Dynamic Asian stock market convergence: Evidence from dynamic cointegration analysis among China and the ASEAN-5

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ABSTRACT

This paper examines the dynamic process of convergence among cross-border stock markets in China and the ASEAN-5 countries using recursive cointegration analysis. The results of the recursive trace statistics show that these six stock markets had at most one cointegrating vector from 1994 to 2002. Overall, the regional financial integration of China and the ASEAN-5 has gradually increased. Additionally, the recursive coefficients of the error correction terms show some interesting observations. First, the coefficients of error correction terms are statistically significant and negative in China and Indonesia during much of the period between 1994 and 2002 but the coefficients of other countries are insignificant, meaning that all of the adjustment of this cointegration fell on the stock markets of China and Indonesia. Second, China and Indonesia seem to return to equilibrium after a shock faster than the other four countries studied. This may be because China and Indonesia, as the two largest economies among the six economies studied, are the major drivers of East Asian economic and financial integration.

Key Words: Stock market integration, Recursive cointegration, ASEAN, China

1. Introduction

Numerous studies have investigated the level of integration between the world's stock markets. That stock prices of different countries share a long-run and a short-run relationship implies that convergence of stock markets is possible, which also means that stock markets are integrated.(Narayan et al., 2011) The level of stock market integration across countries is important for both investors and policy-makers. For investors, the level of stock market integration influences opportunities for international portfolio diversification. The integration of stock markets gives investors the opportunity to efficiently allocate capital (Narayan et al., 2011). For policymakers, regional integration can help broaden the investor base and range of products, which strengthens domestic capital markets to compete globally. In virtue of lessening the probability of asymmetric shocks, an integrated financial market also is helpful for financial stability (Umutlu et al., 2010), which can improve the capacity of economies to absorb shocks and may moderate the risk of cross-border financial contagion (Beine et al., 2010; Narayan et al., 2011).

Many past papers indicated that Asian markets usually had low exposure to global factors and little integration with western economies (see Aityan et al., 2010; Harvey, 1993; Singh and Loh, 2010). Hereafter, China and ASEAN[1] countries have been an important part of international portfolio by international fund managers to diversify international portfolio (Jan et al., 2000), which can increase returns and reduce risks (Johnson and Soenen, 2002; Narayan et al., 2014). However, more than 15 years after the Asian financial crisis, China and ASEAN are becoming of increasing importance on the world economic stage, and therefore more and more literature examine emerging Asian stock market integration. Some of them examine stock market integration within ASEAN (Sharma & Wongbangpo, 2002; Click & Plummer, 2005; Goh *et al.*, 2005; Chen *et al.*, 2009; Lim, 2009; Majid *et al.*, 2009), some focus on integration between China and other markets (Chan & Lo, 2000; Huang *et al.*, 2000; Cheng & Glascock, 2005; Tian, 2007; Burdekin & Siklos, 2012;), and some analysis integration between the ASEAN-5 and Japan or the United States (Daly, 2003; Ibrahim, 2006; Majid *et al.*, 2008; among others).

However, few research studies have examined the relationships of the Chinese and ASEAN stock markets. For fill the gap of literature, this paper examines the linkages among six stock markets in China and ASEAN-5 countries[2], namely

[1] ASEAN is the Association of Southeast Asian Nations.

[2] This paper uses ASEAN-5 as a sample of ASEAN, because ASEAN-5 constitutes 72.8% of

Malaysia, Singapore, Thailand, Indonesia and the Philippines. The integration of the Chinese and ASEAN stock markets is interesting for some reasons. First, the population and the growing economic cause the importance of China and ASEAN. China's population is over 1.3 billion, and members of ASEAN have a combined population of 580 million (World Bank, 2012). The combined nominal GDP of China and the ASEAN members was approximately US$6 trillion in 2008 (Brown, 2010). China and ASEAN are becoming of increasing importance on the world economic stage in recent years. Especially, China, longing for a bigger role in the region and in the world, has played a key role in curbing recent financial crisis. Second, there is a fast growth of stock markets in China and ASEAN. Being based on domestic market capitalization, the Shanghai stock exchange is now the sixth largest in the world (WFE, 2013). The ASEAN stock markets are much smaller, but it is possible to become a supranational stock market if capital market integration could succeed (Click & Plummer, 2005). Third, governments of China and ASEAN have promoted cross-border financial transactions through financial market deregulation and capital account liberalization,[3] which also caused capital-market liberalization being an on-going in these countries. Yoshida (2010) shows that regional stock integration of these Asian counties was reinforced after the financial turmoil of the recent sub-prime financial crisis.

Against this backdrop, this study examines the degree to which the Chinese and ASEAN stock markets are integrated and, most notably, whether the degree of integration has intensified as economic integration in the region has deepened. Although there are some recent papers have studies the dynamic relationships of China and ASEAN countries: see, for instance, Lean & Teng (2013), Teulon et al.(2014), and Narayan et al. (2014). The main difference between recent paper and ours is in the approach. The recent papers focus on bilateral correlations of stock markets applying the time-varying correlation technique, while we take a recursive cointegration approach to discuss multi relationships. For the purpose of displaying and estimating multi relationships of stock market integration in the region, we apply a multi-step testing procedure to inquire into the implications of the time-varying behavior of these linkages. The empirical evidence is based on the following framework: First, we investigate the time-varying behavior of the linkages using cointegration tests allowing for the possibility of structural breaks. After the

ASEAN's population and 95.1% of its GDP.

[3] For example, Singapore was the first to liberalize its financial systems in the mid-1970s and Malaysia implemented financial reforms later that decade (Phylaktis, 1997). The Chinese government implemented its security law in 1996 and China reformed its two stock exchanges shortly thereafter.

instability of the long-run relationships are confirmed, we use the recursive cointegration technique to trace the possible dynamic linkages between China and the ASEAN-5 markets. Subsequently, according to recursive analysis results, we estimate the gradual convergence over time. Finally, considering the heteroskedasticity in the data of stock prices, we use error correction model with a GARCH(1.1) error structure to discuss the short-run adjustment of these six stock markets. In a more recent study on this subject, Mylonidis & Kollias (2010) investigate convergence among four major European stock markets using a dynamic cointegration analysis, but they do not discuss the heteroskedasticity in the data. Besides, we apply recent advanced methodology, Narayan and Popp(2010) unit root test with two breaks and Arai and Kurozumi(2007) conitegration tests with multiple structural breaks, which is another difference from Mylonidis & Kollias (2010).

The remainder of the paper is structured as follows: Section 2 introduces an overview of economic development and the stock markets in China and the ASEAN-5 countries. Section 3 presents and discusses the empirical results of the structural change and recursive cointegration analysis. Section 4 concludes the paper.

2. Literature Review

There is a voluminous literature examining the evolution of cross-border equity market correlations and the presence of common stochastic trends (Barari et al., 2008). Some empirical research uses correlations of international equity markets as a foundation for discussing short run market interdependencies and the presence of diversification benefits. (Bracker and Koch, 1999; Bracker et al., 1999; Johnson and Soenen, 2003, Campbell and Diebold, 2005, Mun and Brooks, 2012, Lean and Teng, 2013, etc.) Some literature, known as volatility-spillover literature, focuses on volatility linkages among cross-border equity markets (Fratzscher, 2002; Kim et al., 2005; Bartram et al., 2007; Morana and Beltratti, 2002; Baele, 2005; Hardouvelis et al., 2006, Chakrabarti, 2011, etc.). Except for using the correlation technique, some further investigate what kinds of economic and financial conditions will cause the correlations between these stock markets. (see, for instance, Bracker et al., 1999; Didier et al., 2012; Forbes and Chinn, 2004; Quinn and Voth, 2008; Wälti, 2011, Narayan et al., 2014, etc.)

