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Stationarity Analysis of Macroeconomic Variables in ASEAN-Pacific Region and their Implication for Trade and Industrial Development*

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Abstract

The countries in the ASEAN-Pacific region sharply show a strong upward trend in many aspects of their macroeconomic performance. However, exogenous international shocks can displace a developing country from its long-run stationary growth path. This paper attempts to investigate the existence of Endogenously Determined Structural Breaks of several aspects of economic development by using time series annual data during the period from 1960s to 2000s for countries in ASEAN-Pacific Region—Korea, Singapore, Thailand, Malaysia, Philippines and Indonesia. The paper will concentrate on three different models—Additive Outlier Model, Innovational Outlier I Model and Innovational Outlier II Model to scrutinize the existence of potential structural break points in the trend. The paper considers four main indicators of macroeconomic development—Real GDP, Trading Openness, Structure on Investment and Financial Growth,. The purpose of this paper is to demonstrate whether those potential structural break points did affect the long-run growth in the trend of time series in the ASEAN-Pacific Region. According to empirical estimation and regression, most of the results demonstrate three possible structural break points in this region: around 1979 (oil crisis), around mid-1980s (economic recession), and around 1997 (financial crisis). It shows through econometric methods that the long-run stationarity of macroeconomic development in most selected countries is not affected by these potential structural break points. Since this is mainly due to the successful adjustment of economic policies, especially for trading and financial sectors, the positive adjustments of policies in trading and financial sectors have been able to maintain long-run sustained growth of macroeconomic development in ASEAN-Pacific regions. This paper concludes that the symbiotic relationship between macro and micro economic variables has worked well in the region allowing for sustained growth in spite of exogenous shocks and structural breaks.

JEL Classification: Development Economics, Applied Econometrics

Key Words: stationary tests, structural breaks, economic growth, financial and trade development

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Stationarity Analysis of Macroeconomic Variables in ASEAN-Pacific Region and their Implication for Economic Development*

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1. Introduction

The newly industrialized countries in ASEAN-Pacific Region increasingly show a strong upward trend in many aspects of their macroeconomic performance, such as the growth of GDP, development of financial sectors, quality of investment and trade expansion. A favorable macroeconomic environment, in the era of globalization, is essential for economic development particularly in the fields of trade, industrial and financial sectors. However, exogenous international shocks can displace a developing country from its long-run stationary growth path, particularly in highly open and globally integrated economies such as in the Pacific Asia. It is important to analyse the consequences of such shocks and to investigate whether the underlying growth rates are stable in the face of such shocks. If long run stationarity in trends are maintained in spite of international shocks, then it augurs well for long term development. On the other hand, volatility in trends and structural breaks create problems for the long run.

Much of previous research has considered exogenously determined shocks and structural breaks, such as the financial crisis in Asia during 1997. But these a priori shocks need to be supported by the internal dynamics of the economies concerned. Structural breaks, particularly under rational expectations, can occur even prior to the 'crisis' or 'shock' and arbitrary dates have little meaning in understanding long term developments of the economy and how it responds to these changes in exogenous variables. This paper attempts to investigate the presence of Endogenously Determined Structural Breaks of several indicators of macroeconomic development by employing time series annual data during the period from 1960s to 2000s for selected countries in ASEAN-Pacific Region—Korea, Singapore, Thailand, Malaysia, Philippines and Indonesia. By considering the impact effect of shocks as data-based and endogenously determined we remove the element of arbitrariness associated with historically specified events. We then consider the issue of stationarity and stability in the face of such endogenously determined and calculated shocks.

The paper will concentrate on three different models—Additive Outlier Model, Innovational Outlier I Model and Innovational Outlier II Model to scrutinize the existence of potential structural break points in the trend. The paper consider four main indicators of macroeconomic development—Real GDP, Financial Depth, Openness and Investment. These four variables encompass economic growth per se, financial development, trade structures and capital formation. We analyse time series data for six countries selected in the analysis of empirical estimation: Singapore, Korea, Malaysia, Thailand, Philippines and Indonesia. These present a wide cross section of regional economies with many different characteristics but with the common feature of high growth, trade liberalisation and regional integration.

The purpose of this paper, therefore, is to prove whether those potential structural

break points did affect long-run growth, in terms of the trend of time series, in selected countries of ASEAN-Pacific Regions. According to our own empirical estimation regression, most of results demonstrate that there were three possible structural break points in this region: around 1979 (oil crisis), around mid-1980s (economic recession, following from international macroeconomic problems such as stagflation and the debt crisis), and around 1997 (financial crisis). It shows through econometric methods that the long-run stationarity of variables depicting macroeconomic development in most selected countries is not affected by these potential structural break points. Since this is mainly due to the successful adjustment of economic policies, especially for the trading, investment and financial sectors, the positive adjustments of policies in trading and financial sectors have been able to maintain long-run sustained growth and macroeconomic development in ASEAN-Pacific regions. This in turn has helped trade expansion and industrial development at the microeconomic level. This paper concludes that the symbiotic relationship between macro and micro economic variables has worked well in the region allowing for sustained growth in spite of exogenous shocks and structural breaks. Reduction in volatility in long run trends, and stability and stationarity of long run variables, has helped these economies to withstand shocks such as the oil price rise or the financial crisis. Effectively, we believe that there has been no hysterisis in Asian economies that we consider. This is true for all the six countries selected in the analysis of empirical estimation: Singapore, Korea, Malaysia, Thailand, Philippines and Indonesia.

The next section in this paper describes the economic development, performance and economic problems in the ASEAN-Pacific region. The third section performs the explanation about the econometric methodology in this paper. In terms of that methodology, the fourth section analyses the empirical results in these six selected countries.

2. Reviews about economic performance and problems in ASEAN-Pacific region

The economies in ASEAN-Pacific region recorded a rapid and sustained economic growth during the 1970s, and although some decline in the world economy was reflected in a decrease in growth rates in the mid-1980. The ASEAN-Pacific region was remained one of the fastest growing regions, and some countries, such as Singapore, Korea and Thailand has reached the standard of some developed countries' economies. The surprising growth rates are partly attributed to the favourable world economic conditions at that time, and the oil and commodity boom around 1972. However, there are several economic shocks, from both abroad and domestic, to strike the economic development in this region. Among these shocks, three of them are most significant for economies in this region, which are around 1979, 1985 and 1997. With the notable increase in oil price around 1970s and 1985-1986, the following external factors triggered off the recession in the mid-1980s: the 1979 oil crisis, the slow-down of the US economy, the appreciation of Japanese currency (Yen), and lower external demand for electronics. At the same time, the economies were influenced largely by

some domestic factors: rising costs in investment, a decrease in tourism, lack of confidents in domestic financial system, and other industries aggravated the recession. After the serious economic recession of the mid-1980s and the steady reduces in the price of oil, the governments in ASEAN-Pacific region initiated some important structural adjustments and economic reforms (Leipziger 1997). Controls on trade, finance, tax and investment were gradually declined during the late of the 1980s. For some economies, such as Korea, deregulation has been an important component of the reform agenda.

