectoral analysis is carried out for the agriculture, mining, construction, manufacturing and service sectors.

The empirical analysis is based on macro economic data of 10 Asian countries covering the period of 1970-2005 compiled by Timmer and de Vries (2007). The Asian countries covered in GGDC database are Japan, ASEAN-5 (Malaysia, Singapore, Phillipines, Indonesia and Thailand), Korea, and India. Taiwan and Hong Kong. The data is drawn from the Groningen Growth and Development Centre, the so-called GGDC 10-sector database. The database presents a new panel data set with long-run time series of value added, output deflators and persons employed based on respective country's national statistical sources. Data and detailed documentation of sources and methods of the GGDC 10-sector database are publicly available through http://www.ggdc.net/dseries/10-sector.html.

3.6 Discussion on Empirical Results

In this section, the empirical results are presented. To determine whether there is sectoral convergence for the countries in the study, the convergence analysis is conducted for income per capita, sectoral labour productivity, share of GDP and share of labour. To say that there exists structural convergence in the Asian countries, income per capita should converge, entwined with the convergence at the sectoral level.

3.6.1 Full Panel Convergence

First, the overall convergence analysis on the aggregate level is conducted on the Asian income per capita by using the log *t* test. Next, analysis on the disaggregated sectoral level constitutes the main basis for further discussion since they are easier to interpret and act as robustness check on the aggregate convergence analysis.

In Table 3.2, Panels A and B report the results of the panel convergence for four main analyses in the study. The income per capita shows divergence with t_b = -12.5925 for the full convergence test in the sampling period of 1970 to 2005. According to Phillips and Sul (2007a, 2007b, 2007c) that empirical log *t* regression are based on time series data in which the first *r*% of the data is discarded. Thus, the data trimming focuses attention on the latter part of the sample data. The $r = 0.3$[11] is chosen as a satisfactory choice in terms of both sizes and power, as proposed by Phillips and Sul (2007a). The null hypothesis of full convergence is rejected for the period of 1982-2005 for the Asian countries. Similar evidence of divergent are found for the sectoral labour productivity, sectoral value added shares and to some extent of sectoral labour shares. The result confirms earlier findings by Nguyen-Van (2005), Stegman (2005) and Aldy (2006) that report divergence among large groups of countries containing both developed and developing countries. However, interestingly, the sectoral labour share shows that some sectoral convergence for the manufacturing, mining and construction sectors. In other words, all the countries in the study converge to common steady state and this indicate that they share similar labour structure and labour distribution throughout time. The rejection of the null hypothesis of convergence for the whole sample countries does not imply that there is no evidence of convergence in the sub-group of the Asian countries. Thus, an in depth analysis at the sectoral level is crucial.

In examining the behaviour of income per capita of country *i* relative to the panel average, Figure 1 depicts the relative transition path of each country's real per capita GDP. Transition path, h_{it}, captures the growth course for each country, relative to the sample average, meaning if the h_{it} line is above one, it indicates that the relevant country's real GDP per capita is above cross sectional

[11] Phillips and Sul's (2007c) simulation results indicate that an *r* value in the interval *[0.2, 0.3]* achieves a satisfactory balance. When *T* is small or moderate ($T \leq 50$), $r=0.3$ seems a preferable choice to secure size accuracy in the test for small α, and *T* is large ($T \geq 100$) the choice $r=0.2$ seem satisfactory in terms of size and this choice helps to raise test power. Phillips and Sul further emphasize that the choice of *r* validates the regression equation in terms of the asymptotic representation of the transition distance and ensures test consistency in growth convergence hypothesis.

average and vice versa. Under the assumption of convergence of the full panel of countries, the relative transition path tends to unity for all countries. Moreover, the slope of each curve can be interpreted as the growth rate of real GDP per capita for the relevant country, relative to the cross sectional average. As can be seen in Figure 3.1, the full panel resulted in divergence among the countries, thus the transition paths do not tend to unity. However, there is possibility of the existence of convergence clusters around the separate points of equlibra or steady state as can be seen from Figure 3.1.

Given that the test for convergence of real per capita GDP exhibits divergence, the next thing to examine is the clustering of the countries. Which countries are the cores, how many clusters are there in the selected Asian's income per capita and are there any countries that diverge from the rest of the groups? In other words, each country in the group is allowed to converge to a different equilibrium or even diverge individually from the rest of the countries. Under the assumption of the club convergence in which countries in the study is allowed to converge in different equilibrium, the relative transition paths of each club shall converge to a different constants.

As mentioned earlier, the analysis began with the definition of a base entity (last observation ordering) and the core group formation. For all countries, the log *t* regression is applied and tries to enlarge the group by adding all other individuals separately. Once a group is established as a convergence group, then proceed by searching for clusters in the rest by always following the steps outlined above. Table 3.3 contains all relevant *t*-statistics from the log *t* regressions. The convergence test on real gdp per capita has resulted in four convergence clubs (see Panel A in Table 3.3). The core clubs comprises of a group of rich countries, namely Japan, Singapore and Hong Kong. These countries are the newly industrialized economies, except for Japan as the developed country. Korea and Taiwan as the other newly industrialized economies clustered into a group, sharing some homogeneity in its economic structures which is highly characterized by its high contribution in its services sector. Low and highly populated countries such as Indonesia and India share some synchronization of economies dominated by its agricultural sectors by means of both its sectoral contribution and labour shares. Four clubs convergence indicates that the Asian countries in the study still show weak convergence among them which indicate rather strong dissimilarity in its economic structure as a whole. The transition path (Figure 3.1) also supports the possibility of the formation of four clubs convergence. Further analysis in the study will confirm that the countries are grouped according to its sectoral contribution to the economy. In order to test the robustness of

the results of four club convergence in Panel A as presented in Table 3.3, we endeavor to estimate Equation (3.11) with the inclusion of size and size-squared (size is measured by real GDP). The results of the four club convergence as shown in Panel B in Table 3.3 suggest that size and size squared has no effect on the clustering.

3.6.2 Convergence of Sectoral Labour Productivity

In this study the test for structural convergence was focus on five sectors, namely; agriculture, mining, construction, manufacturing and services manufacturing, agricultural, mining, construction and services sectors of the Asian economies. The results for the aggregate panel of each sector are presented in Tables 3.4 to 3.8.

Turning to the analysis of labour productivity, the results show moderate signs of convergence for majority of the countries in the sample. This is a promising result in terms of convergence because throughout the standard growth theory literature differences in productivity explain the bulk of income convergence in the long run (Weil, 2004). The results reveal that the higher the income per capita (the core group for the highest income per capita countries consists of Japan, Singapore and Hong Kong) the higher is the productivity in its services and manufacturing. In other words, labour productivity in higher income group is mainly driven by these two sectors. Interestingly, in the agricultural sector, Japan has become an outlier, together with Malaysia, particularly due to the shift of the economy to manufacturing and services sectors as in the three sector hypothesis. Malaysia was known to be a resource based country during its 70s and 80's and now the economy in general and labour productivity in particularly is not driven by agricultural sector. The three sector hypothesis states that inter-sectoral convergence is expected to occur whenever poorer countries are able to close the income gap since the consumption pattern then converge towards those of richer countries. The process of productivity growth reduces employment in the agriculture sector and at a later stage reduces the employment rate in manufacturing due to the increased share in the service sectors. Thus, the convergence of income levels and labour productivity is expected to lead to structural convergence. The results emphasizes that the resources-based countries remain poor in terms of per capita and labour productivity.

3.6.3 Convergence of Sectoral Value Added Shares

Tables 3.9 to 3.13 show the clustering results in terms of the value added shares. The results are more diverse and mixed. Manufacturing shows stronger convergence within the group by having the most members in the core group. Interesting point is Hong Kong and Indonesia diverges from the rest as well as in the labour productivity. Hong Kong shows divergence as well in both mining and construction sectors. Mining, however, shows such a contradiction by having most of the countries diverge, forming only two clubs that shows convergent behaviour within the clubs. As for the agricultural sector, low income countries become the fast growing countries in agricultural sector dominated by Philippines and Indonesia while having India diverging from the rest. Referring to the labour productivity, the same set of countries shows weak convergence as compared to the rest. As Japan, Singapore and Hong Kong which has the lowest value of the last year observation formed their own group even though their productivity is among the highest. The services sector shows wide differences among its transition paths that formed four groups in total. Each groups share similar structures/homogenous within its group, yet heterogeneous among other groups. In other words value added shares shows less probability of convergence in the services sector a sign of weak convergence throughout the particular sector.

3.6.4 Convergence of Sectoral Labour Shares

Turning to the labour shares, the log *t* test (Table 3.2) has revealed that three sectors have shown full convergence, namely manufacturing, mining and construction. In other words, for these particular sectors, the countries exhibit common steady state path, with all of them are grouped in one big cluster. Having full convergence indicates that countries share similar sectoral structure, thus, economic integration and monetary union is feasible in this condition. These countries should have sufficient flexibility in the labour markets to be able to adjust to asymmetric shocks once they are in the union. The results are interesting, indicates that these countries are in the transformation stage by experiencing high degree of labour specialization and distribution of labour concentration. In other words, the industries are shifting from the primary sectors to secondary sectors, namely manufacturing and construction. Labour shares in agricultural sector shows full divergence with 3 clustering whilst Malaysia and India is diverging from the rest as seen in Table 3.14. More interesting that, India listed as the lowest labour productivity in its group, is found to become an outlier or diverging from the rest in its agricultural sector, despite the fact that it has the highest

labour shares. Perhaps lack of capital intensive scheme, government subsidies and low wages contributed to the outcome. In addition to that, India is also found to be diverging from the rest of the groups in service sector as shown in Table 3.15, indicating that country has long way to go in its economic transformation phase. As expected, more advanced and industrialised countries as Hong Kong and Singapore exhibit the core group, with Japan, Korea and Taiwan membered the second group. This support the three sector hypothesis in predicting that as the country become more industrialised, the primary sectors (agriculture) will then shift to manufacturing and at later stage shall be well developed in the services sector.

3.7 Conclusion

In this study a new and flexible convergence test procedure was applied on selected Asian countries for the period 1970-2005 with five major sectors in focus. The method developed by Phillips and Sul (2007a) is more general and flexible which does not depend on the stationarity assumption and is not limited to the convergence and divergence issues only but as also includes a clustering/grouping algorithm. In general, the results of the study reveal interesting stylized facts on the convergence issues in the Asian countries.

Analysis at the disaggregated level is important as it shows the true scenario of similarity/dissimilarity of sectoral structure of an economy, ultimately to determine whether the shock is symmetric or asymmetric. When the economy shares similar sectoral structures, any external shocks will resulted in symmetric/similar impact on the particular areas, thus fixed exchange rates or a monetary union, or one policy is appropriate (Mundell, 1961). Thus, the existence of sectoral convergence in the sample is crucial to enhance the economic integration between Asian nations, in achieving the objective of Asian Economic Community (AEC). In this study, structural convergence does not exist, but, instead club convergence exists in most of the sectors indicating the different level of convergence progressing to its own distinguished common path.

Asian economy is mostly driven by manufacturing sectors, as the results shows stronger clubs in these sectors, besides convergence in aggregate in labour shares. The three sector

hypothesis states that, inter sectoral convergence is expected to occur whenever the poorer countries are able to close the income gap with those richer countries. Rising incomes lead to a decline in consumption of necessity goods and a rise in consumption of luxury goods. When the production side adapts to these changes in demand, employment in agriculture declines whereas employment shares rose first in manufacturing; similarly in later stages declines whereas service industries increase. Asian economies are in transition process of heading to the later stage of this hypothesis. The three measures of structural convergence, namely productivity, value added and labour share indicates divergence in aggregate, (except for three sectors in labour shares) a strong and conclusive result to support the dissimilarity of sectoral structure in Asian's industrial sectors, even though there is still evident of weak convergence in some sectors.

An interesting results find that convergence in labour shares was quite rapid, indicating the highest level of convergence with three aggregates convergence in three sectors (manufacturing, construction and mining sectors) as compared to entirely divergence in structures (value added and employment shares) during the period under investigation. There is a clear evidence for a catching up countries to form large clusters. This is the most promising result as it indicates that an employment share is a better measure to evaluate structural convergence. Hohenberger and Schmiedeber (2007), Wacziarg (2004) argue that labour share is commonly used in the literature and most comprehensive and robust measure of sector share available. Besides, output oriented indicators such as value added have the risk of being biased by inflation, exchange rates, world market influences (e.g. prices of intermediate inputs) and variation due to the business cycle fluctuation that leads to measurement error (Imbs and Wacziarg, 2003).

Thus the questions remained, as to whether the selected Asian (JAKITH) is an appropriate group of countries to create a regional economic block. The study shows that choices of countries are very important to establish the bloc. Should we add different countries that share much more similar structure of transition path, then the realisation of AEC could be achieved? Past experience has taught us that economic integration is a very slow and scrutinized process, for example, the establishment of European Union took 50 years to materialise with only 12 members as a start. Then it grew up by adding each member at a time as it fulfils the Maastricht Criteria. A further question to be asked is how far the policies implemented by the Asian countries to promote economic integration have had any noticeable effects on the convergence process. The progress of integration is under way though seems to be rather slow. For the sub-group of Asian countries that

exhibit weak convergence or divergence, more intense growth policies are required to facilitate closer integration with the rest of the members. The results are highly relevant to the policy makers as to indicate the degree of economic similarity /dissimilarity among the countries. Analysing the convergence process via looking into the sectoral perspective shall give a deeper view into the economic structure of the countries.

Table 3.1 Shares of Major Sectors in GDP (percent)

	Agriculture			All			Manufacturing			Services		
	1990	2000	2006	1990	2000	2006	1990	2000	2006	1990	2000	2006
East Asia												
China	26.9	14.8	11.8	41.3	45.9	48.7	36.7	40.4	43.1	31.8	39.3	39.5
Hong Kong	0.2	0.1	0.1	23.4	12.7	9.2	16.1	5.1	3.3	72.4	82.7	90.7
Korea	8	4.3	2.9	37.3	36.2	35.2	24.5	26.1	24.7	54.6	59.5	61.9
Taipei	4	2	1.6	38.4	29.1	25	31.2	23.8	21.4	57.6	68.9	73.4
Southeast Asia												
Brunei	1	1	0.9	61.6	63.7	71.6	11.1	15.4	12.3	37.5	35.3	27.5
Cambodia	55.6	35.9	30.1	11.2	21.8	26.2	5.2	16.9	19.6	33.2	37.1	38.6
Indonesia	19.4	15.6	12.9	39.1	45.9	47	20.7	27.7	28	41.5	38.5	40.1
Lao	61.2	52.6	44.8	14.5	22.9	29.5	10	17	20.7	24.3	24.6	25.7
Malaysia	15.2	8.6	8.7	42.2	48.3	49.9	24.2	30.9	29.8	44.2	46.3	43.5
Mynmar	57.3	57.2	48.4	10.5	9.7	16.2	7.8	7.2	11.6	32.2	33.1	35.4
Philippines	21.9	15.8	14.2	34.5	32.3	31.6	24.8	22.2	22.9	43.6	52	54.2
Singapore	0.4	0.1	0.1	32.5	33.5	33	25.7	26.2	27.7	67.2	66.4	66.9
Thailand	12.5	9	10.7	37.2	42	44.6	27.2	33.6	35.1	50.3	49	44.7
Vietnam	38.7	24.5	20.4	22.7	36.7	41.6	12.3	18.6	21.3	38.6	38.7	38.1
South Asia												
Bangladesh	29.4	24.6	18.7	20.9	24.4	27	12.7	14.7	16.5	49.7	51	54.3
Bhutan	42	27.7	22.4	24.6	34.3	35.9	8	8.3	7.3	31.8	36.3	37.2
India	29.3	23.4	17.5	26.9	26.2	27.9	16.7	15.6	16.3	43.8	50.5	54.6
Mldives	14.9	8.8	8.4	12.8	15	16.7	9.2	8	6.8	72.3	80.1	78.8
Nepal	50.6	39.6	38.1	15.9	21.5	20.3	6	9.2	7.5	33.5	38.9	41.5
Sri Lanka	22.9	19.9	16.5	27.3	27.3	27.1	17.3	15.1	12.2	49.8	52.8	56.5

Sources:Country sources at current prices

Table 3.2 Results Of Log *T* Convergence Test

Country/Sector	$\hat{b}$	Remarks
Panel A: Income convergence (Real GDP per capita)		
All countries	-12.5926*	Divergence
Panel B: Structural convergence		
Sectoral real GDP per capita		
Agriculture	-23.4386*	Divergence
Mining	-21.6132*	Divergence
Construction	-4.9534*	Divergence
Manufacturing	-21.2600*	Divergence
Services	-10.5932*	Divergence
Sectoral Labor shares		
Agriculture	-59.4457*	Divergence
Mining	2.181891	Convergence
Construction	6.306492	Convergence
Manufacturing	1.399491	Convergence
Services	-112.786*	Divergence
Sectoral Productivity		
Agriculture	-30.76262*	Divergence
Mining	-7.428816*	Divergence
Construction	-17.56528*	Divergence
Manufacturing	-19.28035*	Divergence
Services	-61.85607*	Divergence

Notes: Asterisk (*) denotes rejection of the null hypothesis of convergence at the 5% level.