Another important line of empirical literature applies cointegration techniques for assessing the degree of long run co-movements between international equity markets, and the results are mixed and uncertain. Kanas (1988), Garcia-Pascual (2003) and Phengpis and Apilado (2004) suggest that integration among developed markets

is partial, slow and incomplete. Kasa (1992) finds just one cointegration vector in the major equity markets between 1974 and 1990, which indicates a low level of convergence. Choudhary (1994) cannot find evidence of a long run relationship between G-7 countries between 1953 and 1989. In addition, Arshanapalli and Doukas (1993) (major world markets), Gilmore and McManus (2002) (US and Central European markets), and Ratanapakorn and Sharma (2002) (global continents markets) obtain limited evidence of long run co-movements.

While the above literature cannot find significant evidence to support the existence of long run co-movements between international stock markets, other studies have obtained paradoxical results. The empirical results of Corhay et al. (1993) show strong integration among five major European markets. This evidence of convergence is also supported by Masih and Masih (2002) for major markets, including the G7. Several studies, Atteberry and Swanson (1997), Gilmore and McManus (2004) and Aggarwal and Kyaw (2005) obtain similar results for NAFTA markets. Chen et al. (2002) examine the stock market cointegration of six countries in Latin America, which shows that cointegration was the result of deregulations, privatizations and trade alliances.

Based on the literature on the stock market linkages in South East Asia, the results are also mixed and uncertain. Chung and Liu (1994) study Asian stock market integration using multivariate cointegration, and the results finds the existing of cointegration vectors in the Asian stock market. Conversely, using weekly data for January 1989 to May 1995, DeFusco et al. (1996) show that capital markets are segmented, as there is no cointegration in a block of Asia-Pacific countries. Manning (2002) confirms, using both the Johansen approach and the Haldane and Hall Kalman Filter technique, that in general, there are two common trends present among the eight Asian equity markets. Click and Plummer (2005) find only one cointegrating vector among ASEAN-5 stock markets, which implies that ASEAN-5 stock markets are integrated in the economic sense, but that integration is incomplete. Many other studies use cointegration techniques to determine whether the Asian markets are integrated but generally get inconsistent results (see Roca et al., 1998; Masih and Masih, 1999; Ng, 2002; Sharma and Wongbangpo, 2002; Daly, 2003; Choudhry et al., 2007; Abd. Majid et al., 2008).

The aforementioned studies treat convergence as a static concept. This static research assumes stability in long run relationships, but this assumption may not be warranted because structural breaks are a common problem in the macroeconomic series. Instead, linkages between stock markets may be time-varying and periodic

(Gilmore et al., 2008). Hence, Voronkova (2004) use cointegration with structural breaks, a method derived by Gregory and Hansen (1996), to examine the linkages of the three major Central European equity markets and those of France, Germany, the UK, and the US. The empirical results of Voronkova (2004) show cointegration within the Central European markets as well as between those markets and more developed markets. Considering a regime-switching cointegration relationship with multiple structural breaks, Davies (2006) finds significant evidence of a long run relationship between seven developed stock markets when a two-regime Markov switch is applied.

However, little attention has been paid to the dynamic integration of stock markets. Considering convergence as a gradual and ongoing process, some papers discuss the dynamic process of convergence applying either the Kalman filter or rolling cointegration analysis. Serletis and King (1997) and Rangvid (2001) apply dynamic cointegration methodologies and find some evidence of increased convergence among European stock markets. Conversely, Garcia-Pascual (2003) conducts a rolling cointegration test on several European stock markets, which fails to find any significant changes in the European stock markets' long-run co-movements. Additionally, Gilmore et al. (2008) have failed to obtain evidence of an increasing convergence of the Central European (CE), German and UK stock markets. Investigating the dynamic process of convergence among four major European stock markets, Mylonidis and Kollias (2010) find that some convergence has been taking place and the German and French markets have a higher degree of convergence. Yu et al. (2010) apply rolling cointegration to investigate the dynamic convergence of 11 Asian stock markets, and the results show weak cointegration among these markets. However, these Asian equity markets likely became integration during the Asian financial crisis (between 1997 and 1998).

Although there are some empirical works that have examined the dynamic evolution of stock market integration in Asian countries, few research studies have examined the dynamic relationships of the Chinese and ASEAN-5 stock markets. Some important development has been completed between China and ASEAN countries in the areas of trade and finance. It is expected that interdependence of stock markets between China and ASEAN countries will reflect economic integration in the form of trade linkages and investment flows (Narayan & Smyth, 2004). Fujiwara and Takahashi (2012) also indicate that China emerges as an important driver of real economic activities among Asian economies. Considering the properties of a theoretical model, the specific spillovers of real economic activities between China and ASEAN should display similar dynamics between stock prices. Hence, using

dynamic convergence method, this paper investigates stock market interrelationships between China and the ASEAN-5 countries.

3. Background

The ASEAN was founded on August 8, 1967 by Indonesia, Malaysia, the Philippines, Singapore, and Thailand (the ASEAN-5). By 1999, five more countries had joined the association: Brunei, Vietnam, Laos, Myanmar and Cambodia. The ASEAN countries constitute the fourth largest trading region in the world (Lim, 2011). ASEAN-5 constitutes 72.8% of ASEAN's population and 95.1% of its GDP. The economic growth of ASEAN's counties was average annual economic growth rate of approximately 5% over the past two decades (Petri et al., 2012). Several wide-ranging political and economic reforms were implemented during the Asian financial crisis. In addition, the region benefits from its large economic and political partners, including China, Japan, the U.S. and the European Union (EU) (Chachavalpongpun, 2010). China's recent rapid economic growth and its signing of the Free Trade Agreement with ASEAN for the development of a single market and production base, which increases economic integration between China and ASEAN.

Table 1 displays basic information on China's stock market and the ASEAN-5. From 1996 to 2011, the market capitalization is increasing 4.3 times for Indonesia, 1.3 times for Malaysia, 2.0 times for Philippines, 4.0 times for Singapore, 2.68 times for Thailand, 29.8 for China, all of which, except Malaysia and Philippines, are higher than average increasing 2.3 times globally. The increase in market capitalization is attributed to both price appreciation of listed firms and to an increase in the number of listed firms. During the last two decades, the rapid economic growth in the ASEAN countries was accompanied by an incredible increase in the size of their stock markets. Additionally, the high inflow of foreign investment, as well as financial liberalization and deregulation undertaken domestically, had created a boom in ASEAN capital markets.

The performance of the Chinese stock market is remarkable because its market capitalization and total value of stock trading increased approximately 30 times between 1996 and 2011. Based on domestic market capitalization, the Shanghai stock exchange, in China, is now the sixth largest in the world (WFE, 2013). Since China opened its stock market**s** on December 19, 1990, the Chinese government has used different policies to improve its underdeveloped stock markets, which successfully attracted foreign investors and enhanced financial market development. Although the fact that investors continually face questions about information transparency and corporate governance of Chinese companies, China's stock market has developed the

fastest-growing stock market in the world (Lin & Swanson, 2008). As to the ASEAN-5 stock markets, prior to the 1997 Asian financial crisis, Malaysia was the largest stock market within ASEAN. After the crisis, however, Singapore displaced Malaysia as ASEAN's largest stock market. In Singapore increased approximately four times from US$ 150.22 billion in 1996 to US$ 598.27 in 2011, and the total value of stock trading increased more than six times over the same period.

The market capitalization-to-GDP ratio can show the development of capital market. The rapid economic growth of China and the ASEAN-5 caused financial markets to develop faster. Compared with 2011 average stock market indices globally, in all of these markets (except China and Indonesia), the market capitalization-to-GDP ratios are higher than the average percentage of 68.3% globally. In 2011, Malaysia has the greatest market capitalization to-GDP ratio and Singapore is second, both are bigger than 100%, while the ratios of other countries are smaller than 100%. The market capitalization-to-GDP ratio in 2011 was 128.6% for Singapore and 137.2% for Malaysia, larger than the comparable figures in the US and the UK, which means that both markets are overvalued[4]. Indonesia and China have the lowest market capitalization-to-GDP ratio, 46.1% and 46.3%, respectively, and both markets are undervalued. All these countries introduced reforms to further develop and deepen capital markets after the Asian financial crisis of 1997. As a result, market capitalization steadily grew, at least before the global financial crisis in 2008 (Lee and Takagi, 2013).