During the same period, more efficient macroeconomic policies were made and implemented, such an outward-oriented trade and financial policies to service the economies. The Singapore and Malaysia government is the best one to implement these renewed economic reforms to stimulate and sustain the economic growth, but Philippine and Indonesia experienced political instability and poor economic management in the late 1980s and early 1990s. Government of both Korea and Thailand continue to reform their trade policies and update their financial services, and then become more outward economies, especially the reforms in Korean financial systems to be more openness.

In the second half of the 1980s, economies in ASEAN-Pacific region achieved significantly positive performances in macro-economies, trade, financial and investment growth. The recovery of the US economy in 1987 raised the demand for ASEAN product, such as electronic products from Singapore, Korea and Thailand, agriculture products from Thailand and Indonesia, construction materials from Malaysia, raw industrial materials from Indonesia and Malaysia and so on. According to Park (2001), Tan (2004), Baharumshah and Lau (2003), Indonesia, Malaysia and Thailand became the largest capital imports in the world in the 1990s; Singapore became the biggest offshore financial centre in Asia in the 1990s. Stable economic indicators, such as renewed and stable exchange rates, high saving ratio in GDP, remarkable reduction in fiscal deficits were announced and implemented in most of countries in AESAN-Pacific region.

The Asian financial and economic crisis of 1997-1998 can be regarded as a collective shock (Haggard 2000) and it is the most serious crisis in this region's post-ward economic history. After 1990s, the globalisation was processed in most developing countries, especially in the ASEAN-Pacific region. During this period, the financial markets were becoming too much integrated and some investors aboard targeted higher profit returns by short-term lending, but this result in severe potential financial risks. Compared with the previous two economic crises, the existence of the Asian financial crisis 1997-1998 was highly because of much greater integration with the rest of the world. Measure of trade and financial liberalization without having adequate institutional strength made the region more vulnerable to a speculative attack. For example, the short-term portfolio investment abroad was nearly four times higher than long-term foreign investment in Thailand. A pegged exchange regime, the weak and unstable financial system, highly leveraged borrowers initiated the crisis in Thailand, which in short time spread to Malaysia, Korea, Indonesia, Philippines and Singapore. All of economies in the ASEAN-Pacific region have been more or less

influenced by this financial crisis.

After this crisis, economies in this region were restructured with initiating and implementing wide-ranging regulatory and institutional reforms, especially in the financial system. Singapore and Korea's government announced and implemented a series of internal reforms; Thailand and Indonesia conducted considerable institutional and the regulatory reforms; in the Philippines on-going reforms are continued; in Malaysia some reforms in its banking system were initiated. In 2000, the demand of electronic and computer products reached a peak level, which simulate the economic growth in this region.

According to Poon and Thompson (2000), there is a significant relationship between the expectations of reforms and improvements in ASEAN economic environment. Accordingly, the financial crisis in 1997-1998 did not damage the economies, but stimulated trade flows inside and outside the ASEAN framework and more efficient reforms in domestic financial systems.

3. Methodology

In the empirical regression of time series analysis, it is crucial and fundamental to understand whether the variables in the econometric tests are stationary or non-stationary, and whether we can use the level of variables or the difference of variables. And the critical problems of structural break, such as the consequential implications by potential structural breaks, must be considered in empirical studies in order to overcome the possible spurious results involved in unit root tests. There could be many different reasons to cause the structural breaks, such as trading or financial policy changes, industrial structural changes by government, diverse environments as economic crises, or even regime shifts. In the case of ASEAN-Pacific region, since countries in this region are all new industrial developing countries, the changes of trading, financial, industrial policies take place frequently in the period of economic sharply growth. Furthermore, the three critical economic crisis i.e. around 1979 (oil crisis), around mid-1980s (economic recession), and around 1997 (financial crisis) could lead to three potential structural breaks, which could in turn influence vitally the economic development and then economic policies.

In the light of this consideration, it is crucially important to examine the null hypothesis of structural stability against the alternative hypothesis of one-time structural break. When the potential structural changes are not allowed in the specification of an econometric model, but in fact they exist. The regression results might be spurious because they can be biased towards the mistaken acceptance of the non-stationarity hypothesis (Perron, 1989 and 1997; Leybourne 2003, Valadkhani and Worthington 2005). According to Campbell and Perron (1991), if we fail to test the existence of unit roots in time series analysis, that indicates the standard asymptotic distribution theory does not apply, and then to lead to some problems of misspecification, coefficient bias and spurious estimation inferences.

According to studies by Perron (1989), it is evident that there is a crucial problem in some traditional unit root tests, such as Dickey Fuller and Phillip Perron, i.e. both approaches assumed absolutely the deterministic trend is specified correctly.

Supposed a time series is stationary around a deterministic time trend which might be able to have a permanent shift, the usual approach for stationarity, such as ADF or P-P, will definitely lead to some mistaken results without a consideration of that change. Perron (1989) presents an effective method to examine the roles of a structural break in a time series, which appears to be non-stationary but in fact stationary. In the light of descriptions by Perron (1989), it is evident that apparent persistence in empirical data might be a result of un-considered structural breaks in the econometric modelling. Accordingly, some macroeconomic variables that were judged to have unit roots might really be a stationary process with some underlying structural break points in the estimation process.

Perron's (1989) works are based on an unrealistic assumption that break points are considered as exogenously determined in the econometric modeling, which means break points are *priori* (Perron 1989) and are independent of empirical variables and data. This unrealistic assumption has been criticized by many econometricians, e.g. Andrew and Zivot (1992), Banerjee, Lumsdaine, and Stock (1992), Perron and Vogelsang (1992) and Perron (1997), and these scholars have augmented Perron's (1989) model through a consideration of structural break points as endogenously dominated in the regression modeling. Andrew and Zivot (1992) employ a variety of recursive tests to obtain the asymptotic distribution of the test statistic and to tabulate the critical values. Vogelsang and Perron (1992) use similar approaches to consider the structural breaks endogenously in their empirical studies. Later, Perron (1997) considers the structural break points before applying the empirical data, whereas Perron (1989) argues the structural break points are *prior*. This thesis is employing the Perron (1997) methodology to examine the structural breaks in our empirical analysis, as this approach covers mostly possible structural break points in the empirical data.

According to Perron (1997) methodology, the null hypothesis is that a series is a realizations of time series process characterized by the existence of a unit root and a possibly non-zero drift (Perron 1998). And this method is generalized to allow a one-time change in the structure at a time T_b with $1 < T_b < T$ where a sample size $T+1$ is available. It should be noted, however, the break time of T_b are different from accurate break point, as the regression are only estimated with assumed break dates of T_b. With a consideration of this null hypothesis, there are two different models to be used in the light of Perron's (1989, 1997) studies: Additive Outlier (AO) Model and Innovational Outlier (IO) model. In empirical estimation procedures, the latter is normally divided into two approaches, i.e. IO1 and IO2 models. The Additive Outlier (AO) model is referred to a series presenting a change suddenly in the break pint (Tb), while the Innovational Outlier (IO) model is suitable for a series presenting a change gradually over the time.