Table 3.3 Results Of Convergence Clubs For Real GDP Per Capita

Last T order	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Club	Remarks
Panel A: Without Size and Size-Squared									
1	Japan	**Base**	**Core**					1	Convergence
2	Singapore	6.3090	**Core**					1	Convergence
3	Hong Kong	9.9433	**Core**					1	Convergence
4	Korea	7.9862	**Base**					2	Convergence
5	Taiwan		0.2577					2	Convergence
6	Malaysia		-5.3406*	**Base**				3	Convergence
7	Thailand			1.9905				3	Convergence
8	Indonesia			-9.1222*	**Base**			4	Convergence
9	Philippines				-0.0557			4	Convergence
10	India				4.8851			4	Convergence
Panel B: With Size and Size-Squared									
1	Japan	Base	Core					1	Convergence
2	Singapore	18.89742	Core					1	Convergence
3	Hong Kong	24.15883	Core					1	Convergence
4	Korea	4.086012	Base					2	Convergence
5	Taiwan	0.269973	-0.318356					2	Convergence
6	Malaysia		-9.22530	Base				3	Convergence
7	Thailand			-0.770968				3	Convergence
8	Indonesia			-5.562950	Base			4	Convergence
9	Philippines				0.789676			4	Convergence
10	India				2.132007			4	Convergence

Table 3.4 Results of Convergence Clubs in Labour Productivity -Agricultural Sector

Last T order	Country		Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Japan	-2.6135	Outlier					Divergence
2	Korea		Base	**Core**			1	Convergence
3	Sing		-1.37157	**Core**			1	Convergence
4	HK		24.82616	**Core**			1	Convergence
5	Taiwan		27.41411	**Core**			1	Convergence
6	Malaysia		9.41406	**Base**				Divergence
7	Thailand		-5.015182	**-7.78539**	**Base**		2	Convergence
8	Phil				1.831061		2	Convergence
9	Indon				-1.816632	**Base**	3	Convergence
10	India					**-0.53918**	3	Convergence

Table 3.5 Results of Convergence Clubs in Labour Productivity -Manufacturing Sector

Last T order	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Club	Remarks
1	Japan	**Base**					1	Convergence
2	Sing	2.18465					1	Convergence
3	Kor	**-1.3356**	**Base**				2	Convergence
4	Taiwan		0.540602				2	Convergence
5	HK		4.0704				2	Convergence
6	Mal		-6.59943	**Base**				Divergence
7	Thai			**-1.956**	**Base**		3	Convergence
8	Phil				-1.37664		3	Convergence
9	Indon				-2.08929	**Base**		Divergence
10	India					**-3.26787**		Divergence

Table 3. 6 Results of Convergence Clubs in Labour Productivity-Mining Sector

Last T order	Country		Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Malaysia	-6.51605	**Outlier**					Divergence
2	Jap		**Base**	**Core**			1	Convergence
3	Taiwan		-0.461256	**Core**			1	Convergence
4	Korea		-7.7014	**Base**			2	Convergence
5	HK			4.14599			2	Convergence
6	Thailand			4.224			2	Convergence
7	Sing			-6.21160	**Base**		3	Convergence
8	Indn				-1.65		3	Convergence
9	Phil				-4.053	**Base**		Divergence
10	India					**7.45504**		Divergence

Table 3. 7 Results of Convergence Clubs in Labour Productivity-Services Sector

Last T order	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Club	Remarks
1	Jap	**Base**					1	Convergence
2	HK	0.408845					1	Convergence
3	Sing	10.67497					1	Convergence
4	Taiwan	4.8621	**Base**					Divergence
5	Kor	-4.352	-3.542	**Base**			2	Convergence
6	Mal			6.2664			2	Convergence
7	Thai			-2.57577	**Base**			Divergence
8	India				-3.421182	**Base**	3	Convergence
9	Indon					0.15184	3	Convergence
10	Phil					-0.77239	3	Convergence

Table 3.8 Results of Convergence Clubs in Labour Productivity-Construction Sector

Last T order	Country		Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Jap	-5.17675	**Outlier**					Divergence
2	Kor		**Base**				1	Convergence
3	HK		0.616131				1	Convergence
4	Sing		2.809615				1	Convergence
5	Taiwn		1.74964	**Base**				Divergence
6	Mal		-12.5838	-21.85017	**Base**		2	Convergence
7	India				0.567251		2	Convergence
8	Thai				-2.193041	**Base**	3	Convergence
9	Phil					1.68396	3	Convergence
10	Indon					0.481428	3	Convergence

Table 3.9 Results of Convergence Clubs in GDP Shares -Agricultural Sector

Last T order	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Club	Club
1	Philipines	**Base**	**Core**					1	Convergence
2	Indonesia	-1.439	**Core**					1	Convergence
3	India	-7.168	**Base**						Divergence
4	Thai		-3.951	**Base**				2	Convergence
5	Malaysia			-0.023				2	Convergence
6	Korea			-3.6037	**Base**				Divergence
7	Twn				-13.269	**Base**			Divergence
8	Japan					-15.911	**Base**	3	Convergence
9	Singapore						2.420	3	Convergence
10	HK						5.164	3	Convergence

Table 3.10 Results of Convergence Clubs in GDP shares-Manufacturing Sector

Last T order	Country	Step 1	Step 2	Step 1	Club	Remarks
1	Twn	**Base**	**Core**		1	Convergence
2	Thai	6.245	**Core**		1	Convergence
3	Malaysia	7.866	**Core**		1	Convergence
4	Korea	8.450	**Core**		1	Convergence
5	Indonesia	11.138	**Core**		1	Convergence
6	Singapore	11.197	**Core**		1	Convergence
7	Philipines	7.948	**Base**		2	Convergence
8	Japan		-0.807		2	Convergence
9	India		-25.282	**Base**		Divergence
10	HK			-3.709		Divergence

Table 3.11 Results of Convergence Clubs in GDP Shares-Mining Sector

Last T order	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Malaysia	**Base**	**Core**					1	Convergence
2	Indonesia	-1.596	**Core**					1	Convergence
3	Thai	1.324	**Core**					1	Convergence
4	Korea	-1.761	**Base**						Divergence
5	Philipines		-5.0073	**Base**				2	Convergence
6	Singapore			0.9155				2	Convergence
7	Japan			-2.8295	**Base**				Divergence
8	India				-15.949	**Base**			Divergence
9	HK					-5.195	**Base**		Divergence
10	Taiwan						-3.948		Divergence

Table 3 .12 Results of Convergence Clubs in GDP Shares-Services Sector

Last T order	Country		Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	HK	-16.1741	**Outlier**					Divergence
2	India		**Base**	**Core**			1	Convergence
3	Taiwan		9.212728	**Core**			1	Convergence
4	Japan		7.388354	**Base**			2	Convergence
5	Singapore			0.036008			2	Convergence
6	Korea			-7.96183	**Base**		3	Convergence
7	Philipines				6.30971		3	Convergence
8	Thai				0.131992	**Base**	4	Convergence
9	Malaysia					6.544739	4	Convergence
10	Indonesia					-9.5522		Divergence

Table 3.13 Results of Convergence Clubs in GDP Shares-Construction Sector

Last T order	Country		Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Korea		**Base**	**Core**			1	Convergence
2	Indonesia		-1.54929	**Core**			1	Convergence
3	Japan		-1.14607	**Core**			1	Convergence
4	India		-0.05054	**Core**			1	Convergence
5	Philipines		-0.60835	**Base**			2	Convergence
6	Singapore			2.228429			2	Convergence
7	Twn			-2.718172	**Base**		3	Convergence
8	Malaysia				3.7906		3	Convergence
9	Thai				0.40672	**Base**		Divergence
10	HK					-2.67591		Divergence

Table 3.14 Results of Convergence Clubs in Labor Share-Agricultural Sector

Last T order	Country		Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	India	Outlier	-18.2126					Divergence
2	Thai		Base	**Core**			1	Convergence
3	Indon		0.922471	**Core**			1	Convergence
4	Phil		2.60635	**Core**			1	Convergence
5	Msia		-54.1723	Base				Divergence
6	Korea			-12.0881	Base		2	Convergence
7	Twn				-1.17504		2	Convergence
8	Japan				1.26694	Base	2	Convergence
9	Sing				-72.273	Base	3	Convergence
10	HK					2.946049	3	Convergence

Table 3.15 Results of Convergence Clubs in Labor Shares-Services Sector

Last T order	Country	Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	HK	**Base**	**Core**			1	Convergence
2	Sing	-1.53535	**Core**			1	Convergence
3	Jap	-3.79019	**Base**			2	Convergence
4	Kor		9.805614			2	Convergence
5	Twn		17.02144			2	Convergence
6	Msia		2.15808	**Base**		3	Convergence
7	Phil			5.059027		3	Convergence
8	Indn			1.512497	**Base**	4	Convergence
9	Thai				2.765504	4	Convergence
10	India				-9.67814		Divergence