Focusing on the changing trend from 2006 to 2011, market capitalizations and the total value of stocks trading, China and the ASEAN-5's stock markets are rising, although both average figures are decreasing in global at the same period. In light of the changing trend of the market capitalization-to-GDP ratio form 2006 to 2011, the ratios of Indonesia, Philippines and Thailand are growing, while the ratios of China, Malaysia and Singapore have been decreasing. The pattern shows that Indonesia, Philippines and Thailand have the potential to develop its capital market. At the same period, the value of stock trading-to-GDP ratio in Singapore is also decreasing, but the same ratios in other five countries are increasing. The decreasing two ratios in Singapore may be caused by Singaporean investors shifting their funds to other five countries in recent years. Hence, without formal integration, capital markets in these

[4] Generally, a ratio greater than 100% is said to mean that the market is overvalued, while a value of around 50%, which is near the historical average for the U.S. market, is said to mean undervaluation. However, using what percentage level is accurate in judging undervaluation and overvaluation has been debated.

countries already integrate themselves (USAID, 2013).

It is projected that linkage of stock markets across countries will reveal economic integration in the form of trade links and investment movements (Narayan & Smyth, 2004). In 2012 China was ASEAN's largest trading partner, and ASEAN was China's top fourth trading partner (Xu, 2013). The growth of trade in goods between the ASEAN-5 and China has increased obviously. As a percentage of ASEAN-5 GDP it has augmented five times since the Asian financial crisis and reached $US400 billion a year in 2012 (Xu, 2013). Likewise, stock market linkage could also show the industrial structure of countries. Allen & McDonald (1995) argues that similar industrial bases and export similar sorts of products can lead to stock markets among countries be expected to have interdependent. There are similar industrial bases in China and ASEAN, which causes a cross-border regional production network in Asia. Much of ASEAN-China trade is intra-industry trade which revealed in the dominance of trade in materials, parts and components (Tong & Chong, 2010).

As to quantitative measures of financial integration among China and the ASEAN-5, there is some evidence (see Table 2) that intraregional financial integration has been increasing. Over one decade after the Asian financial crisis of 1997–1998 that distressed the Asian financial markets and economies, several regional initiatives, including the Chiang Mai Initiative and the Asian Bond Markets Initiative, have reinforced financial cooperation and integration in the region. Except for the regional initiatives, globalization has also made Asia more integrated through the rise in cross-border trades and economic activity in the 1990s. Table 2 displays cross-border holdings of total international portfolio assets in China and the ASEAN-5. The total recorded level of portfolio asset holdings of China and the ASEAN-5 were US$103.72 billion and US$20.42 billion in 2001, respectively. China's portfolio asset holdings approximately tripled to US$309.4 billion in 2011 and the ASEAN-5's portfolio asset holdings increased approximately twenty times to US$395.66 billion that same year. China's assets constituted 7.92% of ASEAN-5's total holdings in 2001 and increased to 15.02% in 2011. Conversely, Japan's share in ASEAN-5's total holdings declined to 2.25% in 2011 from 8.18% in 2001. Thus, China and the ASEAN-5 economies are now integrated more with each other than they are with Japan. Although the level of financial integration between China and the ASEAN-5 has increased, it nonetheless falls behind the level of integration between the U.S. and global financial markets (Kim & Lee, 2012).

Table 1 Stock Market Characteristics of China and the ASEAN-5

		1996	1997	2001	2006	2011
Market capitalization (US$ billion, % of GDP)	World	20,252.7 (68.1%)	23,116.4 (77.7%)	27,906.3 (88.5%)	53,317.5 (109.8%)	46,499.1 (68.3%)
	Indonesia	91.02 (40.0%)	29.11 (13.5%)	23.01 (14.3%)	138.89 (38.1%)	390.11 (46.1%)
	Malaysia	307.18 (304.6%)	93.61 (93.5%)	120.00 (129.3%)	235.36 (144.7%)	395.08 (137.2%)
	Philippines	80.68 (97.4%)	31.36 (38.1%)	41.52 (54.5%)	68.38 (56.0%)	165.07 (73.6%)
	Singapore	150.22 (158.6%)	106.32 (101.7%)	117.34 (128.7%)	276.33 (198.6%)	598.27 (128.6%)
	Thailand	99.83 (54.9%)	23.54 (15.6%)	36.35 (31.5%)	141.09 (68.1%)	268.49 (77.7%)
	China	113.76 (13.3%)	206.37 (21.7%)	523.95 (39.6%)	2,426.3 (89.4%)	3,389.09 (46.3%)
Total value of stocks trading (US$ billion, % of GDP)	World	13,601.4 (45.7%)	18,870.5 (63.6%)	42,073.6 (133.1%)	67,485.4 (139.0%)	66,409.2 (97.7%)
	Indonesia	32.14 (14.1%)	42.93 (19.9%)	9.67 (6.0%)	48.83 (13.4%)	139.62 (16.5%
	Malaysia	173.57 (172.1%)	153.29 (153.0%)	20.77 (22.4%)	66.90 (41.1%)	128.91 (44.8%)
	Philippines	25.52 (30.8%)	20.39 (24.8%)	3.15 (4.1%)	11.24 (9.2%)	32.85 (14.6%)
	Singapore	42.74 (45.1%)	63.95 (61.2%)	63.39 (69.5%)	184.38 (132.5%)	253.77 (105.9%)
	Thailand	44.37 (24.4%)	24.21 (16.0%)	35.70 (30.9%)	100.80 (48.7%)	232.44 (67.2%)
	China	256.01 (29.9%)	369.57 (38.8%)	448.93 (33.9%)	1,635.1 (60.3%)	7,671.36 (104.8%)

Source: These data are from http://www.indexmundi.com/.

Table 2 Total Portfolio Investment Assets in China and the ASEAN-5

Year	countries	Total value of investment (US$ Billion)	Investment from (US$ Billion & % of total value)		
			ASEAN-5	Japan	U.S.
2011	ASEAN-5	309.40	33.51(10.83%)	13.62(4.40%)	126.48(40.88%)
	China	395.62	59.41(15.02%)	10.11(2.56$)	74.73(18.89%)
2001	ASEAN-5	103.72	12.33(11.89%)	7.43(7.16%)	35.63(34.35%)
	China	20.42	1.62(7.92%)	1.67(8.18%)	3.00(14.71%)

Source: These data are from the IMF's coordinated portfolio investment survey.

4. Data and Empirical Results

4.1. The data and results of the unit-root tests

This empirical analysis covers China (CI) and the ASEAN-5 countries [Singapore (SG), Malaysia (MY), Thailand (TH), Indonesia (ID) and the Philippines (PH)], which are the original members of ASEAN and have the largest and most developed stock markets in ASEAN. The weekly stock index data of these six countries[5] were obtained from the Taiwan Economic Journal Data Bank (TEJ). All of the variables are in natural logarithms. The sample period runs from January 6, 1992 to January 16, 2013 and excludes holidays (amounting to 948 usable observations)[6].

When seeking an explanation of the integration of the Chinese and ASEAN-5 stock markets, the first step in the analysis is to test for a unit root type of non-stationarity. To test for stationarity, we start by testing for the presence of a unit root in stock prices using the DF-GLS (Elliott et al., 1996). Additionally, to take into account the possible shift in regime in the unit root tests, we apply the Zivot and Andrews (1992, hereafter ZA) test to allow an endogenous structural break. Table 3 reports the results of these univariate unit root tests with intercept and time trend. The results show that all variables follow I(1) processes at 5% significance.