The Innovational Outlier (IO) model is performed with two different approaches due to different types of changes in the trend over time. The first Innovational Outlier (IO1) model allows a change only in the intercept under the null and alternative

hypothesis, whereas the second Innovational Outlier (IO2) model allows changes not only in intercept but also in the slope. But the unit root tests with both approaches are performed with the t statistics for testing δ=1 in the regression tests. Based on this description, two types of the Innovational Outlier model can be exhibited as following:

A.1 $$X_t = \alpha + \theta DU_t + \beta t + \lambda D(T_b)_t + \delta X_{t-1} + \sum_{j=2}^{q} \gamma_j \Delta X_{t-j+1} + \varepsilon_t$$

where $DU_t = 1$ if $(t > T_b)$ and zero otherwise; $D(T_b) = 1$ if $(t = T_b + 1)$ and zero otherwise;

A.2 $$X_t = \alpha + \theta DU_t + \beta t + \rho DT_t + \lambda D(T_b)_t + \delta X_{t-1} + \sum_{j=2}^{q} \gamma_j \Delta X_{t-j+1} + \varepsilon_t$$

where $DT_t = (t > T_b)$ if $(t > T_b)$ and zero otherwise; $D(T_b) = 1$ if $(t = T_b + 1)$ and zero otherwise. The dummy variable $D(T_b)_t$ is introduced by Perron (1998). If the t-statistic for δ in absolute value is larger than critical value, the null hypothesis of the unit roots can be rejected in favor of an alternative hypothesis of stationary around break dates (Tb).

The Additive Outlier (AO) model allows a series to include shifts in the trend over the time rather than some sudden changes in the IO models. The procedures here are applied for two steps. It should be noted that the discussion about two-step procedure is different from the discussion by Perron (1989), since there are some errors in the additive model. This two-step procedure has been criticised by Perron (1993) and more extensively by Vogelsang and Perron (1992). The first step is to estimate the trend function of the series and removed from the original function, and that means to define the new term of $\tilde{X}_t$ as the de-trended series in the Additive Outlier model. Since the Additive Outlier approach is performed with three equations:

A.3 $$X_t = \alpha + \beta t + \theta DU_t + \tilde{X}_t$$

A.4 $$X_t = \alpha + \beta t + \theta DU_t + \rho DT_t^* + \tilde{X}_t$$

A.5 $$X_t = \alpha + \beta t + \rho DT_t^* + \tilde{X}_t$$

The equations (A.3) and (A.4) means the dummy variable is associated with a change in intercept, and for equation (A.5) there is no change in level and the two segments of the trend are joined at the break time. The second step is based to test on the sum of the autoregressive coefficients is to unity in the autoregression applied to the estimated noise component $\tilde{X}_t$:

A.6 $$\widetilde{X}_t = \delta \widetilde{X}_{t-1} + \sum_{i=2}^{q} \lambda_i D(T_b)_{t-i+1} + \sum_{j=2}^{q} \gamma_j \Delta \widetilde{X}_{t-j+1} + \varepsilon_t$$

A.7 $$\widetilde{X}_t = \delta \widetilde{X}_{t-1} + \sum_{j=2}^{q} \gamma_j \Delta \widetilde{X}_{t-j+1} + \varepsilon_t$$

The equation (A.5) is referred to the equations (A.3) and (A.4), while the equation (A.6) is referred to the equation (A.5). This two-step approach permits a test for a unit root that is invariant to the magnitude of the change in slope asymptotically under the null hypothesis.

With understanding three approaches, i.e. the AO, IO1 and IO2 models, the next step for Perron's unit roots test with structural break is how to choose and estimate the break points in these models. The first method used in the empirical parts of this thesis is given as UR method, which involves choosing T_b that $t_{\hat{\alpha}}$ is minimized with the definition $t_\alpha(i) = Min_{Tb \in (K+1,T)} t\hat{\alpha}(i, T_b, k)(i = 1,2,3)$ (Perron 1997). The second method is named as STUD method, where T_b is chosen to minimize not only the t-statistic on the coefficient linked with the change in the intercept but also the t-statistic on the change in slope. The third method performed as STUDABS method, with which the break date is chosen without a consideration of the sign of the change, so that the break time is selected by the maximum of the t_θ or t_γ in absolute value.

4. Explanation about data and variables

This paper uses annual data covering the period of 1953-2005 (except some individual variables which have some shorter observation). All of annual data in all countries come from International Financial Statistics (IMF, 2006) and World Development Indicators (World Bank, 2006). Although most papers use the quarter data or month data, this thesis are employing the annual data for every country's study; actually, there are two main reasons for employing the annual data, rather than quarterly data or monthly data: Firstly, some financial variables of ASEAN-Pacific region countries in the past did not move too much, because of the implementation of fixed or pegging exchange rate system, so that it needs some variation of it in our studies. The annual data is a more efficient way to reveal the higher variation than the quarterly data or monthly data. Secondly, the GDP data revealed annually is more accurate and reliable than quarterly or monthly GDP data, in other words, the GDP reported in higher frequently is less efficient in most econometric models. Finally, most papers in the subject of development economics are prefer to employ per capita GDP for evaluating the economic growth, rather than only nominal gross GDP. Accordingly, this paper

uses the per capita GDP, which requires using annual data of population. Although variety data are represented as different kind of currency (US currency or local currency), all variables in this thesis have been transferred to local currency, and most variables' data are quoted as constant local currency with some mathematical transferring method. The data are normally represented as the form of natural logarithms; therefore, the data with natural logarithms can be explained in growth terms after taking the first difference.

In the empirical studies of this paper, the variables used in the regression models are for each country are composed of four variables to present economic growth , the development of trading sectors and financial sectors

Firstly, by the problem of economic development, it seems to be narrow to use only GDP or per capita GDP, since development patterns normally involve us in thinking of more other aspects of societies (Lucas 1988). However, when peoples speak of a developed society, the intuitive notions of development are always in their mind. In short, most of people would insist that a minimal requirement for a developed nation is that the physical quality of life be high, and be so uniformly. Therefore, it is tempting to suggest that the state of material well-being of a nation is captured accurately in its per capita gross domestic production (GDP) or gross national production (GNP). Here, the variable of per capita gross domestic production is defined as the per-head value of final goods and services provided by the people of a country over a given year (Ray 1998). The measure of economic growth in this paper is represented as the logarithm form of per capita real GDP. Because the growth rate of population in most ASEAN countries plays a significant role in the economic growth, the empirical experiences indicate that it is more efficient to employ the per capita value, instead of gross value. It is believed there are varieties of inflation variations in ASEAN countries, so that this thesis is employing the real GDP value, rather than only nominal GDP value. Accordingly, per capita real GDP can be regarded as an efficient way to measure the economic development for most countries in ASEAN-Pacific region.

Secondly, the empirical regression in this thesis is employing the ratio of the sum of gross exports and imports over nominal GDP as an indicator to measure the degree of trading openness for selected developing countries in ASEAN-Pacific region. The rapid growth of trading sectors is always an important part for macroeconomic development, especially for these countries. Some econometric scholars employs the ratio of export over GDP to be an indicate of development of trading sectors in an economy. But with the consideration of some issues by exchange rate, it is more efficient to consider total amount of trading goods, rather than only exports. Furthermore, since our data is collected by the local currency, the ratio of export and import over GDP is better than only the amount of sum of export and import; and this method can overcome the problem of different currencies.