FIGURE 3A : TRANSITION PATH FOR GDP PER CAPITA AND LABOR PRODUCTIVITY

Figure 3.1 GDP Per Capita

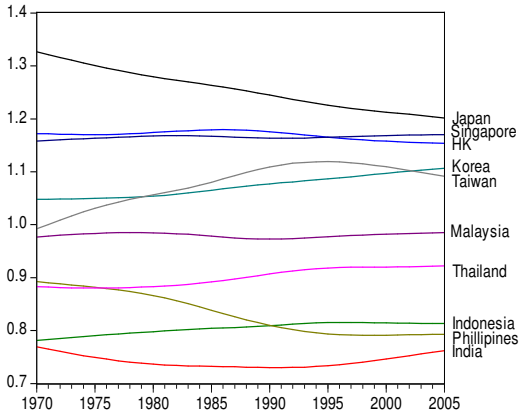


Figure 3. 2 Agriculture Sector

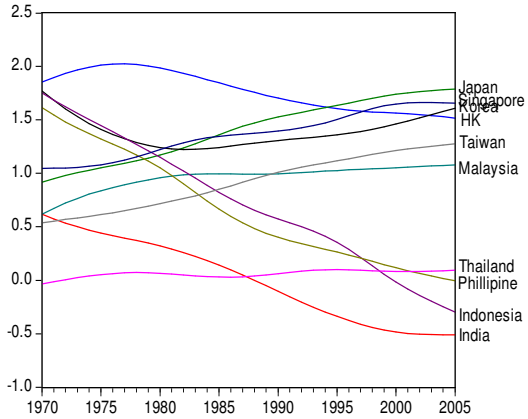


Figure3.3Construction

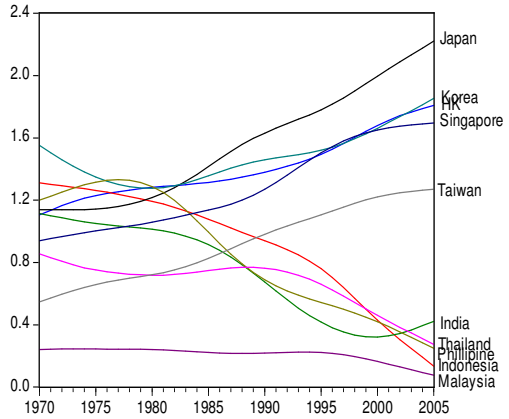


Figure 3. 4 Manufacturing Sector

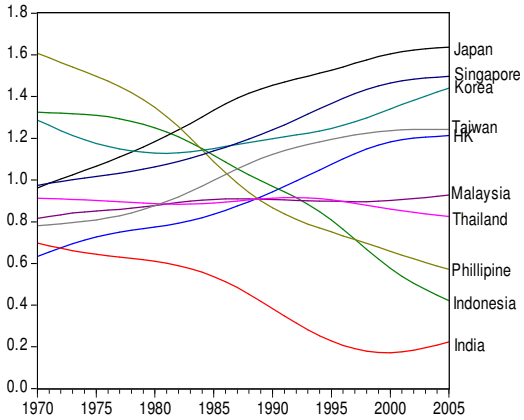


Figure 3.5 Mining Sector

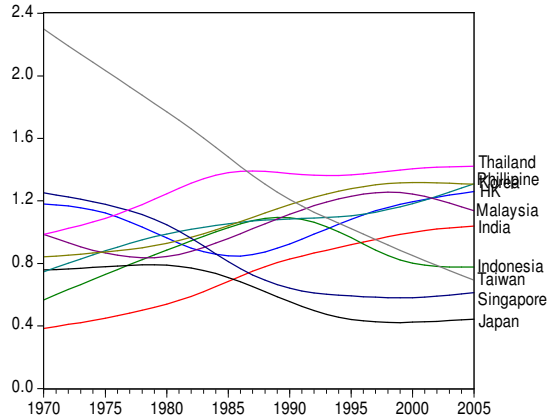


Figure 3.6 Services Sector

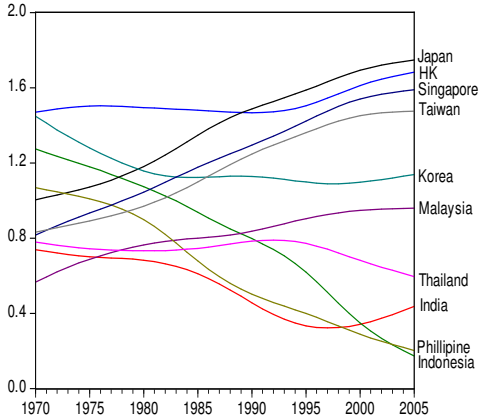


FIGURE 3B: TRANSITION PATH FOR GDP SHARE

Figure 3.7 Agriculture Sector

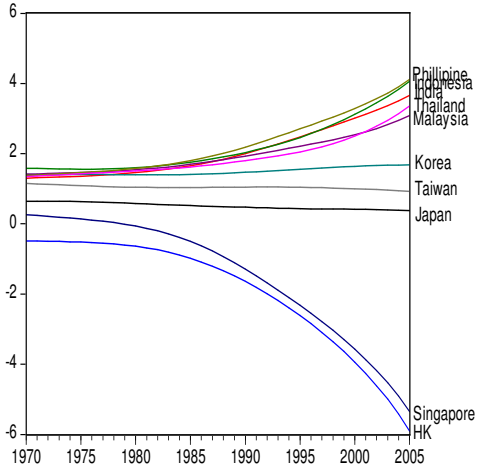


Figure 3.8 Construction Sector

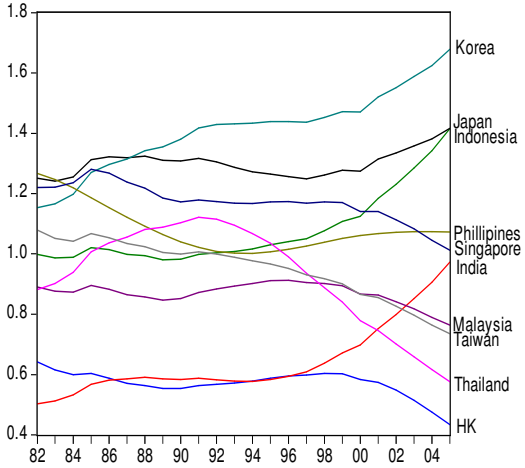


Figure 3.9 Manufacturing Sector

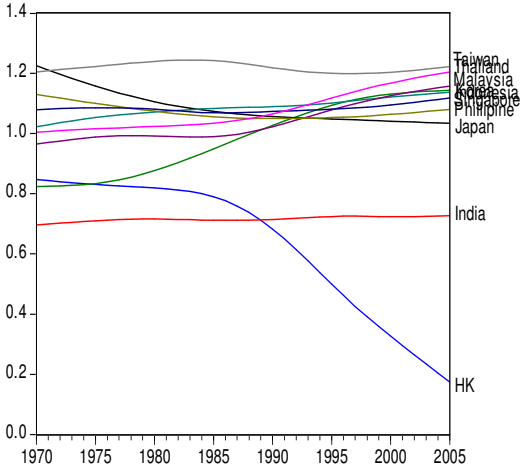


Figure 3.10 Mining Sector

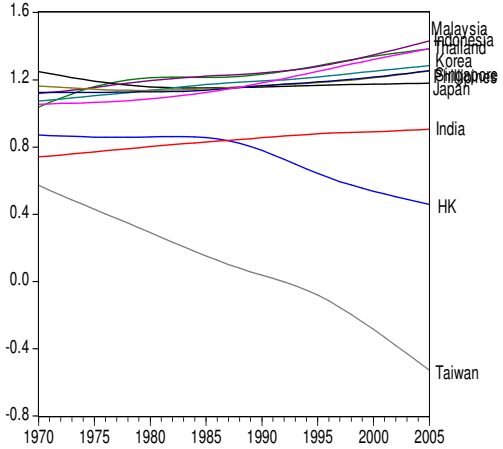


Figure 3.11 Services Sector

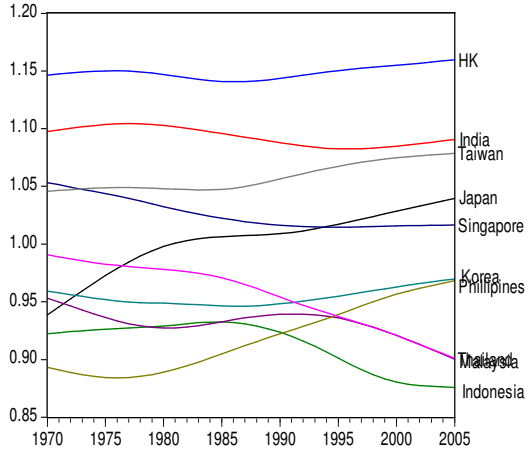


FIGURE 3C: TRANSITION PATH FOR LABOR SHARES

Figure 3.12 Agricultural Sector

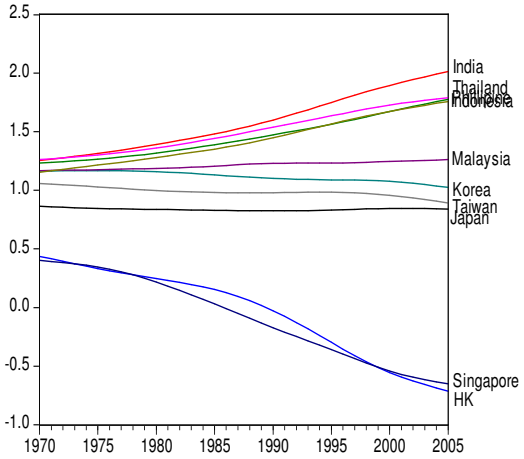


Figure 3.13 Construction Sector

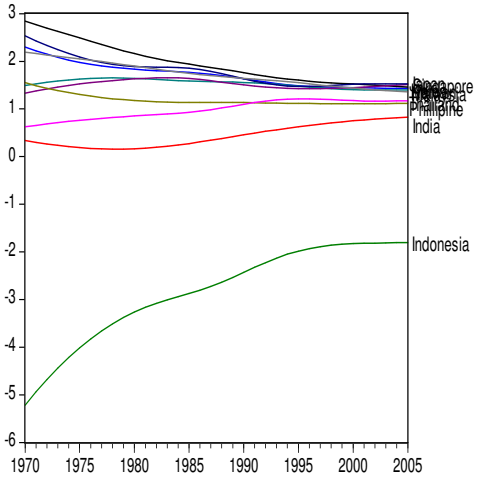


Figure 3.14 Manufacturing Sector

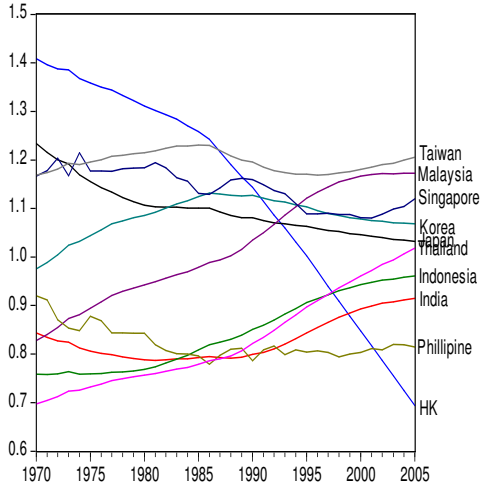


Figure 3.15 Mining Sector

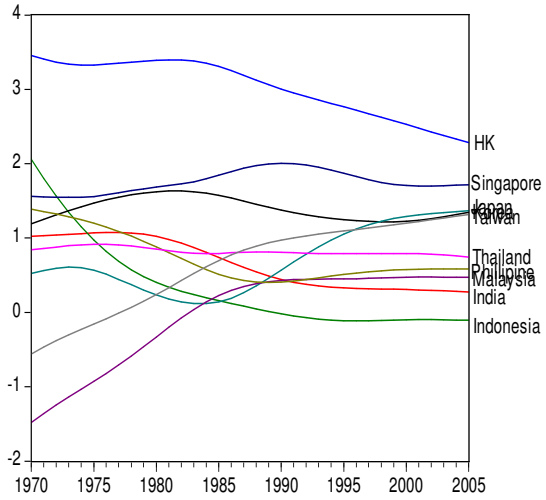
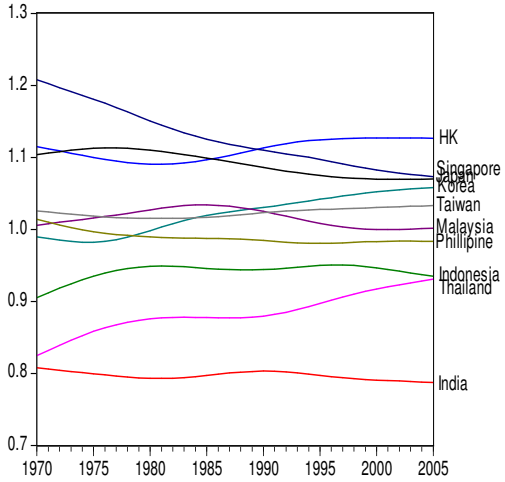


Figure 3.16 Services sector



CHAPTER 4

CONVERGENCE OF COMPETITIVENESS AND SPECIALISATION IN ASIAN MANUFACTURING INDUSTRIES

4.1 Introduction

The ability of Asian countries to recover swiftly and successfully from the crisis of 1997 and to undergo rapid economic growth has attracted the world's attention. Ever since, its economic performance and competitiveness has been heavily debated. Export-led growth was the engine of growth for these economies before the crisis, especially during 1980s and 1990s. Strictly speaking, even a 'competitive nation' would not be exporting in all industries. Instead, it would tend to export from the sectors in which its relative productivity advantage was greatest and to import goods and services in which its productivity advantage was small. Improved productivity performance helps a firm lower its production costs, sell more products at a lower price, and enhance its relative ability to compete. If one nation has a productivity advantage over other countries in all industries, it will necessarily have a higher per capita income. Broadly speaking, if one nation has wider range of sectors in which country has such absolute productivity lead, it will result in high real wages, high per capita income and growth rate. As Krugman defined competitiveness as 'a poetic way of saying productivity', thus productivity is the robust and ascertain measure of the performance of a national economy.

By undertaking convergence analysis, it is possible to examine whether countries in the Asian region are converging in terms of economic growth in the steady state, or whether the structure of their economies is diverging. In addition to examining convergence in per capita income, focus is placed on the competitiveness level of Asian countries at the level of individual industrial sectors. Competitiveness is a meaningful concept when applied to sub industries. The question of whether, how and when poor or low competitiveness countries will catch up with rich or highly productive countries is of great interest to economic theorists and policymakers alike.

Figure 4.1 shows different levels of labour productivity in the manufacturing sectors of Asian economies, highlighting the increasing level of productivity in Japan, Korea and Taiwan accompanied by the stagnation of productivity in low income countries such as India and Indonesia. Despite that, according to UNIDO (2009), developing countries (excluding China) increased their manufacturing value added share significantly by almost five percentage points between 2000 to 2005, an outstanding achievement as compared to other regions (Table 4.1). Yet, Michael Porter (1990), who focused much of his writing on the 'competitive advantage' of firms, industries, nations, regions and cities - suggests the substitution of the notion of national competitiveness with that of firms and/or sectors. Based on this view, he claims that a country is competitive when a concentration of competitive firms and sectors exists on its territory. By focusing on particular sub-industries, it is thus possible to obtain a clearer picture of productivity and competitiveness.

ADB (2007) provides evidence that the manufacturing sectors in a number of Asian economies, especially Korea, Malaysia, Singapore, and Taiwan, China, have undergone important transformations and shifted their manufacturing output to more technology- and scale-intensive sub sectors. This upward shift is an important component of what structural change is about, as the production of more sophisticated manufactured products leads to faster growth by enlarging the potential for catch-up. According to the UNIDO Industrial Development Report 2009, countries that tend to grow fast are the ones which concentrate on the high tech products for exports.

A more detailed look is obtained by selecting sectors in medium and high technology at the three digits ISIC level analyzed for 13 Asian countries, making it comparable across countries within the sectors. Figure 4.2 shows the average level of competitiveness in terms of productivity and labour input efficiency in medium and high technology industries of Asian countries in two averaged periods. All of the medium and high sectors in the study show a continued increase except for the labour input efficiency of Printing and Publishing Industry (342). Despite the increase in the 1990s for all sectors, printing and publishing shows some countries experiencing a reduction in its average productivity on the second period, such as Cyprus, Hong Kong, Kuwait and Israel, which interestingly are the high income countries. Another point to be noted is that India has stagnant growth of productivity in all of its sectors. To emphasize more on the selected industries, productivity and labour input efficiency are compared between selected sub sectors of the countries.

This paper focuses on the dynamics and convergence of the competitiveness of labour in Asian countries over the last three decades, considering the specific medium and high technology sectors in manufacturing industry using several indicators of competitiveness. This study comprises an in-depth investigation into the process of convergence in labour competitiveness both in aggregate and sectoral measures. Patterns of labour productivity and effective unit of labour input convergence are considered across medium/high technology manufacturing sectors in 13 countries during 1971-2001. The analysis is conducted both in aggregate and within sub groups of countries seen to be in clubs. The convergence analysis on the disaggregated data at individual sectoral level, namely printing and publishing, manufacture of industrial chemicals, manufacture of plastic products and manufacture of transport equipment, should provide a better understanding of economic structures.

The study hypothesizes that convergence is likely to exist in labour competitiveness throughout Asia's industry. Despite the heterogeneity of Asian countries, the consistently high growth of the manufacturing sector led Asian countries to be among the main competitors in the world.

Thus, the objective of the present study is to examine the competitiveness of labour in manufacturing industry in Asia in terms of two indicators, labour productivity and labour input efficiency. The study also aims to examine empirically the convergence of competitiveness in the medium/high technology industries among the selected Asian countries.

This study makes important contributions to the literature in several aspects. First, the novelty of this paper stems from the in-depth research of medium/high technology in sub-sectors of industry in Asian countries in the perspective of labour competitiveness. It attempts to examine whether there exists a statistically significant movement towards structural homogeneity in competitiveness in the three digit manufacturing industries. Secondly, in order to analyze the transitional behaviour of labour cost and productivity in Asian countries, we apply a test of non linear time varying factor model developed by Phillips and Sul (2007a). The methodology is chosen as it is based on a nonlinear time-varying factor model that incorporates the possibility of transitional heterogeneity or even transitional divergence. Most important, it indicates that the non existence of convergence would also indicate the possibility of convergence clubs. Thirdly, the Krugman specialization index is applied in the hope of

explaining in depth the pattern of labour competitiveness convergence/divergence in the sub-sectors.

The paper is organized into several sections. The first section contains the introduction and background of the paper. The next section is the literature review, followed by theoretical discussion in section 3. Section 4 (methodology) will discuss in depth the method proposed by Phillips and Sul (2007a, 2007b) in testing convergence and the algorithm of convergence clubs and the Krugman specialization Index. Next section of the paper is the discussion on empirical results. The final section summarizes and draws out some policy implications.

4.1.1 Competitiveness and Convergence

With regard to definition, the study aim to analyze competitiveness at the sector level, thus the definitions of competitiveness given for this study is connected to the sector. A general definition is proposed by Pitts and Lagnevik (1998) who define competitiveness of industry as "the ability to profitably gain and maintain market share in domestic and/or foreign markets". Kim and Marion (1997) consider competitiveness as "the sustained ability of a nation's industry rise or firms to compete with foreign counterpart in foreign markets as well as in domestic markets under conditions of free trade"

Productivity measures are useful for studies of international competitiveness. Countries with rapid productivity growth rates are better positioned to sell their products and services at lower prices. However, competitiveness is not only measured by productivity solely, i.e. by the numbers of workers, but also by the cost of inputs in the production process. Indeed, a well-known measure of international competitiveness combines labour cost and productivity into a single measure of labour cost per unit output. Unit labour cost (ULC) is defined as the cost of labour required to produce one unit of output in a particular industry, sector or the aggregate economy.

In the literature, there are different approaches used for the definition of labour costs. Abraham (2001) argues that "the labour costs issues are of main concern to global companies". Firstly, firms are interested in the magnitude of the total labour cost differentials between countries. All other things equal, countries with higher labour costs is less attractive investment locations. All other things are usually not equal and that is why, as a second factor, unit labour

costs matter. Unit labour cost indicators take into account productivity differentials in comparing labour costs. An increase implies that labour costs rise by more than productivity gains such that the competitive position of the company deteriorates. Hence, unit labour costs reflect the competitive (dis)advantage due to (higher) lower labour costs.

Generally, theories teaches us that where there is enough competition in the labour market, over workers, wages are likely to closely match workers' productivity levels. If wages are lower than productivity, another employer can recruit a worker for a higher wage and still make a profit. Yet, if wages are higher, employers will lose money and sooner or chose to dismiss the worker. Thus, loosely speaking, changes in wages should follow changes in productivity, which in turn implies that, unit labour costs should remain fairly constant over time. However, not all markets have enough competition over workers to ensure a match between wages and productivity. Wages may grow faster than productivity simply because they were at such a low level to begin with. Warner (2006) studies the occupational wages and GDP in modern economies. He claims that GDP per capita exceeding wage growth for a sector or sub sectors can be justified by a few broad key factors. The key factors are (1) rising labour force participation; (2) faster growth in other sectors' wages, or in profits; and (3) migration of labour toward other sectors with higher wages. Despite that, labour force participation does not appear to explain the entire GDP/wage gap, leading to the focus on measuring and evaluating competitiveness in term of labour (productivity) and wages (efficiency input) of the industry separately yet jointly analyzed.

Some other reasons can contribute to the inequality of movements in wages and productivity, even with enough competition. Broadly speaking, there are two reasons why the competitiveness of nations may differ; first, one country may have higher productivity at the industry and sub industry level; second, one country may have its work force concentrated in high-productivity industries and sub industries. This might due to the fact that some industries produce far more value added per worker than others. In practice, differences in overall productivity and competitiveness are likely to be resulted from both factors, higher productivity in individual countries and distribution of employment among sectors. Nevertheless it is interesting to investigate the importance of these two sources particularly in concentrated sectors.

Another important issue in exploring competitiveness, concerns the hypothesis of convergence. The growth of labour costs over time does relate with convergence. Firms that take advantage of lower labour costs want to know how long the labour cost advantage will last. If unit and total labour cost quickly converge to the levels in other countries, companies are less likely to base their investment decisions on labour cost conditions. The most likely question is how and when labour cost advantages erode over time. The convergence process is slow and often partial. Convergence does not apply to all countries or to all time periods. It might not converge at all in all sectors. Hence, cost-based advantage may in specific case survive the short and sometimes even the medium run. Real convergence can be attained through a differential increase in productivity as in this case efficiency labour input and (thus) competitiveness. Convergence is conditional, depending on the ability of an economy, judged by its sectors to become more competitive. Thus it is a long, winding process. Macroeconomic policy can only contribute in the long run. A nominal convergence can contribute to macroeconomic stability, by putting things into place. Competitiveness in general and productivity in particular allows a nation to support high wages, a strong currency and attractive returns to capital and with them indicates a high standard of living (Porter and Ketels, 2003).

4.2 Literature Review

Studies that view competitiveness as an extension of the theory of comparative advantage (e.g., Bank of England,1982; Durand and Giorno ,1987; Anderton and Dunnett, 1987; Fagerberg, 1988) maintain that the competitiveness of a nation depends on its advantage in the price of goods and services in the international marketplace. Although the role of price in determining competitiveness has been well documented by economists, problems have arisen in measuring price competitiveness. Bank of England (1982) suggested that competitiveness, especially within the manufacturing sector, should be measured in terms of relative export prices, relative export productivity, and relative unit labour cost. Among the three measures mentioned, the unit labour cost was found to be the most popular (Fagerberg, 1988; Anderton and Dunnett, 1987). It was simple, widely available and internationally comparable. Using a slightly different approach, the Economics and Statistics Department of Organization for Economic Cooperation and Development (OECD) measured the overall competitiveness of a nation as a

summation of its export and import competitiveness, where import competitiveness was estimated by the ratio of actual market price to producer's market price. Export competitiveness was calculated by taking both the home-country market price and the import price in the concerned market. Some of these studies incorporated the fluctuations in the foreign exchange market to measure price competitiveness approaches; the productivity-based index (micro level) and the trade performance-real income (macro-level). These classifications describe various parameters that determine the state of a country's international competitiveness at the micro level, parameters at the firm or industry, and macro; parameters that determine competitiveness at the national level.

Kogut (1993) states that overall institutional support, affect country capabilities and technology diffusion. He points out that the evolution of institutional environments is path-dependent and that technology and knowledge diffusion tends to remain within national borders. In a previous study, Kogut (1991) also argues that country competitiveness might explain differences in country capabilities in terms of technology and organization principles. He claims that technology and organization principles diffuse more slowly across rather than within national and regional borders. Kogut's belief is that the study of international competition is, in large part, the study of comparative management and societal institutions among countries. While viewing the minor role of government as a contributor to country competitiveness, Kogut recognizes that trade patterns among countries reflect the sectors favoured by a country's organization and technological capabilities. From Kogut's perspective, these patterns promote further expansion and investment in these capabilities.