[5] These stock indices are Shanghai Stock Exchange Composite Index for China, Straits Times Index for Singapore, KLSE Composite Index for Malaysia, SET Index for Thailand, JSX Composite Index for Indonesia and PSE Index for the Philippines.

[6] We use weekly stock index data by taking the Friday (or other end of week) observations.

Table 3 Results of the Unit Root Tests

	ZA			DF-GLS	
Model	A	B	C	Without trend	With trend
levels					
CI	-3.793	-3.848	-4.751	-0.019	-1.763
	[8/30/06]	[10/28/09]	[11/8/06]	(1)	(1)
MY	-4.867	-3.220	-4.832*	0.095	-1.785
	[7/9/97]	[4/11/01]	[7/9/97]	(0)	(0)
SG	-3.301	-2.843	-3.263	-0.526	-2.135
	[2/26/97]	[7/18/01]	[2/26/97]	(0)	(0)
ID	-4.221	-3.871	-4.346	1.089	-2.104
	[8/6/97]	[9/5/01]	[1/19/00]	(3)	(3)
TH	-4.113	-3.184	-4.014	-0.968	-1.006
	[7/10/96]	[6/24/98]	[7/10/96]	(0)	(0)
PH	-3.242	-3.176	-3.565	0.705	-1.209
	[8/13/97]	[7/3/02]	[7/14/99]	(0)	(0)
First differences					
CI	-19.565***	-19.536***	-19.692***	-13.626***	-27.299***
	[7/27/05]	[2/15/95]	[2/15/95]	(2)	(0)
MY	-12.104***	-11.820***	-12.554***	-28.559***	-28.740***
	[9/9/98]	[8/13/97]	[9/9/98]	(0)	(0)
SG	-12.089***	-11.851***	-12.337***	-10.207***	-19.559***
	[9/9/98]	[3/26/97]	[9/9/98]	(4)	(1)
ID	-14.053***	-13.899***	-14.113***	-13.624***	-13.851***
	[10/30/02]	[8/27/97]	[9/30/98]	(2)	(2)
TH	-12.595***	-12.517***	-13.020***	-4.205***	-16.961***
	[9/9/98]	[10/16/96]	[9/9/98]	(10)	(1)
PH	-19.137***	-19.110***	-19.258***	-4.001***	-16.676***
	[7/10/96]	[8/27/97]	[9/16/98]	(10)	(1)

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. DF-GLS and ZA are unit root tests proposed by Elliot et al. (1996) and Zivot and Andrews (1992), respectively. The numbers in parentheses are the lag order, being selected on the basis of SC, in the DF-GLS tests. The numbers in brackets of the ZA tests are the estimated structural break dates.

There are two main breakpoints of ZA's tests for ASEAN-5. The first breakpoint is around 1997-1998 which is caused by the 1997-1998 Asia financial crisis. The second breakpoint is around the period from 2000 to 2002, which contained a number of events that drove stock prices lower including the internet bubble, 911 terrorist attacks and Bali bombing terrorist attacks. As to China's breakpoints, the first breakpoint is around 1995 which is triggered by the promulgation of the Commercial Bank Law in 1995. The Commercial Bank Law further deepened the country's financial reforms and lay the foundation of a modern banking system in China. The second breakpoint is around the period from 2005 to 2006, which contained some financial reforms including the Renminbi reform[7] of July 2005 and its banking sector was fully open to foreign competition by 2006 under China's commitment to the WTO. The third breakpoint, on Sep. 2009, is caused by Chinese government adopting some important steps toward internationalization of the RMB since 2009.[8]

Besides, Table 4 presents the results of unit root test with two endogenous structural breaks by applying the method of Narayan and Popp(2010 , hereafter NP), in which they propose a new augmented Dickey–Fuller-type test for two-break unit roots. The NP test chooses the break date by maximizing the significance of the break dummy coefficient. Table 4 presents the unit-root tests with null hypothesis of stationary. We show the level and first difference in Panel A and Panel B, respectively. All results of Table 4, the NP unit root tests with two structural breaks, also confirm that all variables follow I(1) processes at 5% significance level. This paper also applies monthly data to examine NP unit root test with two endogenous structural breaks, and the results of NP unit root test are on table A1 of appendix, which also confirms that all variables follow I(1) processes as weekly results.

[7] The fixed exchange rate regime in China was abandoned until July 22, 2005.

[8] In July 2009, China launched a pilot program that permitted settlements in RMB of the trade from some mainland cities with Hong Kong, Macau, and ASEAN. In September 2009, to create an offshore market to set the benchmark "risk-free" interest rate for RMB debt instruments, RMB-denominated sovereign bonds were issued to offshore investors in Hong Kong.

Table 4 Results of NP's Unit Root Test with two endogenous structural breaks

Panel A: Level									
		M1				M2			
No.	Country	Test statistics	TB1	TB2	k	Test statistics	TB1	TB2	k
1	CI	-3.751	20011022	20080118	4	-3.788*	20011022	20080118	4
2	ID	-2.487	19980122	19990430	4	-2.723	19980122	19990430	4
3	TH	-0.7098	19980122	20061218	4	-2.439	19980122	20061218	4
4	MA	-2.483	19971204	19980122	1	-1.688	19971204	19980122	4
5	PH	-1.78	19980122	20001102	1	-2.165	19980122	20001102	1
6	SG	-1.727	19980122	20010910	1	-1.87	19980122	20010910	1
Panel B: First Difference									
		M1				M2			
No.	Country	Test statistics	TB1	TB2	k	Test statistics	TB1	TB2	k
1	CI	-25.16***	20011019	20080117	5	-25.26***	20011019	20080117	5
2	ID	-33.87***	19980121	19990428	3	-34.04***	19980121	19990428	3
3	TH	-32.54***	19980121	20061215	3	-32.74***	19980121	20061215	3
4	MA	-33.78***	19971203	19980121	3	-34.17***	19971203	19980121	3
5	PH	-25.5***	19980121	20001031	5	-25.66***	19980121	20001031	5
6	SG	-59.66***	19980121	20010907	0	-59.7***	19980121	20010907	0

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

4.2 *The results of cointegration tests with structural breaks*

Our innovation period encompassed a violent era in China and the ASEAN-5 characterized by financial and economic innovation. Thus, it is important to ensure the cointegration relationship with structural breaks (Lee, 2013). The methodology of Gregory and Hansen (1996, hereafter GH) is used to test for cointegration between variables in the models with structural breaks. The GH test is based on the notion of structural change and is a generalization of the usual residual-based cointegration test for the null of no cointegration against three alternative hypotheses (models) of cointegration with a regime shift.[9] Table 5 shows the results of GH cointegration tests, which are based on a single equation with CI as the dependent variable.[10] Most of the ADF^* and Z_t^* test statistics reject the null hypothesis, which reveals the existence of a long run co-integrating relationship with a structural break between the Chinese and ASEAN-5 stock markets. However, the Z_α^* test statistic produced opposite results. The empirical evidence shows that the main structural break around early 2007 affected the stability of convergence among cross-border equity markets in China and the ASEAN-5. In early 2007, the benchmark Shanghai Composite Index drop down nearly 9% on Feb. 27th, which followed the news that the People's Bank of China raised the required reserve ratio for financial institutions engaging in deposit business by 0.5 percentage points. Besides, in the meeting on 17 January 2007, the Bank of Thailand decided to use repurchase rate in place of inflation as the monetary policy operating target.

Table 5 The Results of Gregory and Hansen Cointegration Tests

Test statistic	C	C/T	C/S
ADF^*	-5.819**	-5.806	-7.081**
	[1/24/07]	[1/24/07]	[1/17/07]
Z_α^*	-58.507	-58.737	-78.092
	[1/17/07]	[1/17/07]	[8/14/02]
Z_t^*	-5.996**	-5.998**	-6.824**
	[1/17/07]	[1/17/07]	[1/26/05]

Notes: A, B, and C denote model types and correspond to the three models in Gregory and Hansen

[9] GH consider three alternative models - a level shift (model C), a level shift with trend (model C/T), and a regime shift that also allows the slope vector to shift (model C/S).