Thirdly, the financial growth in ASEAN-Pacific region is represented by two indicates in the empirical regression i.e. the ratio of M2 over GDP and the ratio of M1 over M2. In this paper, the narrow money and broad money are represented as M1 and M2 respectively (International Financial Statistics Data Explanation, 1998). The

notion of money in this thesis is composed of narrow money and broad money. Narrow money is defined the sum of currency and demand deposits, but not include those from the central government. Quasi-money consists of time, savings and deposits of resident sectors, but not from central government. Broad money is the sum of narrow money and quasi-money. This paper uses two variables to present the performance of financial systems in this region: the ratio of M2 over nominal GDP and the ratio of M1 over M2. The ratio of M2 over GDP is the most popular variable in the studies of financial-economic growth nexus, since this variable can cover all general information about the development of financial systems, especially in the measurement of financial deepening. Although this traditional variable has been replaced by other more accurate financial variables in recent years, it is still an efficient variable in developing countries. Compared with other variables, such as banking claims to private sectors, the data for M2 is much easier to find and employ.

According to Levine (1999), the ratio of M2 over GDP can not be representation of financial growth fully because of some specific reasons, especially in developing countries. However, due to the lack of statistic data in most of developing countries, the ratio of M2 over GDP is still make sense to be an important measurement of financial growth, especially to measure the financial deepening. In the studies about ASEAN-Pacific economies, some econometricians employ some new indicators as general approaches for financial growth, for example, the ratio of M1 over M2 (Ford 2004). This paper employs the ratio of M1 over M2 as another indicator to measure the development of financial sectors in six selected countries in ASEAN-Pacific region.

5. Empirical Results for Stationarity Tests in ASEAN-Pacific Region

With the econometric methodology involved in previous chapter, this chapter begins to analysis the empirical results in six stylized countries in ASEAN-Pacific region i.e. Singapore, Korea, Malaysia, Thailand, Philippines and Indonesia. According to studies by Park (1994), the economic growth in Korea is very similar to some ASEAN countries in terms of trades, investment, and financial growth, and also some papers in recent years analyze the ASEAN economies along with the Korean economic development together. Therefore, this paper studies the six new industrial countries in ASEAN-Pacific Region. In the empirical estimation, this paper involves two stages for the empirical analysis. The first part will be performed through graphic analysis for individual indicate in every country. Although the graphic analysis is regarded not to be accurate in empirical econometrics, the direct analysis is still able to provide some direct information before employing more accurate methods later, and therefore the graphs can show us some possible structural break points in the trend. After that, the Perron (1997) tests with a consideration of structural break with AO, IO1 and IO2 models will be employed to inspect the exact points of potential structural breaks, and then to analyze the issues of potential structural breaks.

Following the discussion above, we should consider the graphic analysis in order to get some direct information for each variable in every selected country. Although the time-graphs might not provide accurate decision for stationary, it is

empirically believed the visual information from time graphs is able to give us a probable direction to test the existence of the unit roots and potential structural break points in the trend of time series.

The time-graphs of variables in every selected country are shown in Figure A.1 until Figure A.7. These figures are composed of total counties' time graphs of all variables in their level: Thailand (1953-2005), Korea (1953-2005), Malaysia (1960-2004), Singapore (1965-2004), Philippines (1960-2005) and Indonesia (1965-2004). All of graphs indicate that the indicators of economic growth, trading openness, financial growth and investment involve a strong trend in their level, and also upward trend visually except the ratio of M1 over M2. The ratio of M1 over M2 will downward when the financial system in an economy grows well.

It should be noted, however, these time series graphs in every country show one or more structural break points in the level trend, but only some are obviously shown graphically and some are not. According to these graphs, the periods of break points are around 1997 financial crisis, 1985 economic recession and 1979 oil crisis. For the indicator of economic growth, donated by LY, there is not obvious existence of structural break points in Singapore, but for rest countries the structural break points are obvious, especially in Philippines and Indonesia. For the indicator of trading sector, denoted by LT, every country shows the relative obvious structural breaks in the trend, and breaks in Korea and Thailand seem to be more serious. The growth of financial sector, denoted by LF1 and LF2 encourages the similar presentation as the trading sector, and not only Korea and Thailand, but Philippines and Malaysia also show some obvious break points. In conclusion, Singapore seems less structural breaks, and Philippines and Indonesia show more structural breaks. In Korea, Malaysia and Thailand, some of breaks are significant and some are not obviously shown.

Actually, this important information provides us an acceptable reason to consider the stationary tests under the structural break, which will be conducted later by the method of Perron (1997) tests. In the following section, we will employ the three different models to inspect the exact time of potential structural break points and to analyze the endogenously structural break points in these selected countries of ASEAN-Pacific Region.

According to the explanation of methodology for endogenously structural break points, the empirical tests will employ the three different models i.e. Additive Outlier (AO) Model, Innovational Outlier I (IO1) Model and Innovational Outlier II (IO2) Model to scrutinize the existence of potential structural break points in the trend, and to identify the years in which a structural break occurs. Some econometricians argue that the model with a consideration of a potential breaks in both intercept and slope is more efficient and accurate in the empirical regression (Perron 1995), however, since this paper investigating the studies for several selected developing countries rather than for individual economy, we employ all of three models to analyze the economic growth, the growth of trading sectors and financial sectors, and investment ratio in six selected country of ASEAN-Pacific region.

In the procedures of inspecting the lag length, this paper employs the method of

endogenously dominating the appreciate lag length, and then a data-dependent approach to select the lag length K is used in the empirical estimation. According to Perron (1989) and Ben and Papell (1998), the data-dependent approach is better than making a prior selection of a fixed value of lag length K. They also suggest we can begin the selection from the upper bound of $K_{\max}$. If the last lag involved in the model is significant, K can be regarded as $K_{\max}$; if the last lag is not significant, K should be reduced one by one. In the empirical econometric operations, we start the analysis with the maximum order of lag parameter $K_{\max} = 10$ since the observations in the empirical data is limited annual data, otherwise if the observations are sufficient, such as quarter data, the maximum order might be $K_{\max} = 20$ (Lumsdaine and Papell 1997).If the coefficient with the maximum lag length is significant compared with critical value, then we get $K = K_{\max}$. If it is insignificant, the value of lag length K will be reduced by one until the coefficient becomes significant. If coefficient is still insignificant when K =1, the minimum value of K will equal to zero.

In the empirical studies, three different methods i.e. UR, STUD and STUDABS method for all of AO, IO1 and IO2 models will be used in every country. Although it is known the results with STUD and STUABS method are the same in most situations, the results with three methods are all presented in this paper. In this paper, the critical values are taken by Perron (1997) are T=60 in the IO1 model, T=70 in the IO2 model and T=100 in the AO model respectively at 1% and 5% level of significant level. The regression equation is run with the values Tb of (2… t-1) for each variable. And break points are then selected and expressed by the values of Tb, which are obtained by minimising the t-statistic on the coefficient δ with accordance to the previous methodology discussion. The unit root null hypothesis can be rejected in favour of the alternative of stationarity if the t-statistic for δ is significant and greater than critical value.