To answer the question of why a nation achieves international success in a particular industry, Porter (1990) proposes the diamond model of country competitiveness. His model, popularly known as the "dynamic diamond", consists of four major factors, which he suggests promotes or impedes the competitive advantage of the firms operating in a nation. The model includes factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry. According to Porter, "the diamond is a mutually reinforcing system". The effect of one determinant is contingent on the state of others. He indicates that the interplay of advantage among the determinants that yields self-reinforcing benefits (that are difficult for foreign rivals to nullify or replicate) ultimately determines the competitiveness of nations. Additionally, two factors outside the "diamond" chance (including major breakthroughs, innovations, wars, and political developments) and government policy, also

affect the competitiveness of nations. Governmental intervention may bring forth what many (e.g., Scott and Lodge, 1985) suggest as the "dynamic comparative advantage" of nations. Dunning (1993) points out that Porter's model do not consider the relationship between multinational enterprises (MNEs) and the nation's diamond. He claims that, the diamond underestimates "the increasing interaction between the cross-border value added activities by multinational enterprises, which directly, or indirectly, impinge upon each of the components of the diamond of national competitive advantage". Therefore, Dunning suggests the introduction of multinational business activity into Porter's diamond. Researchers refer to this as the Porter-Dunning model. Following Dunning (1993), Rugman and D'Cruz's (1993) "double diamond", Cartwright's (1993) "multiple linked diamonds" also revises Porter's diamond while recognizing the critical role of foreign direct investment and multinational business activity's affect on a country's international competitiveness. Finally, Ezeala-Harrison (1999) condenses these views into micro and macro-level approaches; the productivity-based index (micro level) and the trade performance-real income (macro-level). These classifications describe various parameters that determine the state of a country's international competitiveness at the micro level, parameters at the firm or industry, and macro; parameters that determine competitiveness at the national level.

Briefly, a country is competitive if its industries can produce at an average level that is at least equal to or above that of its foreign competitors. This describes the productivity measure because it indicates that the country is able to use its resources and produce efficiently. Just as important, the country should be assessed at the macro level for overall competitiveness. This level addresses the existence of an adequate infrastructure that can support industries. It includes the political and ideological policies that the country adopts in order to compete globally. In summary, scholars have viewed international competitiveness from two different perspectives: the micro (firm) perspective and the macro (nation) perspective. The micro perspective of competitiveness refers to competition among the firms and how this competition within a nation ultimately affects international markets. In contrast, the macro perspective concerns competition among nations (Scott and Lodge, 1985; Porter, 1990). The possible causes discussed in previous studies include factors at the macro and micro levels: macro-environment, government policies, industry structure, and firm activities. While Porter (1990) and Kogut (1991, 1993) study the factors that are appear to be bounded by national borders, Dunning (1990, 1993), Rugman and D'Cruz (1993), and Cartwright (1993) argue that multinational business activities need to be included in the analysis of country competitiveness.

4.3 Theoretical Framework

The debate on the impact of international trade on economic growth has been recognized as early as the mercantilist area of economic thought. The mercantilist trade theory was based on the idea that a country might have absolute advantage over the other country. Taking this opportunity, this country would export its more competitive products and take advantages of markets of its trading partners.

Adam Smith (1776) viewed competitiveness of country as "a positive-sum game in which all trading partners can benefit if countries specialize in the production of goods in which they have absolute advantages". Moving beyond Smith's concept of absolute advantage, David Ricardo (1817) demonstrated that gains from trade could be made when two countries specialize in the production of goods for which they have a comparative advantage. The Ricardian model, states that the differences in production function across sectors and across countries rise due to differences in comparative labour productivity (i.e. output per worker). Upon this, economists argued that the competitiveness of trade originates from differences in factor endowments: labour (as with Ricardo) and capital (Heckscher-Ohlin model). In most studies and researches, competitiveness is mainly related to comparative advantage. Comparative advantage is connected to the Heckscher and Ohlin theory on international trade, in which the specialization of the countries in exports depends on resources endowments and the relative costs. As for Ricardo's 'comparative advantage theory', it was widely believed until recently that trade between countries can be beneficial to all parties involved, provided they specialized in products where they faced the least comparative disadvantage. Few exceptions for protectionism were allowed, notably in cases of 'infant industries'. Competitive advantage on the other hand, is connected to the Porter diamond model which explains the source of competitiveness in the international market in terms of factors of advantage.

The focus on this study lies on the idea of comparative advantage centralized on the theory of specialization and trade. Comparative advantage is a microeconomic concept, focusing on industry-specific trade. Broadly, it explains why one country might export labour-intensive products while another country might specialize in capital-intensive ones. By definition, each country enjoy a comparative advantage in the production of some products – specialized sectors/product for which it has a lower relative (opportunity) cost than its

competitors. Looking comparative advantage in macroeconomic perspective is rather least meaningful. For example, to say that at any time country A in the aggregate has a comparative advantage over country B would mean nothing. Another key to comparative advantage is factor-based that predicts a pattern of trade when prices, trade flows and exchange rates are in equilibrium. Business decisions, in contrast, often must explicitly consider short-term situations as well as long-term equilibrium outcomes. These will include current economic conditions, exchange rates and other factors that may represent deviations from long-run equilibrium, sometimes for fairly long periods of time. Finally, factor-based comparative advantage does not take explicitly into account the technological options available to the producers. At the microeconomic level, when dealing with specific products, it is not always clear from theory alone which country has the most favorable mix of resources and factor prices for various types of production. Depending on technology and infrastructure, a shortage of labour relative to capital which implies relatively high wage rates may be offset by differences in technology. High wages may or may not translate into competitive disadvantage for labour-intensive products if alternative technologies using less labour and more capital are available. For example, many products that are produced by hand in China are also produced, by machine, in the United States.

The traditional theory of international trade is based on the assumption of perfectly competitive markets. Under this assumption, markets can allocate resources efficiently without state intervention. More development on the theory of international trade has challenged the assumption on the perfect market. The new trade theory assumes that, it is possible that countries with high-return industries can do better than others, raising the possibility for strategic trade policies by governments. It explains trade in terms of technology, technology diffusion/adjustment lags and continuous innovation processes, the fact that less developed countries will specialize in the export of old, mature goods where production processes become routine and less skilled labour has to play a greater role. As the export structure of countries changes from resource intensive and labour intensive industries to human capital intensive, technology intensive industries is interpreted as an improvement in the structure and quality composition of exports. With the improvement in the economic structure and resource intensive, countries that compete successfully in high-tech industries and focus on markets in which quality and know-how are more important than low-price strategies will be said to be technological competitive, one aspect of qualitative competitiveness.

4.4 Methodology

This section is to verify the existence of competitiveness profile that near enough to converge towards the same long-term equilibrium. More precisely, the analysis, based on the 3 digits sub industries UNIDO data, has first tested the convergence process from 1971-2001 in the whole sample of 13 Asian countries that is taken as reference scenario. Next the clustering convergence technique is applied that determined the subgroups of regions characterized by its level of competitiveness.

4.4.1 Testing for Convergence Using Non-linear Factor Model

Let say the panel data for a variable y_{it}, where $i = 1,..N$ and $t = 1,..T$, with N, T the number of countries and the sample size, respectively. Usually the panel data are decomposed in the following way:

$$y_{it} = g_{it} + a_{it} \tag{4.1}$$

Where in Equation (4.1) y_{it} is a panel of log per capita income for country $i, (i = 1,..N)$. and at time, $t = 1,...,T$. It is common to decompose y_{it} into two components; systematic, g_{it} and transitory, a_{it}. At this point, we do not assume any particular parametric assumptions of g_{it} and a_{it}, meaning that the framework may include linear, nonlinear, stationary and non stationary processes. Equation (4.1) may contain both common and idiosyncratic components in g_{it} and a_{it} .Thus Phillips and Sul (2007a) separate the common and idiosyncratic components in panel into;

$$y_{it} = \left(\frac{g_{it} + a_{it}}{\mu_t} \right) \mu_t = \delta_{it} \mu_t \qquad \text{for all } i, t \tag{4.2}$$

Thus;

$$y_{it} = \delta_{it} \mu_t$$

Using Equation (4.2), Phillips and Sul (2007a; P&S hereafter) are able to separate the common and idiosyncratic components in the panel by factoring out the common stochastic trend component. Equation (4.2) states that y_{it} is decomposed into two time varying components; common, μ_t and idiosyncratic δ_{it}. The component δ_{it} is a measure of distance between y_{it} and the common component, μ_t. P&S allow δ_i to have random component that absorbs the error term and the unit specific component and therefore allow possible convergence behaviour in δ_{it} over time in relation to common factor μ_t in which μ_t is assumed to have some deterministic or stochastically trending behaviour that dominates the transitory component a_{it} as $t \to \infty$.

In order to model the transition coefficients, δ_{it}, a relative transition coefficient, h_{it} is constructed as Equation (4.3), such that the common factor of μ_t in Equation (4.2) is removed by scaling to give the relative loading or transition coefficient.

$$h_{it} = \frac{y_{it}}{N^{-1}\sum_{i=1}^{N} y_{it}} = \frac{\delta_{it}\mu_t}{N^{-1}\sum_{i=1}^{N} \delta_{it}\mu_t} = \frac{\delta_{it}}{N^{-1}\sum_{i=1}^{N} \delta_{it}} \tag{4.3}$$

Hence, h_{it} represents the transition path of economy i relative to the cross-section average and has a twofold interpretation: first, it measures the individual behaviour in relation to other economies, and second, describes the relative departures of economy i from the common growth path, μ_t. In case of convergence, i.e., when all economies move towards the same transition path, $h_{it} \to 1$ for all i as $t \to \infty$. Then, the cross-sectional variance of h_{it}, denoted by $H_t = N^{-1}\sum (h_{it} - 1)^2$ converges to zero. In case of no convergence there is a number of possible outcomes, i.e., H_t may converge to a positive number, which is typical for club convergence, remain bounded above zero and not converge or diverge.

In order to specify the null hypothesis of convergence, Phillips and Sul (2007a, 2007b, 2007c) model δ_{it} in a semi-parametric form:

$$\delta_{it} = \delta_i + \frac{\sigma_i \xi_{it}}{L(t)t^{\alpha}} \tag{4.4}$$

where δ_i is fixed, σ_i is an idiosyncratic scale parameter, ξ_{it} is iid(0,1), L(t) is a slowly varying function (such that $L(t) \to \infty$ as $t \to \infty$ t) and α denotes the speed of convergence, that is, the rate at which the cross-sectional variation, H_t decays to zero. This representation ensures that the loading coefficient, δ_{it} converges to δ_i for $\alpha \geq 0$ (i.e. for all positive values of α or even when $\alpha = 0$). Using this weak inequality constraint, $\alpha \geq 0$, the null hypothesis of convergence can now be formulated as follows

$H_0 : \delta_i = \delta$ and $\alpha \geq 0$

against the alternative

$H_A : \delta_i \neq \delta$ for all i or $\alpha < 0$.

The employment of the function $L(t)$ will ensures that convergence holds even when $\alpha = 0$, despite at a slow rate.

Note that under the null hypothesis of convergence various transitional patterns of economies *i* and *j* are possible, including temporary divergence and heterogeneity, meaning periods where $\delta_i \neq \delta_j$. Hence, the method used by Phillips and Sul (2007a) enables the detection of convergence even in the case of transitional divergence. To note, the previous stationary time series methods are unable to detect the asymptotic co-movement of two time series and therefore erroneously reject the convergence hypothesis. The null hypothesis indicates convergence for all countries whilst the alternative hypothesis implies no convergence for some countries. In other words, the rejection of null hypothesis implies both overall divergence and club convergence. The existence of club convergence indicates the possibility that one or more subsets of the group of countries to form convergent groups at different factor loadings, but with positive rates of convergence.

To test for convergence, Phillips and Sul (2007a) suggest the following procedure: first, the cross-sectional variance ratio H_1/H_t is constructed and the log *t* regression is run:

$$\text{Log}\left(\frac{H_1}{H_t}\right) - 2\log L(t) = \hat{a} + \hat{b}\log t + \hat{u}_t \qquad \text{for t} = [rT],...\text{T} \qquad (4.5)$$

where in general r ∈ (0, 1) and L(t) is a slowly varying function. The fitted coefficient of log-*t* is $\hat{b} = 2\hat{\alpha}$, where $\hat{\alpha}$ is the estimate of α (the speed of convergence) in H_0.[12] Hence if $\hat{b} \geq 2$ (i.e. $\alpha \geq 1$), then values of $\hat{b}$ that are this large will imply convergence in level per capita incomes. If $2 > \hat{\beta} \geq 0 \left(i.e \;\; 1 > \hat{\alpha} \geq 0\right)$, then this speed of convergence corresponds with conditional convergence, that is income growth rates converge over time. Specifically, the higher (larger) the value of $\hat{b}$ (as well implies $\hat{\alpha}$), the faster the rate of convergence. It can be described as conditional convergence since it tests whether heterogeneous time varying idiosyncratic components converge over time to a constant after controlling for a common growth component among countries. According to Phillips and Sul (2007a) the test statistic $\hat{b}$ is asymptotically standard normally distributed, so that standard critical values can be employed. Based on Monte Carlo simulations, Phillips and Sul (2007a) suggest using $L(t)$ = log *t* and r = 0.3 for sample sizes beneath T = 50. The standard error of the estimates is calculated using a HAC estimator for the long-run variance of the residuals. The null hypothesis of convergence is rejected if t_b < 1.65 (5% significance level). If convergence is rejected for the overall sample, the testing procedure is applied to subgroups following a clustering mechanism test procedure suggested in Phillips and Sul (2007a).

[12]Furthermore, the *t*-statistics of $\hat{b}$ diverges to infinity when $\alpha > 0$ and converges weakly to a standard normal distribution when $\alpha = 0$. The convergence test then proceed as a one sided *t*-test of $\alpha \geq 0$. Under the alternative of growth divergence or club convergence, the point estimate of $\hat{b}$ converges to zero regardless of the true value of α, but its *t*-statistic diverges to negative infinity, thereby giving the one sided *t*-test discriminatory power against the alternatives (see Phillips and Sul, 2007a, 2007c).

4.4.2 Club Convergence Analysis

Thus the next section of this paper is to test the null hypothesis of full panel convergence that is the overall convergence of the competitiveness of the 13 countries. If the null hypothesis is rejected, means divergent, yet it does not imply that there is no evidence of convergence in subgroups of the panel. It may include the possible existence of convergence clusters around separate points of equilibria or steady state growth paths. In other words, similar convergence characteristics as well as cases where there may be both convergence clusters and divergent members in the full panel. Intuitively, is to explore the possibility of forming convergence clubs wherein the most affluent countries should belong to the first (core) club and the poorest or in this case is the least competitive therefore be classified in latter clubs. There is possibilities that any countries either the least competitive or most competitive to diverge and do not belong to any of the clubs. It means that such countries possess no characteristics that appear to be similar with the rest, on the average. A simple algorithm based on repeated $\log t$ regressions is developed here to provide such an empirical approach for assessing club convergence and clustering individual's countries into subgroups. If the full panel convergence test is rejected for the whole countries investigated, the $\log t$ can still identify groups of countries that converge to different equilibria (club convergence) and at the same time allow individual countries to diverge.

The basic assumption is that there is a known 'core subgroup' G_k containing at least K members that possess convergent behaviour. When there is evidence of multiple club convergence as T $\rightarrow\infty$, this is usually most apparent in the final time series observations. Based on this observation, P&S propose that the panel be clustered initially according to the value of the final time series observation (or some average of the final observations). The intuition is that generally, convergence will be most evident towards the end of sample. After choosing the highest final time period observations on panel members, the size k subgroups, G_k = {1... k} for {k = 2…N}, is constructed and the log t regression tests for convergence are conducted within these subgroups, denoting by t_k the test statistic. The clustering of the country into subgroups begun when k^* is choose to maximize t_k over all values for which t_k > c for $k = 2...N$ and c is some critical value. Precisely, P&S describe the empirical algorithm that

can be used to identify convergence clubs from a panel of countries that contains four steps as below;

Step 1 (Last Observation Ordering):

Firstly, test the full convergence in aggregate. If no convergence is found, the next step is to find out the sectoral clustering. The first step in clustering is to rank the members of the panel according to the last observation. When there might exist multiple convergence club within the sample, as when $T \to \infty$, the panel is then clustered via two methods; using the last observation of the final time series X_{it} or using some average of the final observations. In this study, the former approach is used.

Step2 (Core Group formation):

Select the first highest individuals k in the list to form the subgroup G_k for some $N > k \geq 2$ and run the log-t regression by adding each country one by one. The core group size k^* is chosen by maximizing over $t_b(k)$ under the condition min $\{t_{b,}(k)\} >$ 1.65. If the core group, $k^* = N$ there is only one large sample of panel convergent countries, no clusters and no individual divergent. Yet if the condition min $t_{b,}$>-1.65 does not hold for $k = 2$, then the first country is excluded. Next, proceed with the same procedure for forming the next clusters of $G_j = \{2,...j\}$ is conducted with $2 \leq j \leq N$ .If the same condition does not hold for every subsequent pair of units, and then there are no convergence clusters in the panel. Or else, there shall be a core convergence subgroup, denotes by G_k .

Step 3 (Sieve Individuals for Club Membership):

After forming the core group, the remaining unit is added separately to the core group and run the log t test regression. If the corresponding test statistic $\hat{t}_b$ exceeds some chosen critical value *c*, then the unit is included into the current subgroup. After forming the subgroup the log *t* test is run for the whole subgroup. If $\hat{t}_b > -1.65$, the forming the subgroup is finished, otherwise

the critical value c is raised and the procedure is repeated. If the condition is not satisfied, the forming of the subgroup is completed.

Step 4 (Recursion and Stopping):

All the countries that are not included in the core group form a complementary group. The $\log t$ regression is carried out for the remaining countries. If the null hypothesis is not rejected, these countries will form a second cluster indicating two convergent subgroups in the panel. Otherwise, steps 1-3 are to be repeated on the remaining countries in order to reveal other clusters. On the other hand, if there is no other sub-group detected (Step 2), and then these countries display divergent behaviour.