[10] GH has developed versions of the cointegration ADF tests of Engle and Granger (1987), and the Z_t and Z_α tests of Phillips-Quliaris (1990), whereby they were modified according to the alternative considered.

(1996). The critical values are from Table 1 of Gregory and Hansen (1996). ** indicates significance at the 5% level. The numbers in brackets are the estimated structural break dates.

Besides, we also apply the Arai and Kurozumi (2007) (AK hereafter) cointegration, which is conditioned on multiple structural breaks, and the null hypothesis of the AK method is that the variables have a cointegration relation. Table 6 displays the results of AK's cointegration tests, which are based on the regime shift model.[11] As Table 6, the value of the test statistic for 2 breaks, $\widetilde{V_2}(\hat{\lambda})$, is 0.041, which means that the null hypothesis is accepted at 5% significant level. In other words, there is a cointegration with two breaks between the Chinese and ASEAN-5 stock markets, and the timings of two structural breaks are on Oct. 1995 and on Nov. 2004, respectively.

What brought about the structural break around 1995? The promulgation of the Commercial Bank Law in 1995 caused the country's financial reforms more deep. The Commercial Bank Law ensures and protects the independent operations of commercial banks, and explicitly separates the commercial banking from the securities business and investment banking. Therefore, the Commercial Bank Law lay the foundation of a modern banking system in China. With regard to the second structural break, around the end of 2004, which contained some events of changing the economic interrelationship between China and ASEAN-5 including a key element in the 2002 ASEAN-China Agreement is an Early Harvest Programme set to start in 2004, and in the ASEAN+3 Foreign Ministers' Meeting on Nov. 2004, it was agreed that an East Asia Summit be held.

Table 6 Arai and Kurozumi Conitegration Tests with Multiple Structural Breaks

Test $\widetilde{V_2}(\hat{\lambda})$		$\hat{T}_1$	$\hat{T}_2$
0.041		1995/10/5	2004/11/3
	10%	5%	1%
Critical values of $\widetilde{V_2}(\hat{\lambda})$	0.0754	0.0934	0.1545

Notes: $\widetilde{V_2}(\hat{\lambda})$ is the test statistic for 2 breaks, and $\hat{T}_1$ and $\hat{T}_2$ are the first and second breaks, respectively. Critical values are obtained by simulation using 2000 replications.

[11] They considered three types of models: level shift, level shift with trend, and regime shift. The regime shift model is considered in this paper.

Brada et al. (2005) argue that "traditional tests for the presence of cointegration over the entire sample period would thus tend to reject the hypothesis that the series are cointegrated if the extent of cointegration changes over time. Additionally, because the change is gradual, tests for structural breaks in the model are likely to reject the hypothesis of a structural break." Breaks occur regularly, which preclude a stable, long run relationship between the variables. Although the results of GH (1996) and AK (2007) show the inconsistent structural breaks, the former break is around early 2007, while the later breaks are on Oct. 1995 and on Nov. 2004, which still suggests the possibility of time-varying cointegration among these six stock markets. Hence, to study the possibility of slowly time-varying cointegration, we apply rescursive cointegration, a technique allowing for changes in the relationship between a system of variables, to discuss the dynamic cointegration among China and the ASEAN-5 stock markets.

These tests suggest that a structural change in the cointegration vector is important and must be considered in the specification of the long-run relationship between these series.

4.3. The results of the recursive trace statistics

To reveal the dynamics of convergence, a recursive cointegration test is used to examine the time-varying nature of convergence. We use the recursive cointegration tests to investigate the degree of convergence during different sub-sample periods of the full sample using the cointegration rank tests of Johansen (1988, 1991). The Johansen tests use the following vector autoregressive (VAR) system:

$$\Delta Y_t = \sum_{i=1}^{k-1} \Gamma_i \, \Delta Y_{t-i} + \Pi Y_{t-1} + \varepsilon_t \quad , t = 1, \dots, T \quad , \quad i = 1, \dots, k-1 \quad ,$$

$$\Gamma_i = -I + \Pi_1 + \cdots + \Pi_i \quad , \qquad \Pi = -(I - \Pi_1 - \Pi_2 - \cdots - \Pi_k) \qquad (1)$$

where Yt indicates a vector containing the six Asia stock market indices in log form. The impact matrix Π can be decomposed as $\alpha\beta'$, where α is the matrix of the short-run adjustment coefficients to the cointegrating vectors (the β matrix). The relevant hypotheses are in regard to Π; if the rank of Π is r, where r ≤ n-1, then r is called the cointegration rank.

There are two alternative test statistics for the rank of ∏ in Johansen's model:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{g}\ln(1-\hat{\lambda}_i) \quad (2)$$

$$\lambda_{\max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1}) \quad (3)$$

where $\hat{\lambda}_i$ are the eigenvalues of the estimated Π matrix and T is the number of usable observations. The first statistic of equation (2) is the trace statistic and the second statistic of equation (3) is the maximum eigenvalue statistic.

Next, we use the trace statistic of the recursive cointegration test to investigate the time-varying nature of convergence. The continuous graph of trace test statistics for are recursive, fixed-length window shows essential information about the dynamics of the number of cointegrating vectors. Here we adopt a one-calendar year of initial recursive cointegration estimation. That is, the test statistics are estimated using 47 observations at first and by adding one observation to the end as time increasing. The optimal lag length of one is selected on the basis of SC. Fig. 1 shows the standardized trace statistics for the numbers of common trends in the VAR over time

Figure 1 plots the scaled trace test statistics for the null hypotheses $\mathrm{r} \leq \mathrm{i}, \mathrm{i} = 0,1,2,3,4,5$. The upper line in figure 1 showing the path of tests for $\mathcal{H}(\mathrm{r} \leq 0|\mathrm{r} = 6)$ is over 5% critical value over much of the period from 1994 to 2002, which shows that the six non-stationary time series are linked together by one cointegration vector. In other words, this finding shows that the six national stock markets have at most one cointegrating vector from 1994 to 2002. In a common trend framework, this result suggests that five stochastic trends drove the Chinese and ASEAN-5 stock markets over much of the period from 1994 to 2002. Does this prove that the integration of the Chinese and ASEAN-5 stock markets increased between 1994 and 2002? We should be cautious in drawing this inference, particularly for the period from 1997 to 1998, because market contagion and volatility spillover may have also contributed to the strong cointegration of the Chinese and ASEAN-5 stock markets during the Asian financial crisis (Yu et al., 2010) In other words, the cointegration of the Chinese and ASEAN-5 stock markets during the Asian financial crisis may be the result of market contagion and volatility spillover.

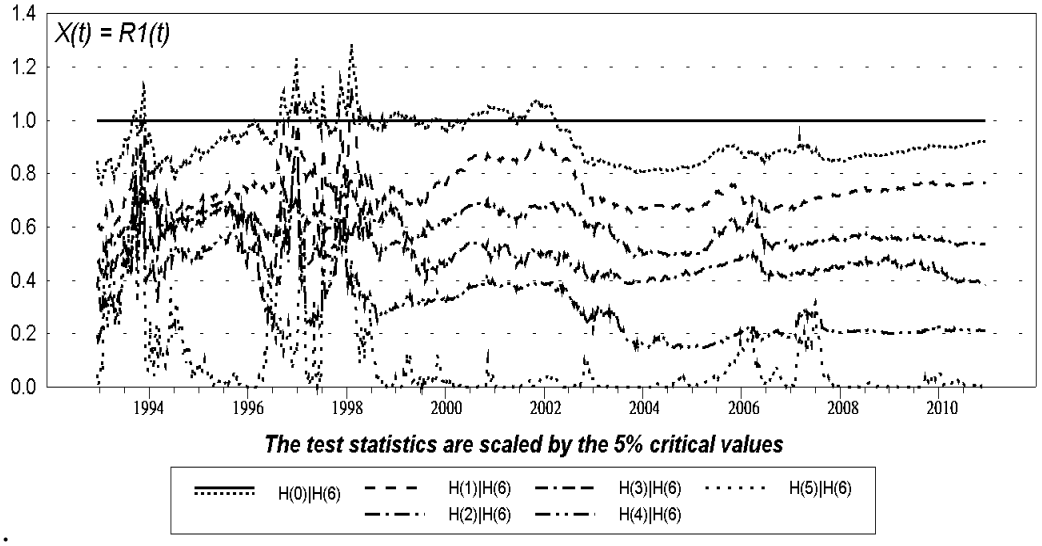

Figure 1 Recursive standardized trace statistics.