The empirical results with AO, IO1 and IO2 models are represented in terms of four different areas i.e. economic growth, trade openness, financial growth and investment ratio, and each part investigate the endogenously structural breaks for six selected countries.

Table 1 investigates the endogenously structural breaks for economic growth with the variable of per capita real GDP denoted by LY. As shown in Table 1, the critical value for LY variable in only Indonesia is consistently higher than the t-statistic of δ =1 (null hypothesis) in IO1 model with all the three methods, which means the unit root null hypothesis can be rejected for LY in IO1 model. With IO2 model and UR method, the null hypothesis cannot be rejected even for Indonesia. With three models, (AO, IO1, IO2) the predominant general break dates of variable LY are the following: for Singapore it is around 1980 oil crisis and around the 1997 financial crisis; for Korea it is around 1985 economic recession; for Malaysia it is

around 1997 financial crisis and 1980 oil crisis; for Thailand it is around 1985 economic recession; for Philippine it is around 1980 oil crisis; for Indonesia is around 1997 financial crisis.

Table 2 investigates the endogenously structural breaks for trading openness with the ratio of sum of nominal exports plus imports over nominal GDP donated by LT. According to Table 2, the critical value for the LT in all countries is less than the t-statistic of δ=1 (null hypothesis) in three models (AO, IO1 and IO2) with all of three methods, which means the unit root null hypothesis cannot be rejected for LT in all models. With three models, (AO, IO1, IO2) the general predominant break dates of variable LT are the following: for Singapore it is around 1980 oil crisis; for Korea it is around 1997 economic recession; for Malaysia it is around 1985 economic concession and around 1997 financial crisis; for Thailand it is around 1985 economic recession; for Philippine it is not due to three economic crisis; for Indonesia it is around 1997 financial crisis.

Table 3 investigates the endogenously structural breaks for financial growth with the ratio of M2 over nominal GDP donated by LF1. As shown in Table 3, the critical value for the LF1 in all countries is less than the t-statistic of δ=1 (null hypothesis) in three models (AO, IO1 and IO2) with all of three methods, which means the unit root null hypothesis cannot be rejected for LF1 in all models. With three models, (AO, IO1, IO2) the predominant general break dates of variable LF1 are the following: for Singapore it is around 1997 financial crisis; for Korea it is noting about three general economic crisis; for Malaysia it is around 1985 economic concession and around 1997 financial crisis; for Thailand it is around 1985 economic recession; for Philippine it is around 1985 economic recession; for Indonesia it is around 1997 financial crisis.

Table 4 is still investigating the growth of financial systems by the ratio of M1 over M2 denoted by LF2. According to Table 4 the critical value for the LF2 n all countries is less than the t-statistic of δ=1 (null hypothesis) in three models (AO, IO1 and IO2) with all the three methods, which means the unit root null hypothesis cannot be rejected for LF2 in all models. It should be noted that this result is the similar with Table 3. With three models, (AO, IO1, IO2) the predominant general break dates of variable LF1 are the following: for Singapore it is around 1997 financial crisis and around 1985 economic recession; for Korea it is around 1980 oil crisis; for Malaysia it is around 1980 oil crisis; for Thailand it is around 1997 economic recession and around 1980 oil crisis; for Philippine it is around 1997 economic recession and around 1980 oil crisis; for Indonesia is around 1997 financial crisis. Compared with the results in Table 3, the potential structural break points are more around 1997 financial crisis.

With the consideration of both figures and tables, the general break periods obtained correspond closely to the expected dates associated with the gradual impacts of the oil crisis around 1980(1979-1981), the economic recession around 1985(1984-1986), and economic crisis in 1997 (1996-1998). Most of the structural breaks for the per capita real GDP for six countries occur in the period of 1996-1999, coinciding 1997 financial crisis. After 1997 financial crisis, real GDP per capita accelerated continuously because of some efficient economic reforms, and thus the

economic growth remains in a stable level again after such potential structural breaks.

Furthermore, it should be noticed the individual case—Singapore, Philippine and Indonesia in this paper. Among six selected countries, Singapore is believed to be a successful economy to overcome the economic concessions and financial crisis. It is, of course, because of the stronger economic background and other political reasons, however, it is still believed that Singapore government has made more efficient reforms for the post economic recession, such as deeper reforms for financial sectors, reduce the ratio of fixed investment in the GDP, and so on. But both Philippines and Indonesia's records of policy selection and implementation was not good, especially around the 1985 economic recession and 1997 financial crisis, and thus Indonesia always took a heavy toll on its growth. According to our studies in this paper, the potential endogenous structural breaks are very obvious and significant in most of indicators in both of Indonesia and Philippines, especially for financial growth in Indonesia. In summary, the Singapore and Korea's economies remain the stable level after the economic crisis and concession, and second is Malaysia and Thailand; the policies by Indonesia and Philippines governments are not so efficient to keep the economic growth stably.

After the past three crucial economic crises, the economies in ASEAN-Pacific are well positioned to be an ever-greater force all over the world. Although India and China are more and more famous as their sharply development and attractive economic reforms, countries in ASEAN-Pacific region are still shines in the international economic landscape.

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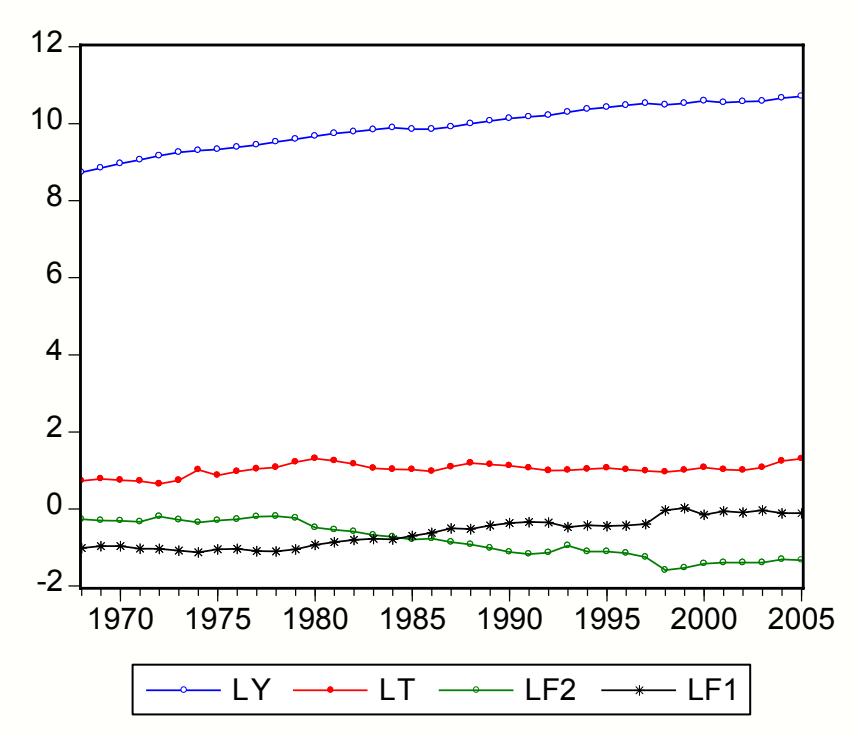
Graph A.1 Time Graph of Variables in Singapore