4.5 Data

This paper considers Asia's competitiveness, its definition and measurement. A more detailed look is obtained by selecting sectors is known as high tech and low tech at the 'three digit' ISIC level. In this study, thirteen Asian countries were selected based on the availability of continuous time-series data ranging from 1970-2001. These countries are Malaysia, Indonesia, Singapore, India, Iran, Turkey, Israel, Cyprus, Kuwait, Jordan, Hong Kong, Japan and South Korea (Table 4.2). The empirical analysis in this study is based on the data for three-digit (ISIC) manufacturing consisting of annual observations ranging from 1971-2001. Data on value added (V), wages and number of employees (N) by industry were collected from UNIDO's Industrial Statistics Data Base. In ensuring that the sample of countries is regionally diversified, we ensure that the sample's manufacturing sectors have undergone major structural changes during the three decades covered by the sample. While these countries achieved their industrial take off in the 20th century, some of them did the catching up in the early decades of the century.

Due to the unavailability of firm level data for most of the Asian countries, the industries selected are Printing and Publishing Allied Industries (ISIC Code 342); Manufacture

of Industrial Chemicals (ISIC Code 351); Manufacture of Plastic Products not Elsewhere Classified (ISIC Code 356); and Manufacture of Transport Equipment (ISIC Code 384).

In order to achieve the objective, the selection of industry category is based on the high technology manufacturing industries. The medium-high technology manufacturing categories are assumed to be the engine of growth for speedy structural convergence. However, because reporting of data at the group level of ISIC is inadequate to allow separation of medium and high technology products, the category high–technology manufacturing was not used, instead, medium and high technology products were combined into one category; namely medium/high technology (MHT). For the purpose of this study, labour competitiveness was computed in two measurements, labour productivity and labour input efficiency.

Productivity is defined as the gross product or value added per person employed or when data on working hours is available, per hour worked. Labour input efficiency (I,e., efficiency per labour unit) is defined as real value added divided by labour wages. If labour productivity increases while worker compensation remains unchanged, then unit labour costs decline, along with the increase of per effective labour unit. If labour productivity remains constant but worker compensation and benefits rise, then unit labour costs rise with the fall in the effective unit labour cost. Hence, changes in per unit effective labour cost reflect the net effect of changes in worker compensation and worker productivity. Each indicator is then transformed into logarithms for analysis and the result should be interpreted jointly. Each industry consists of all countries is analysed separately.

4.6 DISCUSSION ON EMPIRICAL RESULT

4.6.1 Medium/High Technology Industries Convergence

Table 4.3 and Table 4.4 presents the results of labour competitiveness of full convergence analysis by running the log-t regression specified by Equation (4.5) proposed by Phillips and Sul (2007). It shows that all sectors reject the null hypothesis of convergence for both indicators, labour input competitiveness and labour productivity. However, it does not imply that there is no evidence of convergence in the sub-groups of the panel. Next we investigate the

possibility of club convergence among the countries for each sector by using the algorithm spelt out by Phillips and Sul (2007).

In terms of productivity, industries that show high productivity will tend to be more competitive (Table 4.6). Yet the measurement should be analyzed together with the labour input competitiveness to have a better understanding (Table 4.5). Let us first discuss the labour productivity of the sub industries. For the printing and publishing industry (ISIC 342), Turkey leads, with Japan and South Korea follows behind for both labour productivity and per effective unit labour. Interestingly in this industry, Turkey acquires greater specialization than Japan, as the latter consistently leading other industries in the study. We are not able to add further countries to this group and at the same time fulfill the convergence test regression condition. In the next step, few clusters of catching up countries are identified. An interesting point to ponder is that Jordan, India and Indonesia, categorized as lower middle income clustered together and converge to its own common path. The same scenario also took place in the rest of the industries in the study. These intra manufacturing industry shows that the medium/high technology productivity is dominated by high income countries. However, high population countries with high labour with low skills namely India and Indonesia remain among the last in the list and member of the same group. In fact while the traditional industrial specialization based on the labour intensive industries is still dominant, in most of the countries in Asia, there is a trend towards new industries, requiring greater labour skills and being technologically intensive.

In order to see the pattern of productivity and efficiency labour input, the study examine that the transition path parameter h_{it} that enable capturing the performance of competitiveness in each industry relative to the average, of all others in the sample at time t, and can be interpreted as indicating speed convergence. Charting these 'transition parameters' over time illustrates the path that convergent countries follow and can also highlight where other countries may have fallen behind or diverging from each other. Figure 4.3 of the transition path shows a rather stable transition path in the industry of printing and publishing allied industries, indicating greater chances of synchronization of production structure. In terms of labour input competitiveness (per effective unit of labour cost), a very wide divergence exist in the sample (Figure 4.4). Most of the countries are diverging from the rest. A very weak convergence exists among the club of an average, membered by two countries each (Table 4.5). Interestingly, Hong Kong is listed as a high income country is listed as the least efficient in the

sample. As matter of fact, most of high income countries in the sample for example, Israel, Cyprus Kuwait, are in the bottom of the observation list, indicating least efficiency in its profitability and these countries are not sharing any path to converge to each other. Generally saying, the industry specific labour market in these high income countries are not as competitive as other middle and low income countries in the medium-high technology industries.

Table 4.5 indicates that the most promising industry that shows stronger convergence than others are the manufactured of Industrial Chemicals (351) which clustered into three converging clubs for both indicators. In term of labour productivity, an interesting result here is that Iran, classified as upper middle income by the World Bank, emerges as one of the leading medium/high technology industry in term of labour productivity indicating efficient use of labour. A stylized fact is that in term of efficiency per unit labour, Iran is the most profitable country in the sample. The core group consists of mainly the high income East Asian countries except Iran for both indicators indicating that East Asia is highly competitive in the specific industry. According to UNIDO (2009), most of the sources for greater technological sophistication in developing country emanates from East Asia. Singapore, however, is found diverging from the rest. The second cluster consists of upper and middle income countries that converge into a common path. Despite the different level of economic development, these groups of countries are highly competitive towards each other in its club. Looking at Figure 4.3 and Figure 4.4, we observe that the swings in the transition path can be observed for both productivity and efficiency, yet most of the countries grouped themselves together as the period stretch further.

Plastic product (ISIC 356) shows five cluster/clubs of convergence for both labour productivity and efficiency per unit labour. Japan, as the base country, followed by Korea grouped as core, an interesting pair of high leading income country in Asia (Table 4.6). The most feasible combination that can be seen for stronger convergence is the fifth club, consisting of Jordan, India and Indonesia; all classified as lower middle income. Contradict, in labour efficiency unit, the feasible countries for stronger convergence consists of high income countries (Table 4.5). This indicates that high income countries are paying high wages to the workers and thus, giving the chance for the lower income countries to become more competitive in terms of profitability. The transition path of productivity in Figure 4.3 shows a highly diversified transition path among countries with most high income and upper middle

income heading to unity as the transition path of efficiency labour shows more variation in its path leading to the nomination of five club convergence groups.

In Table 4.6, the manufacture of transport equipment (ISIC 384) is very much diversified from other industries in the study in terms of labour productivity. The study identifies Japan as the base entity in the panel. The test indicates a weak convergence of productivity among these countries which leads to six different path of convergence. Looking at the graphs of the transition curves (Figure 4.3) we observe there is no indication of the transition path to converge to a common steady state for all countries, which then converge towards several convergence clubs. This indicates the vast differences in economic structure among the sample countries. As for the labour efficiency per unit, four clubs has been discovered with Turkey, Japan and Israel diverging from the rest (Table 4.5).

There is no strong evidence of an increase in productivity and labour efficiency convergence for the medium/high technology industries in Asia. Furthermore, the result shows that the manufacturing sectors in a number of the Asian economies, particularly South Korea, Malaysia, and Singapore have undergone important transformations and shifted their manufacturing output to more technology- and scale-intensive sub-sectors. This upward shift is an important component of what structural change is about, as the production of more sophisticated manufactured products leads to faster growth by enlarging the potential for catch-up and greater economic growth to the increase of export of specialized products. This study clearly indicates that labour productivity for Japan, a high income country has maintained its production in medium/high technology product in all sectors as it categorized itself in the core group in each sector, leading three sectors as benchmark country. Even after three decades, the sustaining in Japan's pattern of specialization is largely explained by the rapid accumulation of physical and human capital. Japan, in other words, maintain its competitiveness in terms of productivity for high and medium technology industry. As for labour efficiency indicator of competitiveness, countries of upper middle income are being the most efficient in terms of its wage distribution, followed by the lower income. The high income countries are least efficient in the sectors. The study shows that the sectoral structure of high/medium technology of Asian is dissimilar and perhaps the higher degree of concentration/specialization in certain industries might be the answer for the divergence.

Generally, the above results suggest the null hypothesis of convergence is rejected, indicating strong divergence of competitiveness in the manufacturing sub-industries among 13 Asian countries. The club convergence algorithm had suggested few clusters of possible convergence among each sector indicating multiple steady state of convergence. Some countries are found to be diverging from the rest of the groups. If such divergence is found, therefore, the industries in the study indicate dissimilar structure and perhaps there exist product specialization/sophistication in selected countries. The result of the study indicates the divergence in all sectors and the existence in few convergence clubs shows that specialization might be a contributing factor to divergence in the region's industries. Our question is: does the divergence of medium and high technology at the intra level is led by the specialization of the selected industries? Sectoral specialization indicates the degree to which suitably defined economic sectors attract larger shares of employment and output in one region/country relatives to another. A divergence process refers to a process in which region/country become more different in terms of specialization in a particular sector (Dalum et al., 1998). Further, according to the new economic geographic model, specialization leads to divergence. The model predicts that economic activity tends to concentrate in agglomerations which consequently become high income areas. While these centres of activity become wealthy economic places, other areas host few economic activities and remain poor. For example, two regions of different size emerge in the larger market place, i.e. in the larger, more populated region. This region will develop, while the other stagnates, giving rise to regional divergence with a core periphery pattern.

It has been said that convergence of industry structure implies whether the industry structure of the individual countries becomes more similar, in other words, sectoral specialization of countries decreases. Thus, divergence according to the economic geography approach would imply that specialization of countries has been increasing.

In the next section, we endeavor to compute the Krugman specialization index for the four medium/high tech industries for each countries.

4.6.2 The Krugman Index of Specialization

The Krugman (1991) Index of specialization measures the bilateral relative specialization i.e. to what extent the sectoral composition of manufacturing value added differs across pairs of

countries. This index ranges between 0 if both countries have an identical industrial structure and takes a maximum value of 2 if they have no industries in common. Hence, the more unequal the country sectoral share, the greater will be the relative specialization index. An intuitive way to interpret this index is to think of a distance, the higher the values in the histogram, the more a region's industrial structure differs from the average structure. It quantifies the degree of bilateral sectoral disparity of industrial structure. The index will take a value of zero, indicating that country A is not specialize and takes a maximum value of 2 if it has no sectors in common with the rest of the countries.

The Krugman Index is calculate as follows, say for printing industry, KSI_{kl}

$$KSI_{kl} = \sum_{i} \left| \; S_{ik}^{s} - S_{il}^{s} \; \right|$$

Where;

i = Industry (sector, branch)

S = Shares

The Krugman Index above sums up the absolute difference of the industrial structures of two countries, k and l. S_{ik}^{s} the share of sector i in country k, S_{il}^{s} is the share of sector I in Asia less country k. The construction of the index is such that a value close to zero indicates an industrial structure identical to the rest of the Asia interpreted as country *i* is not specialised and identical output composition among the countries while higher values up to 2 if it has no sectors in common with the rest of the Asia, reflecting strong sectoral specialisation and increasing dissimilarity in output structure (see Krieger-Boden et al., 2008). The indicator can only be seen as a relative specialisation compared with a benchmark, which here is the 13 Asian countries; no absolute degree of specialisation can be assessed with this measure.

Thus we calculate four sub industries derived from each industry (printing and publishing allied industries, manufactured of industrial chemicals, manufactured of plastic products and manufactured of transport equipment) and are expressed as within the range 0 to the maximum value of 2. However it should be noted that the Krugman index has a tendency to under-represent the degree of specialization of large countries. In order to identify the sectoral specialization of regions and its trends, the data have been arranged in a way to show the shares of each industry in average for all the countries. The benchmark country here is the average of

Asian countries in the group for the sample year of 1971-2001. An intuitive way to interpret this index is to think of a distance, the higher the values in the histogram, the more a region's industrial structure differs from the average structure.

Looking at Figure 4.5, it reveals that cross-country differences in sectoral specialisation have been rather obvious, besides the generally low specialisation index among the countries. The Krugman index reveals some cross-country heterogeneity in the degree of sectoral specialisation, with high income countries – on average showing a common scenario of being generally more specialised with respect to Asian's average whilst medium and low income countries being relatively less specialise. However, India interestingly become one of the relatively most specialised countries in the medium-high technology industries, together with the high income countries in the study. Kuwait on the other hand, a well known among the richest oil producer countries in the world, is found to be one of the least specialised countries, together with Cyprus. This is probably in this case, due to the fact that filthy rich countries like Kuwait have a more diversified productive structure, reflecting, at least in part, the fact that scale economies may be exhausted for a larger number of industries. On the whole, the low and medium income countries are 'catching-up' in term of its specialisation in the medium and high technology industry, conforming the three sector hypothesis that indicates poor countries will eventually move from the resource based sectors to manufacturing sectors, and in the end up in the service sectors. By and large, the cross-country heterogeneity of the Krugman index remains throughout the three decades of the analysis. Perhaps, one reason for these stronger cross-country differences is due to that Krugman index in manufacturing could be the higher tradability of manufacturing products.

Generally speaking, the degree of sectoral disparity of its industrial structure is rather low, reflecting weak specialization in the medium/high technology industry. The index approaching zeros indicating a more homogenous industrial structure with the rest of the country, such as Kuwait, Jordan, Turkey and Cyprus. These countries are losing its hold in specified industries, becoming less competitive to the middle income countries which shows increasing index from each period. In other words, middle income countries is getting more and more concentrated /specialised in medium/high technology industries and their performance in general has outweigh some of the leaders countries.

4.7 Conclusion

The results indicate that Asia has a constant increase in its competitiveness in terms of productivity, yet no aggregate convergence is achieved. Despite those rich countries is proven to dominate the core groups of convergence clubs in medium and high technology industries, the productivity is likely driven by the high income countries, indicating high value added per worker, an opposite relationship with labour efficiency labour input. As in term of labour efficiency input, a more diverse result is found. In all sectors, no indication of similarity in constant increase in its labour efficiency input. To add, low income countries shows significant increase from each period, and shows higher labour efficiency input as compare to the richer countries. This indicates that the workers are still paid low wages, very much correlated with the population density in these countries as Indonesia and India. Wages are closely linked to labour productivity. Rise in productivity acts as the deciding factor for the expansion of capacity and the adoption of improved technology. The implementation of advanced technology necessitates recruitment of skilled workers and impart of training to the existing workers. Also, experienced and skilled workers are available at relatively higher wages in competitive labour markets. Developed and developing countries mostly had high labour productivity which resulted in high wages while the poor countries especially with the restricted labour law in India and civil freedom in China would designed a unique structure of wages and productivity. For example, Japanese workers increase their work effort over time and consequently earned higher wages yet as for countries with restricted labour law such as India normally generates low efficiency, mainly due to the fact that worker resistance for higher effort due to the surplus of labour, given the factor prices, managers chose to employ more workers per machine. Low wages reduced managerial incentives to make productivity that can enhance the organizational changes. As for China for example with the civil/political freedom labour rationalization was widely implemented which forbidden the dismiss the resultant redundant workers but to absorb them whose earnings suffer as the result. Wages were determined by the state, workers could not bargain with management bonuses and other benefits. Such limitation is not addressed in this study which it is assumed that markets are with complete information. Future study should be undertaken to cater this problems.

The club convergence suggest that poor countries is more competitive in terms efficiency unit labour cost though as not as productive as the high income countries. Poor countries enjoy high value added with lower wages that leads to high competitiveness in efficiency. Contradict, in terms of labour productivity, high income countries enjoy the comparative advantage as compared to lower class incomes. The high labour productivity in high income countries in the study may indicates priorities taken for specific educational and training policies. Indirectly it indicates the high standard of living of the countries as the intensity of labour utilization is low, more effort can be geared to create more opportunities for economic activity through market liberalization of good and services. In contrast, when labour intensity is already high, as in this study, productivity will be the sole key to improving living standards. In any case, increasing labour force participation is at best a transitional source of growth depending on the rate of population growth and the age structure. In the long run, only the productivity of labour determines the rise in per capita income.

Productivity is essentially a concept for analysis as well as policy orientation in the long term. In the short term, labour productivity measures can be volatile, in particular at a disaggregated level as they are strongly affected by the business cycle and shifts in product composition due to changing competitive pressures. Policies to enhance productivity, including investment in productive resources and the creation and diffusion of knowledge, will therefore only show results in the long run. In term of efficiency of labour, poor countries will earn small value added and perhaps the wages is relatively higher in less specialized sectors that will make it less competitive. Thus, to be able to compete in the market, the poor countries will tend to focus on medium and high technology industries which will increase their labour efficiency by gaining higher value added with the high wages yet offset with abundant resource of employment. For example China, the increase in value added for particular sector, will lead the firms to build and open factory internationally, thus reallocating the multinational companies. In general, Chinese wage level is higher in this scenario as industry becoming more specialized and globalize. Therefore, there's a need to specialize in the high value added sectors, generally contributed by the medium and high income sectors that will lead to general increase in wages.