After nearly two years of falling stock prices, stock markets began recovering toward the end of 2003. The recovery was precipitated by the implementation of some important capital market initiatives, including the Asian Bond Markets Initiative (ABMI) and the Asian Bond Fund (ABF) initiative, geared toward reinforcing financial cooperation and integration in the region. Hence, as Fig. 1 demonstrates, the largest eigenvalue of the recursive trace statistics shows an increasing trend approaching the 5% critical value before the global financial crisis of 2008. The crisis caused an adjustment in the financial markets of many countries, which reversed the financial integration that had taken place between China and ASEAN-5. This, in turn, led to a significant downward trend in the trace test statistics under the 5% critical value. Even the test statistics show some signs of a tendency to increase. However, all of the test statistics were consistently smaller than one, indicating that no integration occurred between China and the ASEAN-5 stock markets after 2002. Our results are identical to those of Yu et al. (2010), which found that the Asian equity markets only partially converge.

A number of reports stress an increasing influence of China on other Asian stock markets. However, the Chinese influence has been stable and not very large. As mentioned in Section 2, the U.S. is the largest investor country in the region. Investment in this region increased from 14.71% in 2001 to 18.89% in 2011, which may mean that the degree of integration with the U.S. did increase. According to Park's (2011) analysis of the 2008–09 period, intraregional trades in East Asian were, on average, 45 percent of total exports and 49 percent of total imports. Park (2011) argues that, "Compared to the share of intra-regional trade of the EMU in 1989 (10 years before the creation of the euro), these figures are much lower." Overall, regional

financial integration between China and the ASEAN-5 has been increasing, but remains limited, falling behind the level of integration between the U.S. and global financial markets. Fujiwara & Takahashi (2012) also show that "In regards to the developments in the stock markets in Asian economies, the United States remains the major source of the comovements."

4.4 The estimation of recursive coefficients of cointegration vector β and adjustment coefficient α

The results in Section 3.3 demonstrate the existence of at most one long run relationship between the Chinese and ASEAN-5 stock markets before 2002. Because cointegration determines whether various stock markets contain long-term equilibrium relationships, coefficients of the cointegrating vector can show how the stock markets are related in the long run. Hence, we estimate the recursive coefficient matrix for the cointegrating vectors, matrix $\boldsymbol{\beta}$, in Fig. 2. Figs. 2(A) to 2(E) present the dynamic estimating results of recursive coefficients of cointegration vector β, containing China and the ASEAN-5 stock market indices in the log form. Additionally, the cointegrating vectors are normalized around the China index. It is interesting that China is inversely related to Singapore and the Philippines, as Figs. 2(B) and 2(E) show, in much of the cointegrating period (before 2002). There are some circumstances in which markets are oppositely related, and some shocks may explain the inverse relationship. Investors can make benefits gains toward portfolio diversification in these two inversely related stock markets.

As for other equilibrium relationships, the results are more complicated. The 1997 Asian financial crisis changed the relationships between the Chinese and some ASEAN-5 stock markets. As Figs. 2(C) and 2(D) show, the Indonesian and Thai stock indices negatively affected the China index for much of the period before 1997, while the indices' relationships turned positively after 1997. China's index was positively related to Malaysia's, as Fig. 2(A) shows, for much of the period before 1997, while it became inversely related after 1997. Voon and Yue (2003) empirically studied China and the ASEAN export rivalry regarding the U.S. market, finding that China and Malaysia performed better than the other ASEAN-4 countries in their total exports to the U.S. over the period 1993–2000. This situation could have caused these two stock markets to move in the same direction as the changes in the U.S.'s business cycles. However, the 1997 financial crisis appeared to improve China's industry structure. This, however, adversely affected Malaysia because it cannibalized the country's competitive advantage after the crisis (Voon and Yue, 2003). Additionally, the changes in the competitive advantage of these two countries after the 1997 financial

crisis caused an inverse relationship between Chinese and Malaysian stock prices.

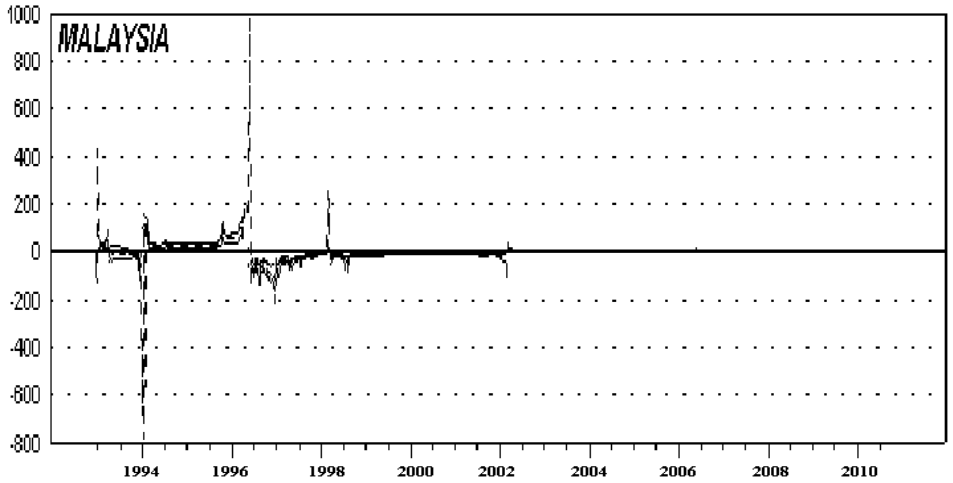

Figure 2(A) The recursive coefficients of cointegration vector β (Malaysia)

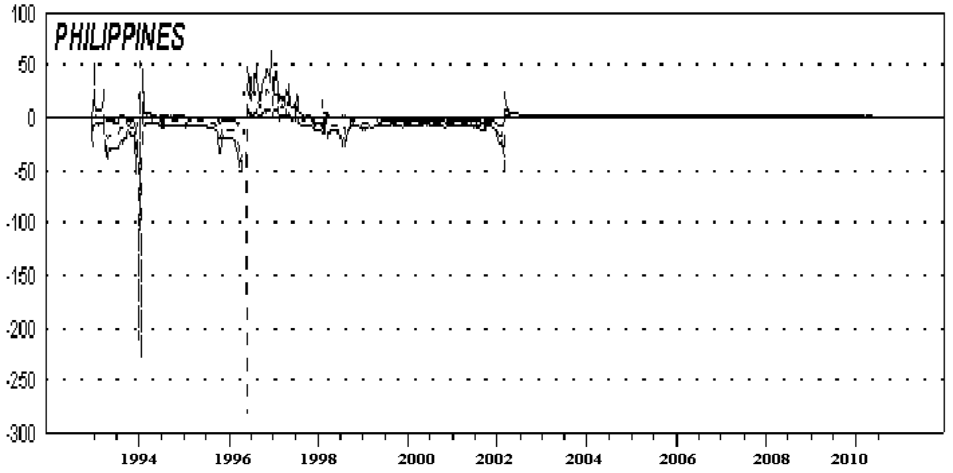

Figure 2(B) The recursive coefficients of cointegration vector β (Philippines)