Time Graph of Variables in their level
Singapore Annual Data (1960-2005)



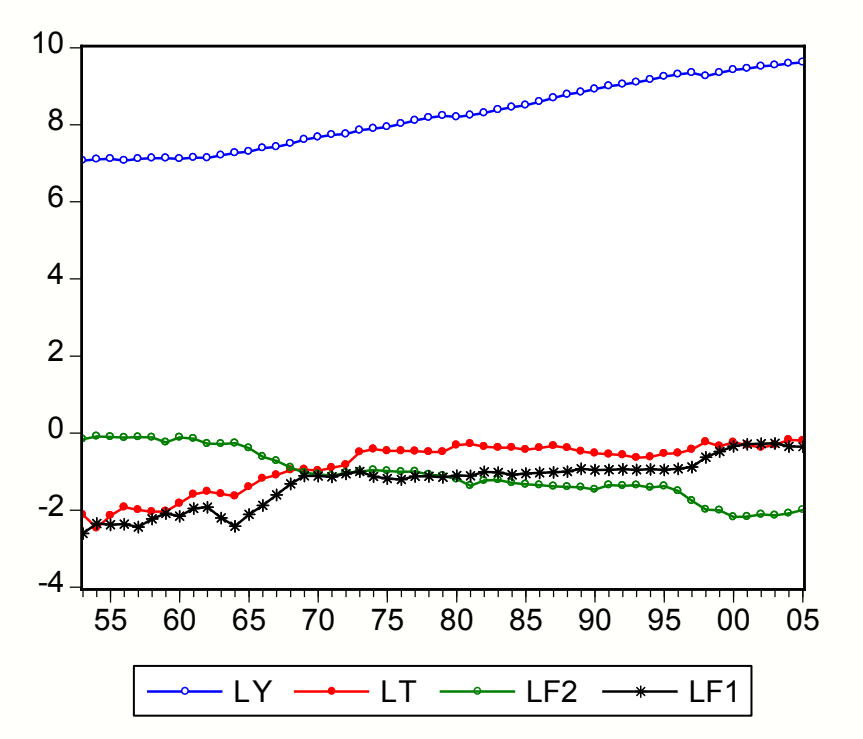
Source:

International Financial Statistics, IMF (2005)

World Bank Development Indicator, World Bank (2005)

Graph A.2 Time Graph of Variables in Korea

Time Graph of Variables in their level
Korea Annual Data (1953-2005)



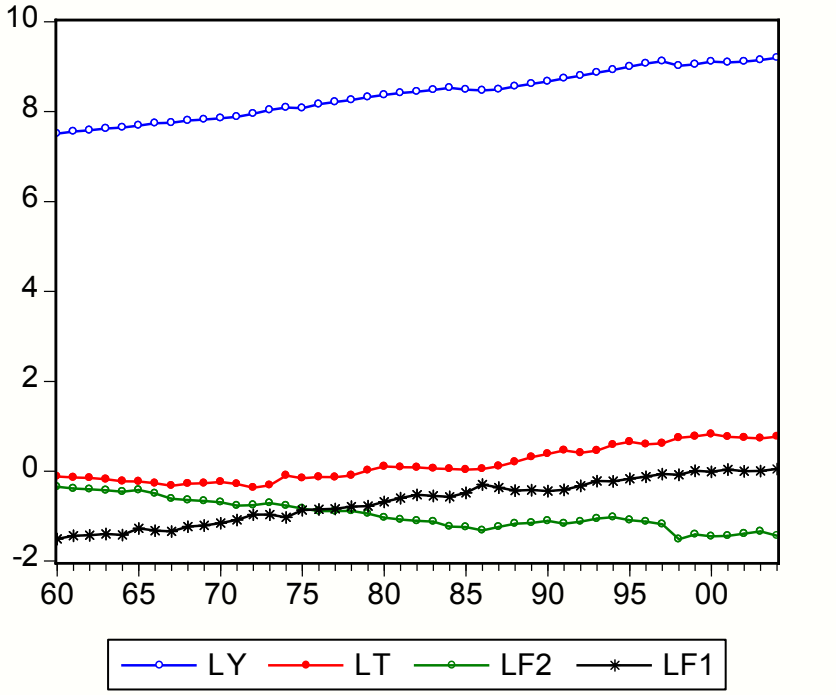
Source:

International Financial Statistics, IMF (2005)

World Bank Development Indicator, World Bank (2005)

Graph A.3 Time Graph of Variables in Malaysia

Time Graph of Variables in their level
Malaysia Annual Data (1960-2004)



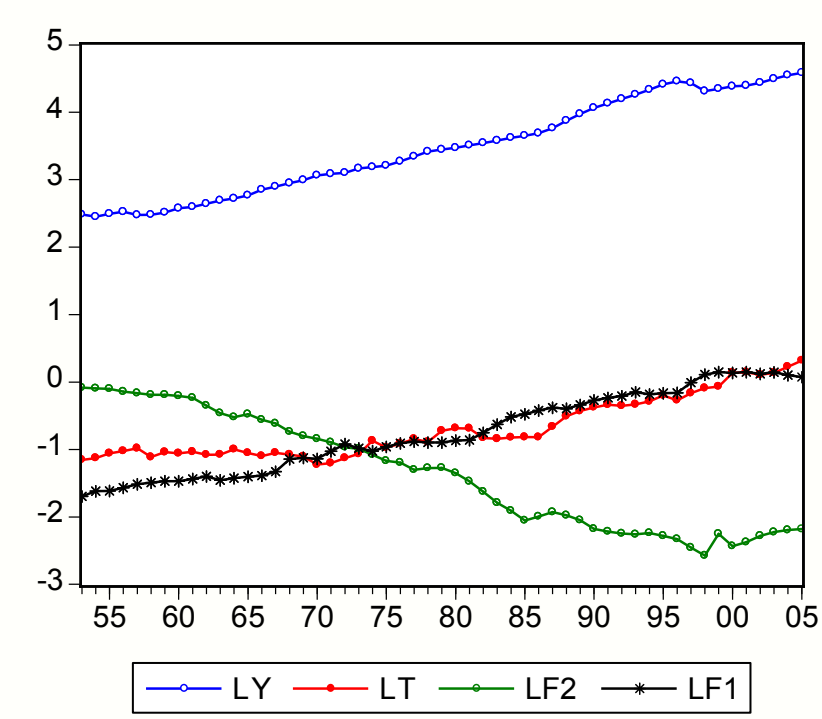
Source:

International Financial Statistics, IMF (2005)

World Bank Development Indicator, World Bank (2005)

Graph A.4 Time Graph of Variables in Thailand

Time Graph of Variables in their level
Thailand Annual Data (1953-2005)