There are also striking differences within sectors with regards to technological sophistication or wage levels. The effect of an increase in efficiency unit labour cost is much smaller in high technology industries, which presumably depend more on skilled labour. These results are very intuitive. Stylized fact is production is increasingly sensitive to unit labour

costs. It suggests that wages have to move in line with changes in productivity in order to keep productivity-adjusted labour costs at competitive levels. This implies that increasing wages can accompany sustained increases in productivity without affecting unit labour costs. Therefore, achieving high and sustained levels of productivity is a competitiveness strategy that does not imply a trade-off between maintaining labour costs and improving the welfare of workers.

Convergence is more likely to exist in the future in Asian industries if more attention is paid in ensuring the wages of the semi and skilled workers up to par of world standard. Rather than having a labour migration, the government should have aggressive effort in keeping the labour to stay in the countries by ensuring their welfare is taken care of. The government is right in making convergence to higher income levels in Asia a priority, as this reflects the legitimate aspiration of the citizenry. But it has to be careful not to mandate increases in wages that are inconsistent with increases in productivity. This will only lead to a loss in competitiveness, higher inflation, and slower growth. Higher wages will naturally come through productivity increases, but the direction of causality should be from productivity to wages for growth to be sustainable. Wages are linked to worker productivity because companies otherwise would not survive. In fact, looking across sectors of the economy, those with higher productivity will generally have higher wages.

Table 4.1 Manufacturing Value Added (MVA)[a] Share, 2000-2005 (%)

Country group and region	2000	2005
Industrialized countries	74.3	69.4
Countries with economies in transition	1.4	1.7
Developing countries	24.3	29.0
Sub Saharan Africa (excluding South Africa)	0.3	0.3
South Asia (excluding India)	0.3	0.4
Middle East and North Africa (excluding Turkey)	1.9	2.2
Latin America and Carribean (excluding Mexico)	4.7	4.7
East Asia and Pacific (excluding China)	6.7	7.7
Least developed countries	0.3	0.3
World	100.0	100.0

Source: UNIDO database (2009)

[a] MVA is a constant 2000 dollar

Table 4.2 List of Selected Asian countries

Regions and Income Classification	
Southeast Asia	
Malaysia	Upper middle Income
Indonesia	Lower middle Income
Singapore	Higher Income
South Asia	
India	Lower middle Income
West Asia	
Iran,Turkey	Upper middle Income
Israel,Cyprus,Kuwait	Higher Income
Jordan	Lower middle Income
East Asia	
HK,Japan	Higher Income
South Korea	Higher Income

Source: Worldbank 2010

Table 4.3 Productivity Competitiveness Convergence in Aggregate

INTRA MANUFACTURING INDUSTRY		
Full Convergence of Sectoral(1971-2001)*	**b hat**	Remarks
342-Printing and publishing allied industries	-11.5457	Divergence
351-Manufactured of industrial chemicals	-6.30223	Divergence
356-Manufacture of plastic products not elsewhere classified	-11.9628	Divergence
384-Manufacture of transport equipment	-7.76854	Divergence

*1/3 of the data covering 1981-2001

Table 4.4 Labour Input Efficiency Competitiveness Convergence in Aggregate

INTRA MANUFACTURING INDUSTRY		
Full Convergence of Sectoral(1971-2001)*	**b hat**	Remarks
342-Printing and publishing allied indsutries	-41.3117	Divergence
351-Manufactured of industrial chemicals	-5.29068	Divergence
356-Manufacture of plastic products not elsewhere classified	-3.65463	Divergence
384-Manufacture of transport equipment	-8.07551	Divergence

*1/3 of the data covering 1981-2001

Table 4.5 Labour Input Competitiveness Convergence of Asian-Sub Industry

Printing and Publishing allied Industries (342)

Last T ord	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Turkey	**Base**											Divergence
2	Japan	-11.54402	**Base**									1	Convergence
3	Korea		2.38954									1	Convergence
4	Jordan		0.348964	**Base**									Divergence
5	Iran			-1.514186	**Base**								Divergence
6	India				-6.51123	**Base**							Divergence
7	Malaysia					-3.911546	**Base**						Divergence
8	Indonesia						-4.489427	**Base**					Divergence
9	Singapore							-27.3778	**Base**			2	Convergence
10	Cyprus								0.082192			2	Convergence
11	Kuwait								-5.726347	**Base**			Divergence
12	Israel									-4.87276	**Base**	3	Convergence
13	Hong Kong										-0.290794	3	Convergence

Manufactured of Industrial Chemicals (351)

Last T ord	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Iran	**Base**						1	Convergence
2	Malaysia	3.646585						1	Convergence
3	Indonesia	4.339617						1	Convergence
4	Korea	4.766733						1	Convergence
5	India	4.479883	**Base**					2	Convergence
6	Japan		1.304326					2	Convergence
7	Turkey		1.460933					2	Convergence
8	Jordan		1.23092	**Base**					Divergence
9	Singapore			-5.340033	**Base**				Divergence
10	Hong Kong				-2.910914	**Base**		3	Convergence
11	Cyprus					3.1107		3	Convergence
12	Israel					4.563999		3	Convergence
13	Kuwait					0.131457		3	Convergence

Manufacture of plastic products (356)

Last T ord	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Turket	**Base**						1	Convergence
2	India	1.468836						1	Convergence
3	Japan	0.625868	**Base**					2	Convergence
4	Korea		1.686055					2	Convergence
5	Jordan		1.645619	**Base**				3	Convergence
6	Kuwait			-0.245363				3	Convergence
7	Malaysia			-0.673271	**Base**				Divergence
8	Indonesia				-6.959031	**Base**		4	Convergence
9	Iran					8.242722		4	Convergence
10	Cyprus					6.545875	**Base**	5	Convergence
11	Singapore						-0.418247	5	Convergence
12	Israel						2.53477	5	Convergence
13	Hong Kong						3.680715	5	Convergence

Manufactured of transport equipment (384)

Last T ord	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Indonesia	**Base**						1	Convergence
2	Iran	2.434933						1	Convergence
3	Malaysia	-0.738994	**Base**					2	Convergence
4	Korea		-0.94837					2	Convergence
5	Jordan		0.76572					2	Convergence
6	India		1.778475					2	Convergence
7	Turkey		1.607199	**Base**					Divergence
8	Japan			-3.19708	**Base**				Divergence
9	Singapore				-7.326777	**Base**		3	Convergence
10	Cyprus					2.885975		3	Convergence
11	Hong Kong					1.430573	**Base**	4	Convergence
12	Kuwait						-0.597054	4	Convergence
13	Israel						-2.33225		Divergence

Table 4.6 Productivity Competitiveness Convergence of Asian Sub Industry

Printing and Publishing allied Industries (342)

Last T ord	Country	Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Turkey	Base				1	Convergence
2	Japan	-0.034706				1	Convergence
3	Korea	4.593861				1	Convergence
4	Hong Kong	4.106223	**Base**			2	Convergence
5	Israel		**5.370882**			2	Convergence
6	Singapore		**6.379001**			2	Convergence
7	Iran		**-1.712261**	**Base**		3	Convergence
8	Cyprus			-0.605268		3	Convergence
9	Kuwait			-2.53722	**Base**	4	Convergence
10	Malaysia				-0.490978	4	Convergence
11	Jordan				0.792187	4	Convergence
12	India				7.9536	4	Convergence
13	Indonesia				18.859	4	Convergence

Manufactured of Industrial Chemicals (351)

Last T ord	Country	Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Japan	Base				1	Convergence
2	Iran	1.637781				1	Convergence
3	Hong Kong	1.924324				1	Convergence
4	Korea	2.04132				1	Convergence
5	Singapore	1.938469	**Base**				Divergence
6	Israel		**-1.7789**	Base		2	Convergence
7	Malaysia			**-1.39438**		2	Convergence
8	Turkey			1.44904		2	Convergence
9	Cyprus			4.592914		2	Convergence
10	Kuwait			5.38769		2	Convergence
11	India			2.780768	Base	3	Convergence
12	Indonesia				2.88073	3	Convergence
13	Jordan				3.321672	3	Convergence

Manufacture of plastic products (356)

Last T ord	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Japan	Base						1	Convergence
2	Korea	10.9272						1	Convergence
3	Israel	10.18239	**Base**					2	Convergence
4	Singapore		**9.478488**					2	Convergence
5	Iran		2.05236	Base					Divergence
6	Turkey			-3.501509	Base			3	Convergence
7	Hong Kong				14.74701			3	Convergence
8	Kuwait				7.688477	Base		4	Convergence
9	Cyprus					2.721371		4	Convergence
10	Malaysia					15.30702		4	Convergence
11	Jordan					-1.703048	Base	5	Convergence
12	India						24.6082	5	Convergence
13	Indonesia						0.920773	5	Convergence

Manufactured of transport equipment (384)

Last T ord	Country	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Club	Remarks
1	Japan	Base						1	Convergence
2	Iran	0.688975						1	Convergence
3	Korea	1.161589						1	Convergence
4	Israel	0.900987	**Base**					2	Convergence
5	HK		**9.546175**					2	Convergence
6	Singapore		**4.6272**	Base				3	Convergence
7	Turkey			**3.27688**				3	Convergence
8	Malaysia			2.567001	Base			4	Convergence
9	Cyprus				**5.188529**			4	Convergence
10	Indonesia				3.485653	Base		5	Convergence
11	Kuwait					0.314996		5	Convergence
12	Jordan					-1.030147	Base	6	Convergence
13	India						2.863691	6	Convergence

Table 4.7 Overall Result of Competitiveness and Specialisation Index

Country	Indicator	SSIC 342		SSIC 351		SSIC 342		SSIC 384	
		1981-1990	1991-2000	1981-1990	1991-2000	1981-1990	1991-2000	1981-1990	1991-2000
Hong Kong	1. Lab productivity	4017.64	18937.77	6108.00	80985.71	2784.13	14737.92	3973.43	20055.25
	2. Efficiency per labor unit	2.28	1.90	3.46	2.59	2.01	2.02	1.73	1.70
	3. Krugman index				0.179683117				
Korea	1. Lab productivity	4981.10	27258.68	11632.91	70893.75	4081.42	27014.60	5882.57	36194.91
	2. Efficiency per labor unit	3.13	3.74	6.48	7.06	3.52	4.18	3.34	3.95
	3. Krugman index				0.181200602				
Japan	1. Lab productivity	16110.58	59683.42	39124.96	133302.63	13518.44	45796.16	18835.27	66885.05
	2. Efficiency per labor unit	2.70	3.69	5.10	5.52	3.02	3.80	3.04	3.15
	3. Krugman index				0.232230716				
India	1. Lab productivity	592.20	2103.36	1824.79	7578.55	776.13	2018.83	818.75	2313.11
	2. Efficiency per labor unit	1.46	1.41	3.21	6.22	3.05	4.13	1.84	2.66
	3. Krugman index				0.196451707				
Malaysia	1. Lab productivity	2561.68	15874.40	21368.59	54378.27	1634.53	6115.46	3354.17	11631.26
	2. Efficiency per labor unit	2.71	3.17	11.10	11.82	3.12	3.28	3.61	4.37
	3. Krugman index				0.16371468				
Indonesia	1. Lab productivity	843.94	4422.36	3360.27	10475.97	567.69	2000.74	1938.08	11430.87
	2. Efficiency per labor unit	2.73	8.63	6.12	9.76	3.48	4.58	5.64	15.09
	3. Krugman index				0.160708251				
Singapore	1. Lab productivity	5648.66	26748.48	24068.70	60102.02	3923.82	15339.34	7046.23	21089.62
	2. Efficiency per labor unit	2.53	2.51	6.04	3.75	2.64	2.13	2.86	2.19
	3. Krugman index				0.183779097				
Iran	1. Lab productivity	3558.51	9613.18	4040.16	42903.35	3568.34	7945.37	3499.86	19109.33
	2. Efficiency per labor unit	2.30	2.91	2.09	8.43	1.47	2.40	1.90	4.91
	3. Krugman index				0.155082651				
Turkey	1. Lab productivity	4396.92	33460.33	8062.24	31177.40	3371.34	15529.51	3967.76	21033.77
	2. Efficiency per labor unit	4.11	8.88	6.47	4.91	4.45	5.36	3.61	4.12
	3. Krugman index				0.135356488				
Israel	1. Lab productivity	6652.47	18219.02	14886.00	39363.24	9882.63	20831.22	8132.35	25442.51
	2. Efficiency per labor unit	1.99	1.69	2.76	2.00	3.65	2.15	1.47	1.27
	3. Krugman index				0.213302007				
Cyprus	1. Lab productivity	3792.45	14164.17	4004.16	18242.76	4009.13	13414.36	3730.34	12206.91
	2. Efficiency per labor unit	1.92	1.98	1.95	2.50	2.44	2.13	2.05	2.05
	3. Krugman index				0.091720514				
Kuwait	1. Lab productivity	3533.74	4607.19	11119.66	33578.88	5762.05	14539.58	2966.41	8986.84
	2. Efficiency per labor unit	1.52	1.09	1.86	1.88	3.13	4.32	1.56	1.82
	3. Krugman index				0.099036395				
Jordan	1. Lab productivity	2408.64	5520.75	7560.63	14273.10	2852.14	4396.02	2260.75	5271.74
	2. Efficiency per labor unit	1.94	2.86	3.89	4.69	3.48	3.46	2.50	3.70
	3. Krugman index				0.114235555				

Figure 4.1 Labor Productivity in Manufacturing-Selected Asian countries (1980-2001)