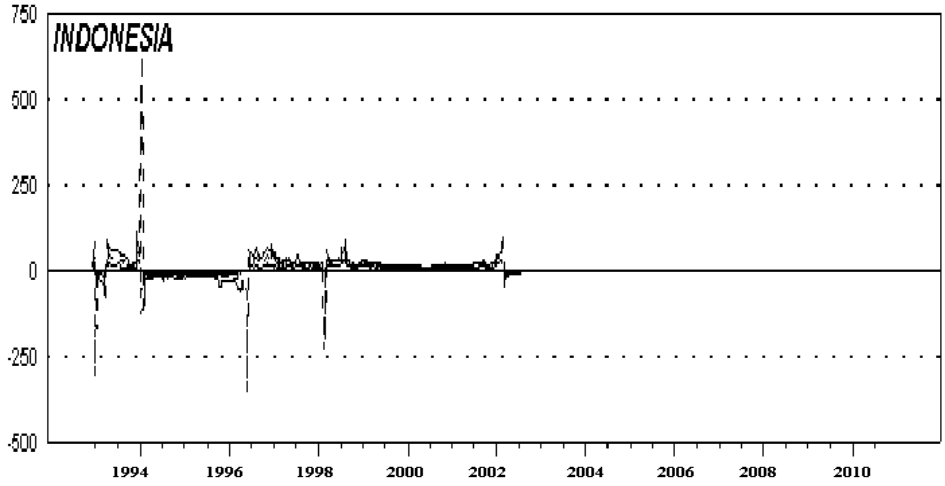

Figure 2(C) The recursive coefficients of cointegration vector β (Indonesia)

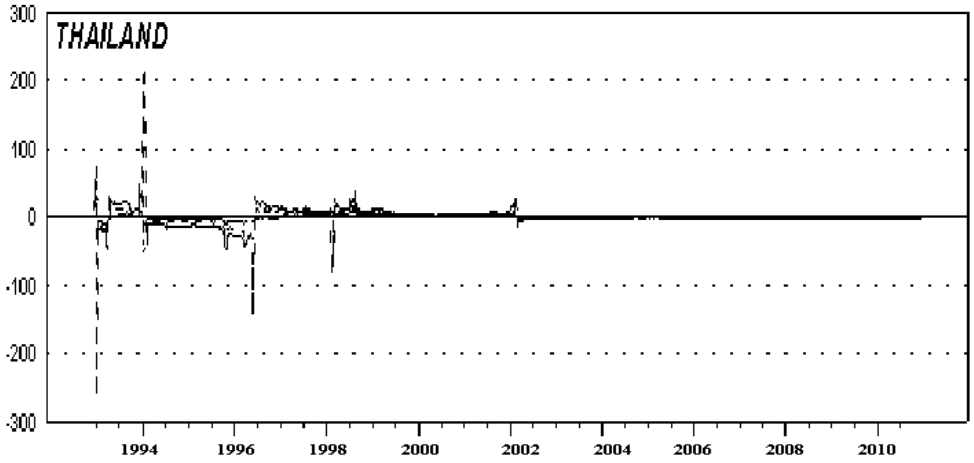

Figure 2(D) The recursive coefficients of cointegration vector β (Thailand)

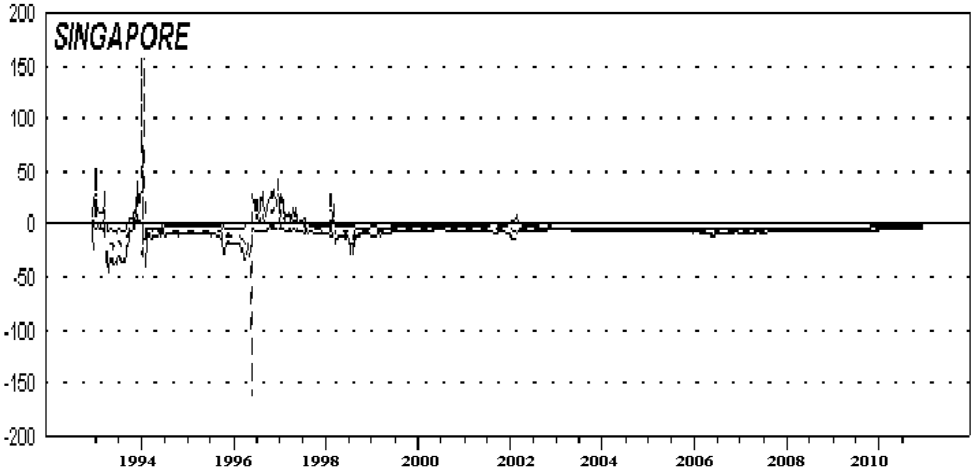

Figure 2(E) The recursive coefficients of cointegration vector β (Singapore)

Next, we estimate the recursive coefficient matrix of the error correction terms (matrixα**)** [see Figs. 3(A) to 3(F)], which present the recursive estimates for those coefficients along with their 95% confidence intervals. Because cointegration existed among the six stock prices before 2002 (as is evident in the results presented in the previous section), we will limit our discussion of the recursive coefficients to the period prior to 2002.

Several main observations emerge from Figs. 3(A) to 3(F). First, in much of the cointegrating period (before 2002), the coefficient estimates of the six stock prices are negative, which shows that these stock prices will decrease in response to a positive deviation from a long-run equilibrium. Second, the coefficients of four stock markets, Malaysia, Thailand, the Philippines and Singapore, are generally statistically insignificant for much of the cointegrating period (before 2002) because they fall inside the confidence intervals, which include the value of zero. As for China and Indonesia, the coefficients of ECTs are statistically significant and negative during much of the cointegrating period (before 2002), which means that whenever the actual value of these two stock prices fell short of equilibrium in a given period, the error-correction mechanism could cause the value to adjust toward the long run equilibrium value in the following period. Additionally, all of the adjustment of this cointegration fell on the stock markets of China and Indonesia.

The final point stemming from the results in Figs. 3(A) to 3(F) concerns the magnitude of the speed of the adjustment parameters. We can classify these six stock markets into two groups. The first group includes China and Indonesia, which had relatively larger magnitude speed of adjustment coefficients[12] during much of the cointegrating period. In general, larger absolute values of those coefficients show a faster response of the short-run dynamics to deviations from the long-run equilibrium. Thus, compared to the other four countries, China and Indonesia seem to return to equilibrium faster after a shock. On a broader level, this can also be caused by the fact that both China and Indonesia, the two largest economies among the six studied, are the major drivers of East Asian economic and financial integration. The second group of economies includes those with relatively smaller adjustment coefficients. The coefficients of Singapore and Malaysia are the smallest and are statistically insignificant, indicating that the changes in their stock systems cannot increase Singaporean and Malaysian stock prices.

[12] The coefficient of China is between -0.01 and 0.02, and the coefficient of Indonesia is between -0.01 and 0.005 during much of the cointegrating period (before 2002).