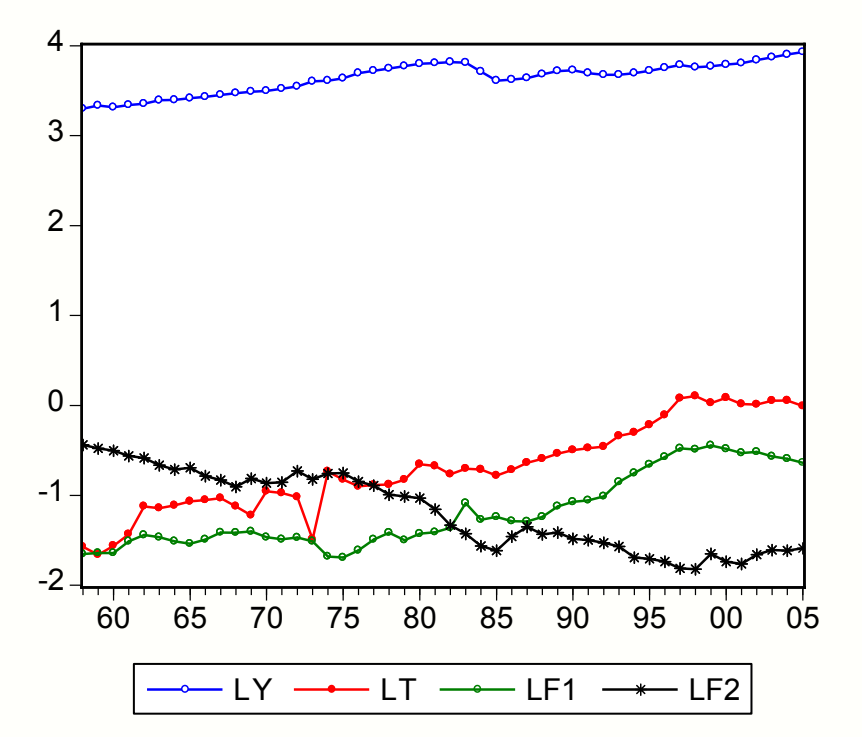
Source:

International Financial Statistics, IMF (2005)

World Bank Development Indicator, World Bank (2005)

Graph A.5 Time Graph of Variables in Philippine

Time Graph of Variables in their level
Philippine Annual Data (1958-2005)



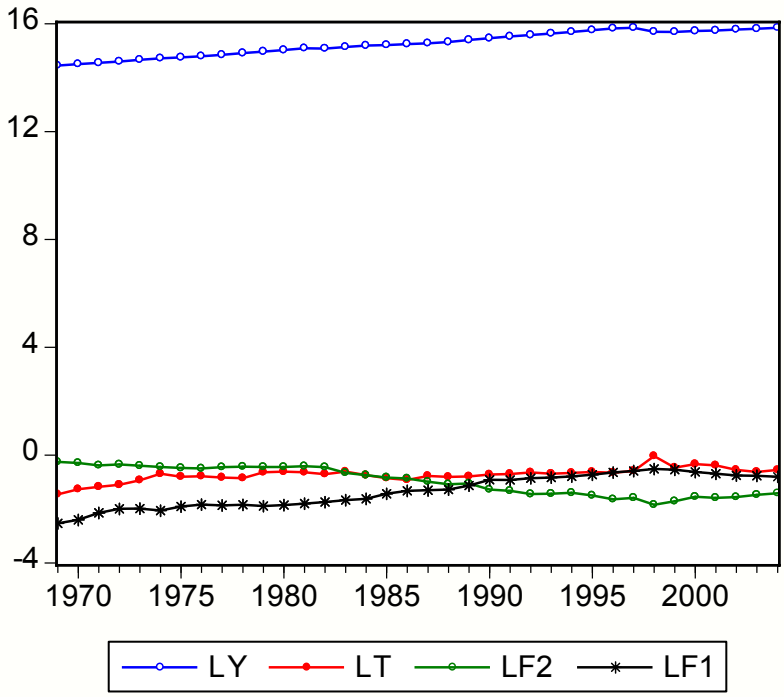
Source:

International Financial Statistics, IMF (2005)

World Bank Development Indicator, World Bank (2005)

Graph A.6 Time Graph of Variables in Indonesia

Time Graph of Variables in their level
Indonesia Annual Data (1969-2004)



Source:

International Financial Statistics, IMF (2005)

World Bank Development Indicator, World Bank (2005)

Table 1. Three models for endogenously structural breaks
for the variable of Economic Growth (LY)

Country	**AO Model for endogenously determined breaks**								
	Level Data								
	UR Method			**STUD Method**			**STUDABS Method**		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	2002	1	-3.34910	1980	1	-2.78081	1980	1	-2.78081
Korea	1962	9	-3.51205	1962	9	-3.51205	1962	9	-3.51205-
Malaysia	2003	5	-4.49322	1997	3	-3.14666	1997	3	-3.14666
Thailand	1963	7	-3.93867	1960	7	-3.77436	1960	7	-3.77436
Philippine	1968	10	-3.11462	1978	10	-2.69080	1978	10	-2.69080
Indonesia	2001	3	-3.9008	1996	0	-2.73039	1996	0	-2.73039
Model	**IO1 Model for endogenously determined breaks**								
	UR Method			**STUD Method**			**STUDABS Method**		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1996	0	-4.03806	1996	0	-4.03806	1996	0	-4.03806
Korea	1985	9	-4.58571	1985	9	-4.58571	1985	9	-4.58571
Malaysia	1977	8	-5.05777	1977	8	-5.05777	1977	8	-5.05777
Thailand	1986	7	-5.18895	1986	7	-5.18895	1986	7	-5.18895
Philippine	1983	5	-4.49304	1982	9	-3.58142	1982	9	-3.58142
Indonesia	1996	7	-6.3562*	1996	7	-6.3562*	1996	7	-6.3562*
Model	**IO2 Model for endogenously determined breaks**								
	UR Method			**STUD Method**			**STUDABS Method**		
Variables	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1994	9	-4.64849	1994	9	-4.64849	1994	9	-4.64849
Korea	1985	9	-4.22822	1972	9	-3.36585	1972	9	-3.36585
Malaysia	1982	8	-6.0566*	1984	8	-5.32311	1984	8	-5.32311
Thailand	1977	7	-4.61107	1991	3	-4.18844	1991	3	-4.18844
Philippine	1982	5	-4.21497	1976	10	-2.77763	1976	10	-2.77763
Indonesia	1993	3	-4.77585	1993	3	-4.77585	1993	3	-4.77585

Notes:

- AO model means Additive Outlier Model; IO1 model means Innovational Outlier I Model; IO2 model means Innovational Outlier II Model
- (**) and (*) indicate 1% and 5% level of significance respectively.
- Tb indicates estimated structural break data; K shows the lag order used in the regression.
- Lag order is selected by general-to-specific method.
- All the variables here are in natural logarithms

Sources:

International Financial Statistics, IMF (2005);

World Bank Development Indicator, World Bank (2005)

Table 2 Three models for endogenously structural breaks
for the variable of trading openness (LT)