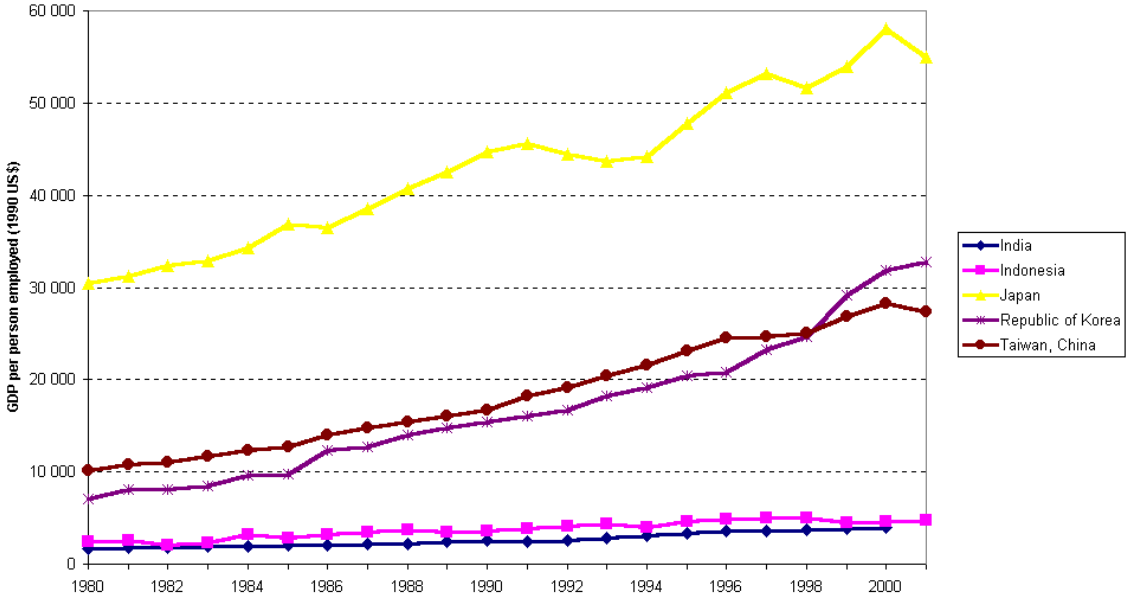
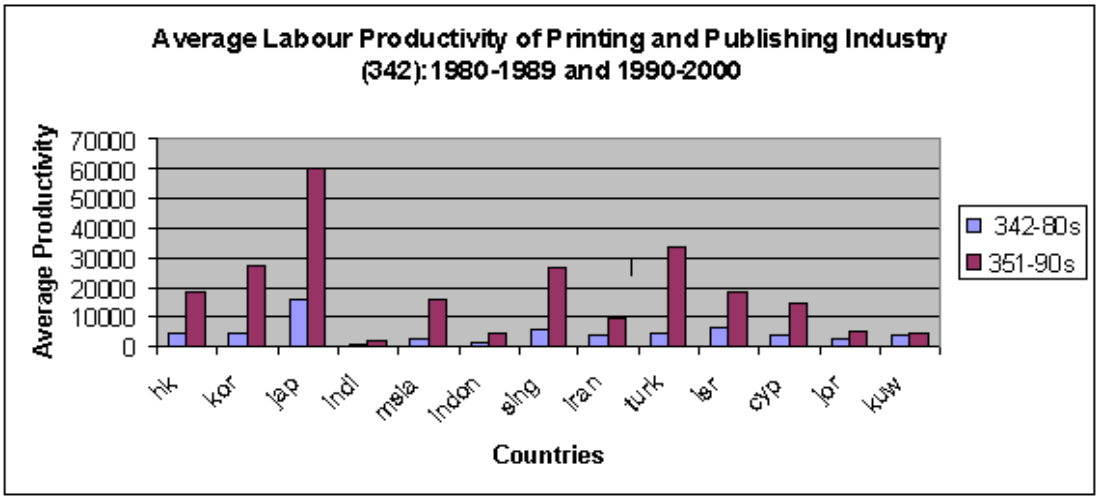
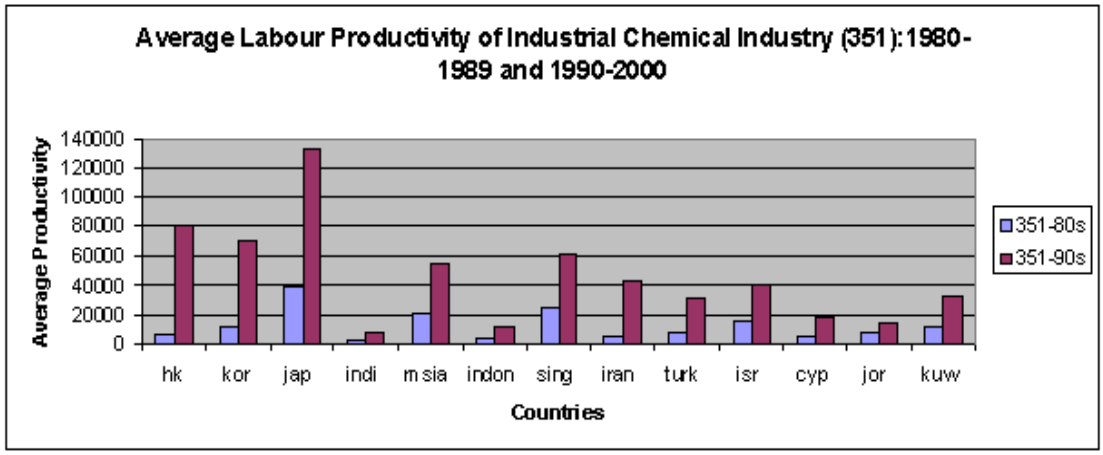
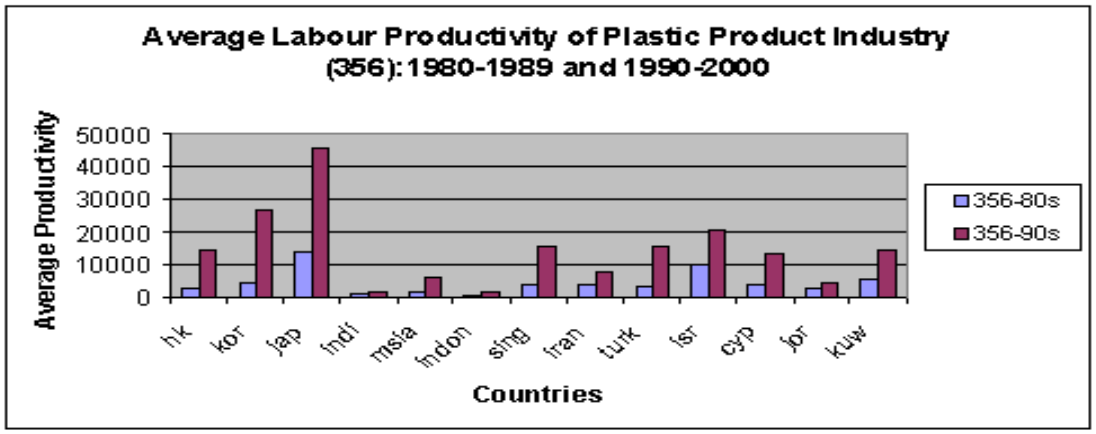
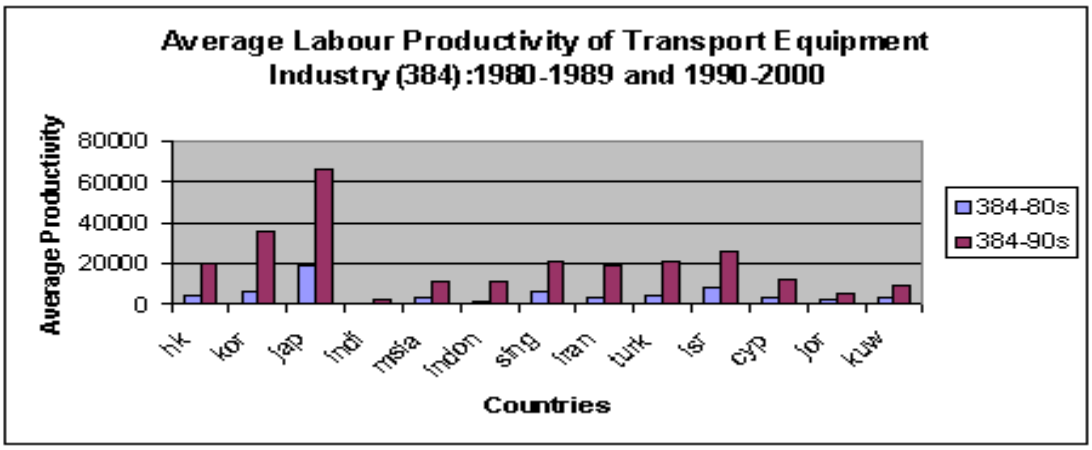


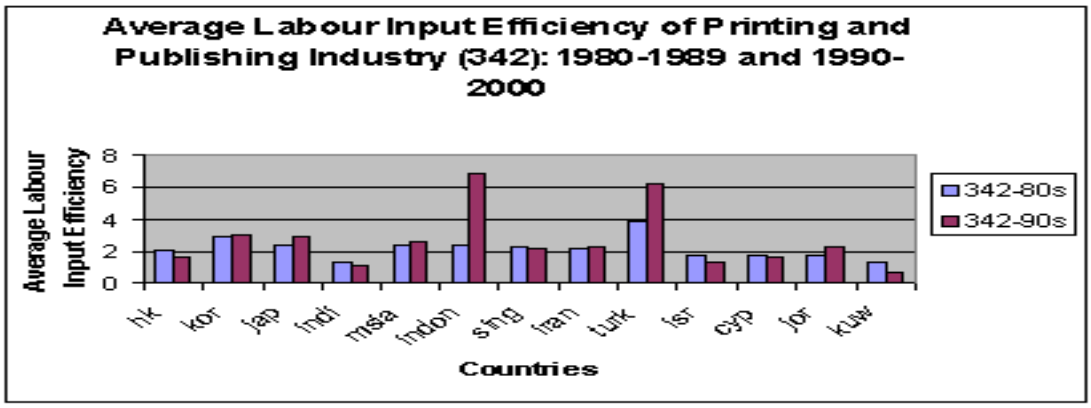
Figure 4.2 Average Competitiveness (Productivity & Efficiency Labour Input) of selected Asian countries

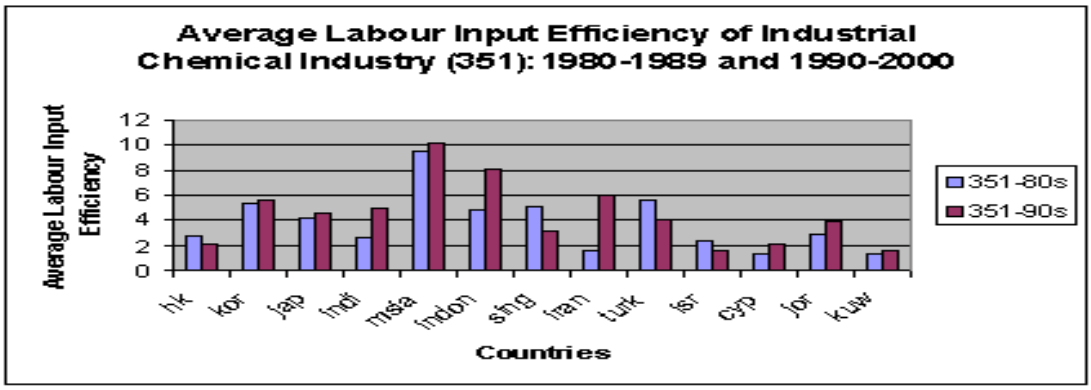


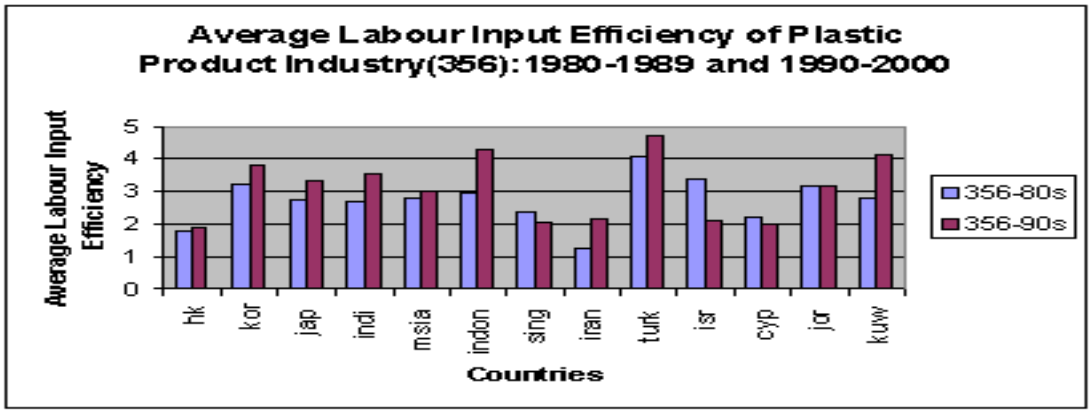

Average Labour Productivity of Industrial Chemical Industry (351):1980-1989 and 1990-2000
Average Productivity
140000
120000
100000
80000
60000
40000
20000
0
hk
kor
jap
indi
msia
indon
sing
iran
turk
isr
cyp
jor
kuw
Countries
351-80s
351-90s


Average Labour Productivity of Plastic Product Industry (356):1980-1989 and 1990-2000
Average Productivity
50000
40000
30000
20000
10000
0
hk
kor
jap
indi
msia
indon
sing
iran
turk
isr
cyp
jor
kuw
Countries
356-80s
356-90s


Average Labour Productivity of Transport Equipment Industry (384):1980-1989 and 1990-2000
Average Productivity
80000
60000
40000
20000
0
hk
kor
jap
indi
msia
indon
sing
iran
turk
isr
cyp
jor
kuw
Countries
384-80s
384-90s


Average Labour Input Efficiency of Printing and Publishing Industry (342): 1980-1989 and 1990-2000
Average Labour Input Efficiency
0
2
4
6
8
hk
kor
jap
indi
msia
indon
sing
iran
turk
isr
cyp
jor
kuw
Countries
342-80s
342-90s


Average Labour Input Efficiency of Industrial Chemical Industry (351): 1980-1989 and 1990-2000
Average Labour Input Efficiency
0
2
4
6
8
10
12
hk
kor
jap
indi
msia
indon
sing
iran
turk
isr
cyp
jor
kuw
Countries
351-80s
351-90s


Average Labour Input Efficiency of Plastic Product Industry(356): 1980-1989 and 1990-2000
Average Labour Input Efficiency
0
1
2
3
4
5
hk
kor
jap
indi
msia
indon
sing
iran
turk
isr
cyp
jor
kuw
Countries
356-80s
356-90s

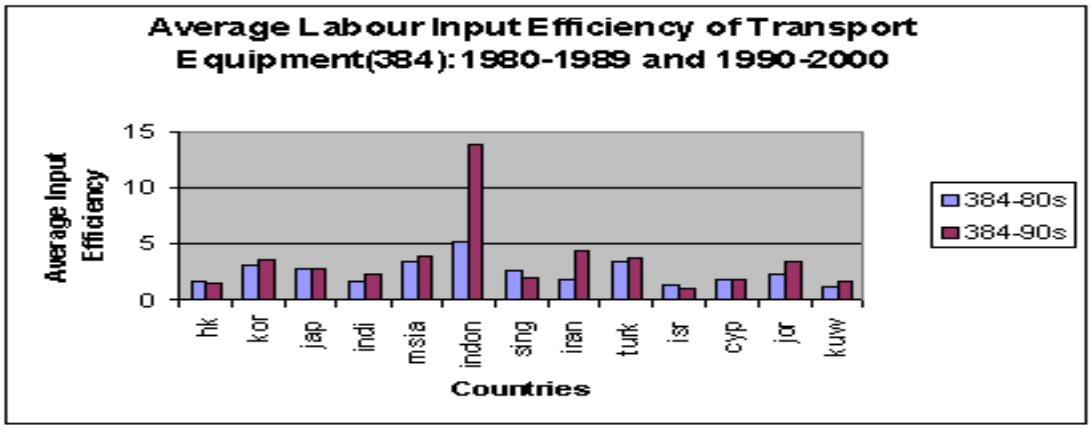
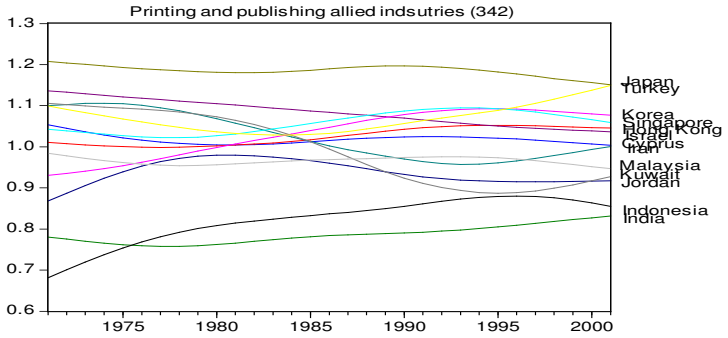
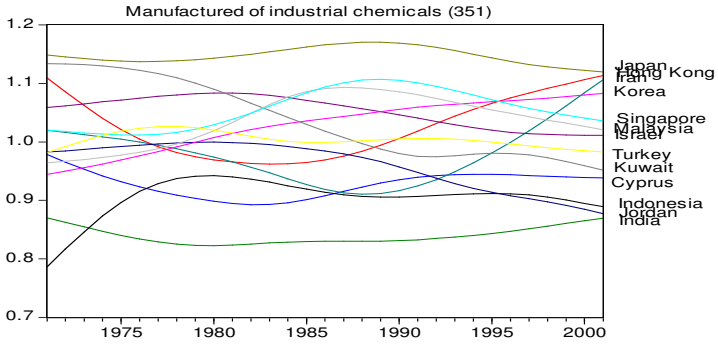
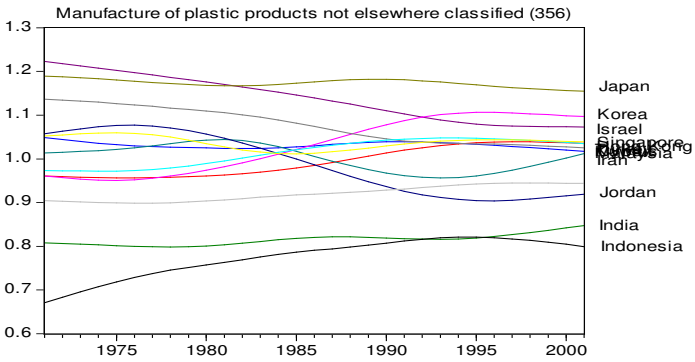

Average Labour Input Efficiency of Transport Equipment(384): 1980-1989 and 1990-2000
Average Input Efficiency
0
5
10
15
hk
kor
jap
indi
msia
indon
sing
iran
turk
isr
cyp
jor
kuw
Countries
384-80s
384-90s