Country	AO Model for endogenously determined breaks								
	UR Method			STUD Method			STUDABS Method		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1977	1	-3.40885	1979	1	-3.27899	1979	1	-3.27899
Korea	1976	1	-4.10801	1975	10	-3.19038	1975	10	-3.19038
Malaysia	1997	1	-3.74350	1972	1	-3.45488	1972	1	-3.45488
Thailand	1977	5	-3.75715	1972	0	-3.21672	1972	0	-3.21672
Philippine	1989	0	-4.67484	1987	6	-3.42101	1987	6	-3.42101
Indonesia	2003	0	-3.91490	1974	0	-3.82662	1974	0	-3.82662
	IO1 Model for endogenously determined breaks								
	UR Method			STUD Method			STUDABS Method		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1974	1	-3.67068	1980	6	2.33245	1980	6	2.33245
Korea	2000	10	-4.15657	1994	10	-0.76141	1994	10	-0.76141
Malaysia	1986	0	-3.68117	1986	0	-3.68117	1986	0	-3.68117
Thailand	1963	0	-2.47186	1985	0	-2.41655	1985	0	-2.41655
Philippine	1994	7	-4.99455	1994	7	-4.99455	1994	7	-4.99455
Indonesia	1997	10	-4.28022	1997	10	-4.28022	1997	10	-4.28022
	IO2 Model for endogenously determined breaks								
	UR Method			STUD Method			STUDABS Method		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1974	1	-3.80703	1974	1	-3.80703	1974	1	-3.80703
Korea	1971	10	-4.09680	1973	0	-3.98387	1973	0	-3.98387
Malaysia	1969	1	-3.71724	1972	1	-3.26118	1972	1	-3.26118
Thailand	1973	0	-3.38621	1973	0	-3.38621	1973	0	-3.38621
Philippine	1966	0	-4.98195	1990	10	-3.33802	1990	10	-3.33802
Indonesia	1996	0	-4.79619	1989	10	-3.64135	1989	10	-3.64135

Notes:

- AO model means Additive Outlier Model; IO1 model means Innovational Outlier I Model; IO2 model means Innovational Outlier II Model
- (**) and (*) indicate 1% and 5% level of significance respectively.
- Tb indicates estimated structural break data; K shows the lag order used in the regression.
- Lag order is selected by general-to-specific method.
- All the variables here are in natural logarithms

Sources:

International Financial Statistics, IMF (2005);

World Bank Development Indicator, World Bank (2005)

Table 3 Three models for endogenously structural breaks
for the variable of financial growth—LF1

Country	AO Model for endogenously determined breaks								
	UR Method			STUD Method			STUDABS Method		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1971	1	-3.20380	1974	0	-2.83506	1974	0	-2.83506
Korea	1969	7	-3.10201	1971	7	-3.03559	1971	7	-3.03559
Malaysia	1984	7	-3.91172	1985	7	-3.89614	1985	7	-3.89614
Thailand	1970	4	-3.70750	1964	4	-3.58013	1964	4	-3.58013
Philippine	1981	6	-4.40917	1978	6	-4.26012	1978	6	-4.26012
Indonesia	2002	1	-3.63573	1998	5	-3.31777	1998	5	-3.31777
	IO1 Model for endogenously determined breaks								
	UR Method			**STUD Method**			**STUDABS Method**		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1993	9	-3.45322	1993	9	-3.45322	1993	9	-3.45322
Korea	1963	7	-5.14393	1963	7	-5.14393	1963	7	-5.14393
Malaysia	1970	0	-3.82774	1978	7	-3.28498	1978	7	-3.28498
Thailand	1987	6	-4.21937	1987	6	-4.21937	1987	6	-4.21937
Philippine	1987	6	-4.48003	1987	6	-4.48003	1987	6	-4.48003
Indonesia	1999	5	-3.52370	1998	5	-3.37019	1998	5	-3.37019
	IO2 Model for endogenously determined breaks								
	UR Method			**STUD Method**			**STUDABS Method**		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1996	7	-3.77345	1996	7	-3.77345	1996	7	-3.77345
Korea	1963	3	-5.08610	1973	9	-0.83249	1973	9	-0.83249
Malaysia	1985	7	-5.08520	1984	10	-4.78390	1984	10	-4.78390
Thailand	1988	4	-4.08190	1995	3	-3.23020	1995	3	-3.23020
Philippine	1982	10	-5.32689	1982	10	-5.32689	1982	10	-5.32689
Indonesia	1996	10	-5.02789	1996	10	-5.02789	1996	10	-5.02789

Notes:

- AO model means Additive Outlier Model; IO1 model means Innovational Outlier I Model; IO2 model means Innovational Outlier II Model
- (**) and (*) indicate 1% and 5% level of significance respectively.
- Tb indicates estimated structural break data; K shows the lag order used in the regression.
- Lag order is selected by general-to-specific method.
- All the variables here are in natural logarithms

Sources:

International Financial Statistics, IMF (2005);
World Bank Development Indicator, World Bank (2005)

Table 4 Three models for endogenously structural breaks
for the variable of financial growth—LF2

Country	AO Model for endogenously determined breaks								
	UR Method			STUD Method			STUDABS Method		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1970	4	-2.91862	1976	9	-1.62176	1976	9	-1.62176
Korea	1971	3	-4.23543	1970	3	-4.22666	1970	3	-4.22666
Malaysia	1981	9	-3.52687	1983	0	-2.82615	1983	0	-2.82615
Thailand	1996	0	-3.74379	1997	8	-2.45265	1997	8	-2.45265
Philippine	2002	3	-3.54351	1998	3	-3.19553	1998	3	-3.19553
Indonesia	2002	8	-3.39959	1999	8	-2.82096	1999	8	-2.82096
	IO1 Model for endogenously determined breaks								
	UR Method			**STUD Method**			**STUDABS Method**		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1985	8	-3.72878	1984	8	-3.63850	1984	8	-3.63850
Korea	1963	3	-4.79909	1964	3	-4.74023	1964	3	-4.74023
Malaysia	1990	3	-4.36048	1990	3	-4.36048	1990	3	-4.36048
Thailand	1997	0	-3.61574	1997	0	-3.61574	1997	0	-3.61574
Philippine	1980	3	-4.25934	1980	3	-4.25934	1980	3	-4.25934
Indonesia	1997	9	-3.66907	1998	0	-1.48951	1998	0	-1.48951
	IO2 Model for endogenously determined breaks								
	UR Method			**STUD Method**			**STUDABS Method**		
	Tb	K	T-stat	Tb	K	t-stat	Tb	K	t-stat
Singapore	1997	7	-3.59669	1991	8	-2.69964	1991	8	-2.69964
Korea	1964	3	-4.73991	1981	9	-3.69255	1981	9	-3.69255
Malaysia	1982	9	-5.40955	1982	9	-5.40955	1982	9	-5.40955
Thailand	1995	0	-3.78846	1981	0	-3.12204	1981	0	-3.12204
Philippine	1988	7	-4.28013	1990	7	-3.39649	1990	7	-3.39649
Indonesia	1997	9	-4.01435	1993	0	-1.93646	1993	0	-1.93646

Notes:

- AO model means Additive Outlier Model; IO1 model means Innovational Outlier I Model; IO2 model means Innovational Outlier II Model
- (**) and (*) indicate 1% and 5% level of significance respectively.
- Tb indicates estimated structural break data; K shows the lag order used in the regression.
- Lag order is selected by general-to-specific method.
- All the variables here are in natural logarithms

Sources:

International Financial Statistics, IMF (2005);

World Bank Development Indicator, World Bank (2005)