Figure 4.3 Transition Path of Productivity Competitiveness







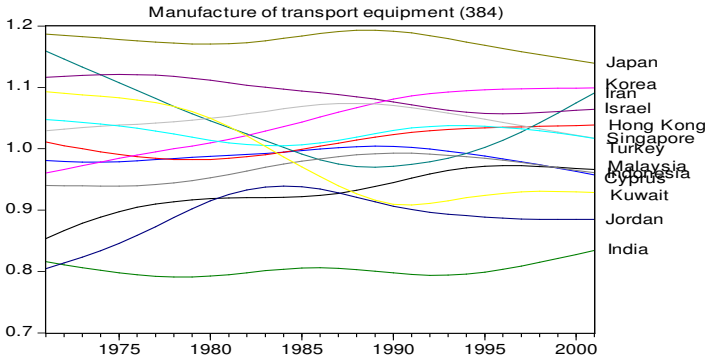
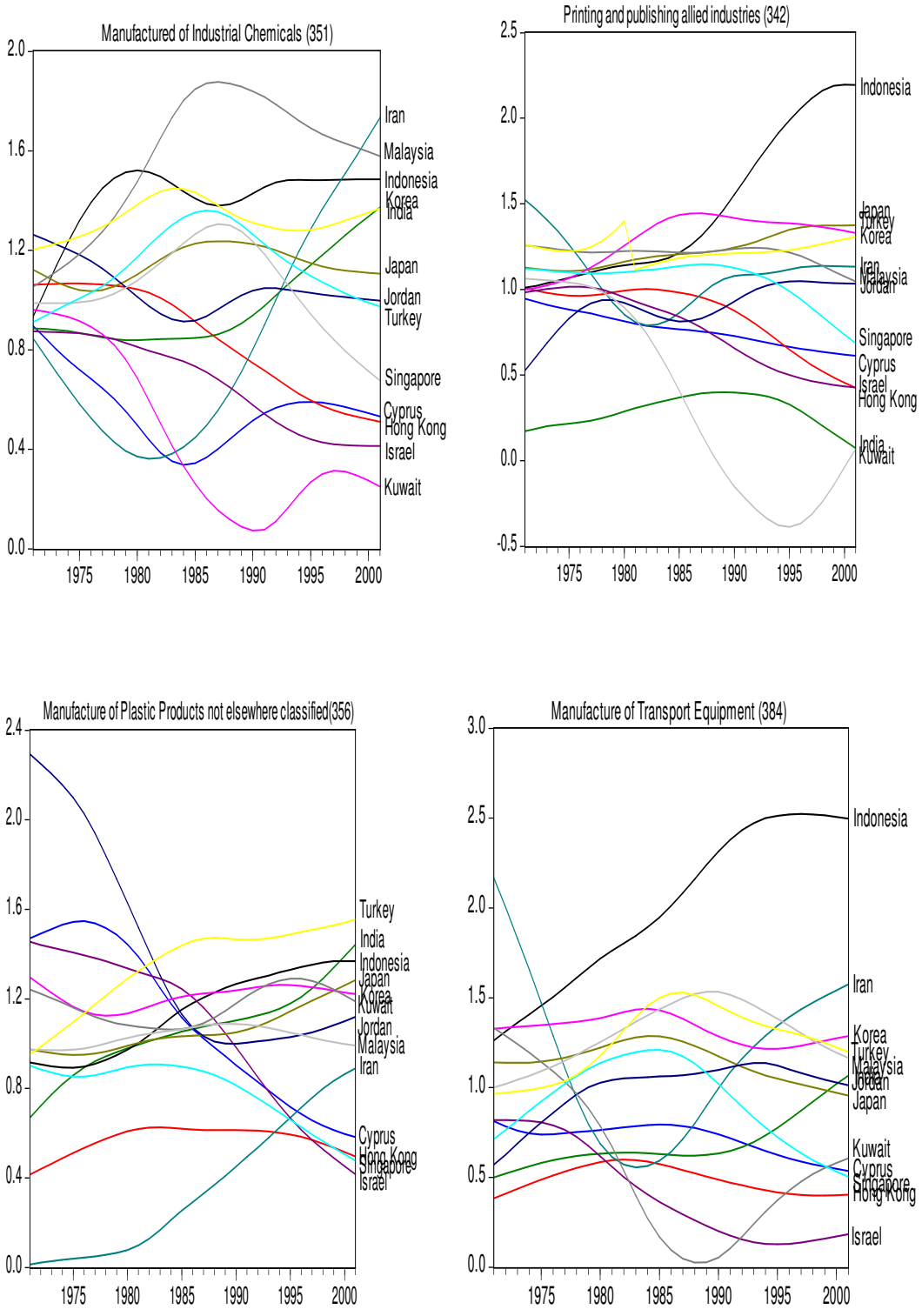


Figure 4.4 Transition Path of Labour Input Competitiveness



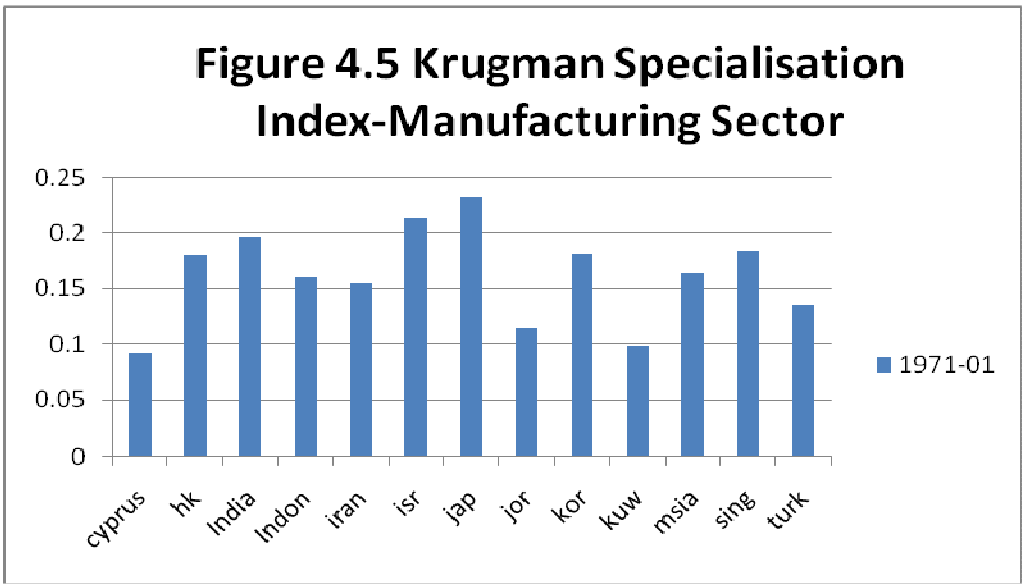


Figure 4.5 Krugman Specialisation Index-Manufacturing Sector
0.25
0.2
0.15
0.1
0.05
0
cyprus
hk
India
Indon
iran
isr
jap
jor
kor
kuw
msia
sing
turk
1971-01

CHAPTER 5

5.0 Conclusion

"If we want to understand why countries differ dramatically in standards of living, then we have to understand why countries experience such sharp divergences in long term growth rates. Even small differences in these growth rates, when cumulated over a generation or more, have much greater consequences for standards of living than the kinds of short-term business fluctuations that have typically occupied most of the attention of macroeconomists."
Barro, R. J. – Sala-i-Martin, X. (1995)

Different levels of economic growth account not only for the existence of income disparities; they also determine the dynamics of the process of development – whether differences across countries increase (known as divergence) or fall (convergence) over time. It has become common in the literature to test convergence as a means of validating or refuting this economic theory. However to date, there is no conclusive result that has established the most appropriate test of convergence theory. The convergence issues do not evolve only with the appropriate methodology being used yet also in terms of theoretical and indepth study of economic structures of one's country that enable economic integration. Such evaluation would raise many caveats that require detail and in depth investigation of economic structure not just in terms of income distribution and inequality. Asia, a perfect example of transitional economics, consists of heterogeneous groups with wide disparities in terms of its economic structures. Despite the active integration involved in planning for the ASEAN Economic Community (AEC), still there is wide variation between the countries in terms of economic structures and socioeconomic development. The success of the AEC plan for economic and political integration depends crucially upon the degree of economic convergence of the potential members.

Chapter 2 has highlighted some problems with using a time series framework in testing for convergence and identified some crucial factors that need to be seriously taken into account in developing a test for convergence. It explains the inconsistencies in results between previous studies that have used time series tests of convergence. Here, the study argues that the standard

time series framework of unit root test and cointegration in testing convergence is inappropriate. The standard time series framework is based on a linear specification, and convergence is achieved when the differential income between countries is stationary. This observation has raised serious concern in the convergence studies. With this perspective in mind, therefore, the primary objective of this study is to thoroughly examine whether there has been a robust and systematic tendency for income levels to converge in ASEAN5+3 economies over the 1960-2007 period. This sample is chosen based on the fact that Asean5+3 are fundamentally a heterogeneous group of countries ranging from low income countries such as Laos to high income countries such as Japan. This group offers a higher possibility of stronger economic integration mainly due to the fact that East Asian economies are mainly democratic economies (perhaps with the exceptions of North Korea, Myanmar and China), located within the Asia-Pacific region, and have a huge joint market that could bring possibilities of working together for economic prosperity and well-being. Their high degree of business cycle correlation and the huge amount of trade could be a signal for possible economic and monetary co-operation (Coleman, 1999). Methodologically, the study attempts to show the discrepancies in the time series framework by applying the standard univariate unit root test (Bernard and Durlauf 1996) that were later challenged by Kapetanios, Shin and Snell 2003. They claimed that the ADF unit root test model is misspecified as it is based on the linearity assumption. Nahar and Inder (2002) argued that the output gap between countries will approach zero as time progresses and this should be taken as an indication of convergence. To cater for the transitional economies of Asean5+3, the convergence methodology of non linear time varying factor proposed by Philip and Sul (2007a) is used, which enables the detection of heterogeneity problems or transitional divergence. The study therefore accommodates different angles of possible convergence methods to exemplify the appropriate methods in testing convergence.

The estimation results emphasize a few important findings. Firstly, in a time series framework, the ADF unit root test shows low power, and the panel unit root techniques would improve these problems. Secondly, the convergence testing based on the linear specification would be misleading if economic growth is nonlinear in nature. These include the unit root test and cointegration techniques in finding convergence. Thirdly, stationarity is not a necessary condition for convergence. In other words, the differential in output between countries can be nonstationary for convergence to exist. Fourthly, and most importantly, these findings are tested on the transitional dynamic economies of Asean5+3 and the results are rather interesting. By applying the non linear time varying factor model that caters for all the problems above,

(i.e. univariate unit root ADF, nonlinearity and stationarity), the study found pairwise convergence towards Japan. Only the Philippines tend to diverge from the rest. This is an indication that the economies of Asean5+3 are experiencing a similar drive to converge with Japan, a positive sign for strong economic integration.

The implication of the study is that the linearity issues do matters in the study of convergence. Testing of convergence using a time series framework may not be appropriate to detect convergence in transitional dynamic economies such as Asian nations. The results of the finding shall be misleading if we ignore the plausible nonlinearities of behaviour in the study of income convergence. A more important implication is that the finding of convergence improves the probability of deepening economic cooperation and integration in Asia. In strengthening the economic integration within the region, more extensive commitment, political will, ideas and insights of income distribution and economic structure should be focused on. In other words, with regard to the findings of this chapter, Asian leaders should be more proactive in enhancing the speed of convergence. It would be interesting in further research to examine the structure of economies of participating countries in understanding the convergence issues in detail.

Chapter 3 examines structural convergence in selected Asian countries. As Asia is targeting to create an optimum currency area, defined as ASEAN Economic Community (AEC), a set of the most promising potential countries (JACIK) is suggested by the literature to be the first members of the bloc. Due to unavailability of the data, this study studies a combination of countries known as JAKITH (Japan, ASEAN, Korea, India, Taiwan and Hong Kong) from period 1970-2005. The JAKITH economies are the core of the East Asian Community, but it is hoped to be able to expand later to include other Asian countries in the bloc. The study seeks to determine whether JAKITH tend to converge at per capita level. Also, the study aims to shed light on the question of whether Asian countries have become more similar in their industry structure, and if so in which industries this development has occurred. Two countries are said to structurally converge if convergence in their per capita income is accompanied by convergence in their sectoral structure (Wacziarg, 2004). Given this development, the study of structural convergence in JAKITH is performed on five major sectors, namely Manufacturing, Construction, Agriculture, Mining and Services. The inter sectoral convergence is tested by computing labour productivity, employment and value added in order to have robustness in performing the sectoral convergence analysis. Convergences where possible, are not towards a single equilibrium but towards different equilibria, creating

thus a pattern of club convergence. The non linear time varying factor coefficients factor model is applied in the study, mainly due to its flexibility to model a large number of transition paths and because it allows for convergence clubs as well. The analysis is undertaken in two steps. Firstly, the study examines the aggregate level convergence on Asian income per capita by using the log t test. The divergence is found in aggregate income per capita and the study proceeds in classifying the countries into clubs. Japan serves as the base country as it has the highest per capita income in the sample. Next, the analysis at the disaggregated sector level is performed using three different measures of sectoral convergence namely productivity, labor and value added.

Main finding indicates that a strong and uniform convergence in JAKITH sectoral industries has not emerged. Yet this outcome leads to significant and rapid intersectoral convergence, indicated by multiple equilibra that clustered the countries into a few clubs according to sectors. Convergence in the aggregate is most found in the labour shares in the sectors (manufacturing, construction and mining). This supports the previous study in suggesting that the labour share is a better measure to evaluate convergence. Wacziarg (2004) states that labour shares are commonly used in the literature and are the most comprehensive and robust measures of sector shares. There is clear evidence for a catching up cluster and strong convergence clubs. With the existence of divergence in the aggregate that leads to clubs convergence in the sectoral analysis, the question of whether JAKITH is a suitable candidate for AEC bloc is open to debate.

Structural convergence between industrialized countries is a topic which has not been paid a great deal of attention in the literature. This study attempts to fill the gap by providing a comprehensive investigation on structural convergence of selected Asian countries, namely JAKITH. These countries are chosen as to achieve the objective in forming an economic union in Asian region, namely ASEAN Economic Community (AEC).The implications of the finding are that for a country or group of countries which do not follow the convergence pattern, more intense policies are required to facilitate closer integration with the rest of the member countries. Will the new members portray the most potential candidate for the formation of AEC? Besides, would it be possible for other countries to catch up with the core group or forming a group of its own? The formation of club convergence enable the analysis of transition behaviour between the clusters and factors that affect these transitions, among all, seems to be such provoking issues to be developed further. The Asian leaders should give

priority to strengthening its efforts in deepening integration in the most critical sectors as to the high value and skill intensive segment of production in order to increase its competitiveness in the region.

Chapter 4 provides an in-depth investigation of the convergence of Asian industrial sub-sectors in the perspective of competitiveness. Despite the fact that the notion of country's competitiveness has proven to be debatable, still there is no precise definition and exact interpretation of the competitiveness concept. Competitiveness is not just about growth or economic performance but should take into account the key factors, which contribute to the ability to compete, such as technology, knowledge, government efficiency, business efficiency, infrastructure etc. (Travkina et al. 2009).Studies have looked into national level and even at the micro level in examining competitiveness in firms and industries to determine what gives certain countries advantages in certain industries and what policies government can pursue or change to give their domestic industries a competitive edge. The competitiveness edge gain by domestic firms is the outcome of the thousands of struggles for against foreign rivals in particular segments and industries, in which products and processes are created and improved, that underpins the process of understanding the competitiveness of nations and its industry.

UNIDO (2009) demonstrates that the more a country progresses well in its economic development, the more it emphasizes and specializes in the medium/high technology manufacturing sector. Nonetheless, country specific factors, particularly economic specialization, significantly shape their growth dynamics. The analysis of structural convergence in the previous chapter indicates the divergence in aggregate that leads to large clusters of club convergence.

Upon these bases, Chapter 4 examines the dynamics and convergence of the competitiveness of medium and high tech industries in 13 Asian countries in terms of two indicators, labour productivity and labour input efficiency. Patterns of labour productivity and effective unit of labour input convergence are considered across medium/high technology manufacturing sectors at three digit level, namely in printing and publishing, manufacture of industrial chemicals, manufacture of plastic products and manufacture of transport equipment. The consistent high growth in manufacturing, lead the study to hypothesize that convergence is likely to exist in labor competitiveness throughout Asia's industry despite the heterogeneity among Asian countries. The analysis applies a test of non linear time varying factor model

developed by Phillips and Sul (2007a) on the 3 digit sub industries of UNIDO data, from 1971-2001 in the whole sample of 13 Asian countries. Next the clustering convergence technique is applied to determine the subgroups of regions characterized by level of competitiveness. It attempts to examine whether there exists a statistically significant movement towards structural homogeneity in competitiveness of the of three digit sub-sectors of manufacturing industries. If sub–sector convergence is found in the sample, it may indicate the fact that production/sector structure is more similar and homogenous in the region. If divergence is found, it is perhaps due to the country specific, for example product specialization on selected countries. To have a precise picture of specialization sector, Krugman Index is computed in hope of explaining the pattern of specialization that may lead to divergence.

The findings indicate that Asian countries have a constant increase in its competitiveness in terms of productivity, yet no aggregate convergence is achieved. The result shows that productivity is likely to be driven by the high income countries, as oppose to the, low income countries that shows higher labour input efficiency instead. This indicates that the workers are still paid low wages, very much correlated with the population density in countries such as Indonesia and India. The club convergence suggests that poor countries are more competitive in terms of labour input efficiency though the convergent rate is slower than the productivity rate lead by high income countries. Poor countries enjoy high value added with lower wages that leads to high competitiveness in efficiency. As in terms of labour productivity, high income countries enjoy the benefits of comparative advantage which indirectly indicates high standard of living. It is an indicator that the intensity of labour utilization is low, thus more effort can be geared to create more opportunities for economic activity through market liberalization of good and services.

Finally, the result of Krugman specialization index suggests that the degree of sectoral disparity of industrial structure is rather low indexed, reflecting weak specialization in the medium/high technology industry. Countries' indexes that are approaching zero indicate a more homogenous industrial structure with the rest of the countries, such as Kuwait, Jordan, Turkey and Cyprus. These countries are losing their hold in specified industries, becoming less competitive to the middle income countries which show an increasing index in each period. In other words, middle income countries are getting more and more concentrated /specialized in medium/high technology industries and their performance in general has outweighed some of the leader countries.

Convergence is more likely to exist in the future in Asian industries if more attention is paid to ensuring the wages of the semi and skilled workers are up to the par of world standard. To inhibit labour migration, the government should be more concerned about the welfare of the workers. However, governments need to be careful in its effort to increase the standard of living of the citizen, for example by not raising the wages. This will only lead to a loss in competitiveness, higher inflation, and slower growth. Higher wages will naturally come through productivity increases, but the direction of causality should be from productivity to wages for growth to be sustainable. Besides, wages contribute significantly to the workers' productivity that will ensure the survival and the performance of industries.

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