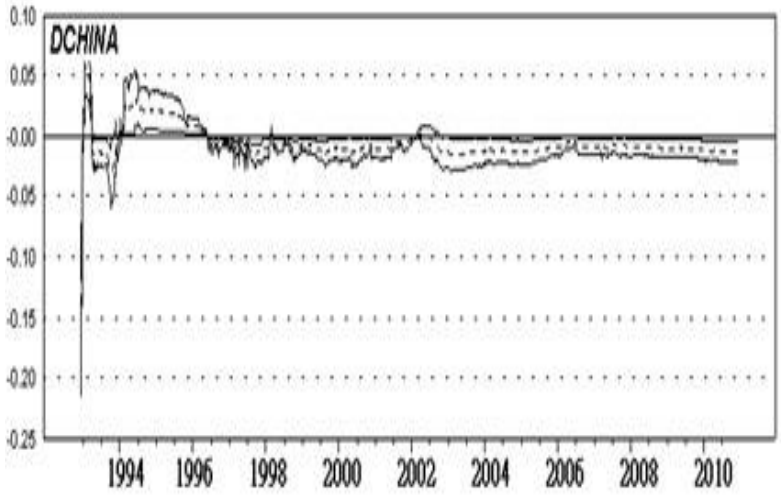

Figure 3(A) The recursive speed of adjustment coefficients α(China)

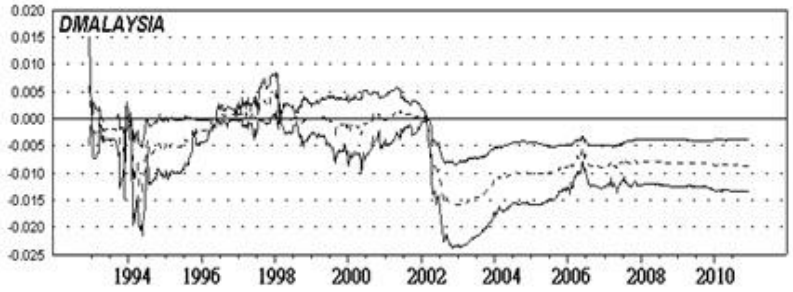

Figure 3(B) The recursive speed of adjustment coefficients α(Malaysia)

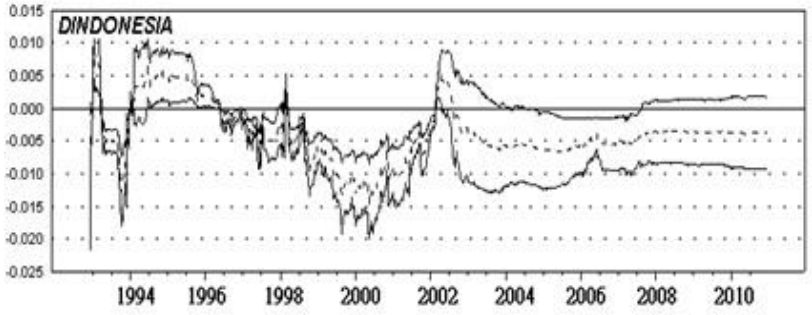

Figure 3(C) The recursive speed of adjustment coefficients α(Indonesia)

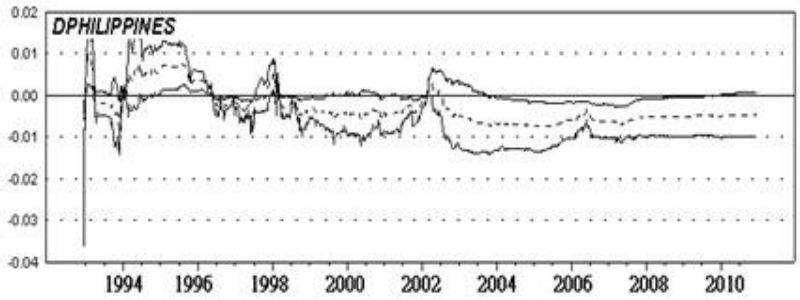

Figure 3(D) The recursive speed of adjustment coefficients α(Philippines)

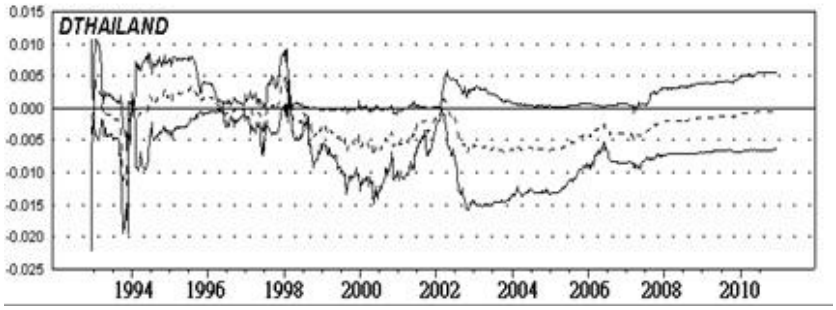

Figure 3(E) The recursive speed of adjustment coefficients α(Thailand)

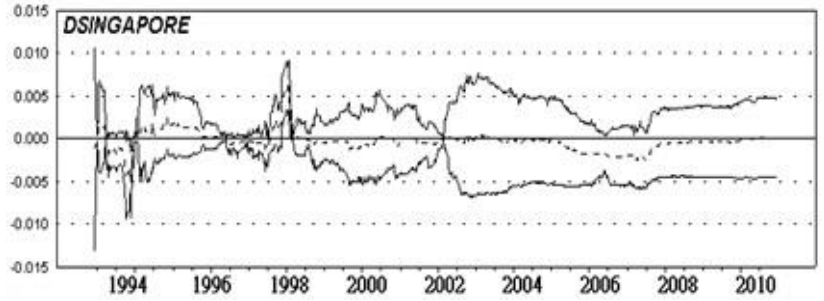

Figure 3(F) The recursive speed of adjustment coefficients α(Singapore)

4.5 Further Discussion

A further issue we are going to investigate is the heteroskedasticity in the data of stock prices. The generalized autoregressive conditional hetroscedasticity (GARCH) model introduced by Engle (1982) and Bollerslev (1986) has been used to account for the time-variant conditional variances. Hence, we use error correction model with a GARCH error structure to discuss the short-run adjustment of these six stock markets. Because the result of recursive cointegration (as figure 1) shows the cointegration existed before 2002 but it did not after 2002, we divide the full sample into subsamples, period Ⅰ is from 1992 to 2002 and period Ⅱ is from 2003 to 2013, and the results of the GARCH(1,1) models for two periods are estimated as Table 7 and 8. All b_1 are significantly positive for these six stock markets on both periods, which implies volatility clustering and persistency in the positive changes of a stock index. Besides, b_1 is smaller on period Ⅱ for most of countries, which shows that volatility persistence of stock return becomes smaller for most of these six countries after 2002. There are two exceptional cases, China and Singapore, volatility persistence of stock return for both countries increases after 2002.

Table 7 the results of GARCH (period Ⅰ - from 1994 to 2002)

dependent variable / independent variable	dCI_t	dID_t	dMY_t	dPH_t	dTH_t	dSG_t
C	-0.0002	0.0004	0.0005	4.17×10^{-6}	-0.0003	0.0004
EC_{t-1}	-0.0014^{**}	-0.0006	0.0001	-0.0009^{*}	-0.0022^{***}	-0.0002
dCI_{t-1}	0.0106	0.0025	-0.0037	-0.0133	-0.0466^{***}	-0.0053
dID_{t-1}	-0.0087	0.2066^{***}	0.0389^{*}	0.0440^{**}	0.0765^{***}	-0.0102
dMY_{t-1}	-0.0524^{**}	0.0148	0.0952^{***}	0.0400	0.0288	0.0340^{*}
dPH_{t-1}	-0.0682^{***}	0.0312^{*}	-0.0130	0.0845^{***}	0.0063	0.0353^{***}
dTH_{t-1}	0.0235	0.0172	0.0039	0.1049^{***}	0.0948^{***}	0.0525^{***}
dSG_{t-1}	0.0648	0.0571^{**}	0.0357	0.0476*	0.0294	0.0305
GARCH parameters						
C	$2.48\times10^{-5***}$	$2.52\times10^{-6***}$	$2\times10^{-6***}$	$1.36\times10^{-6***}$	$1.64\times10^{-5***}$	$1.22\times10^{-5***}$
α_1	0.3319^{***}	0.1380^{***}	0.0628^{***}	0.1176^{***}	0.1403^{***}	0.1749^{***}
β_1	0.7487^{***}	0.8754^{***}	0.9347^{***}	0.8519^{***}	0.8397^{***}	0.7928^{***}

Notes: ***, **, * represent significance at 1%, 5%, and 10% level, respectively. EC_{t-1} is error correction term, and the equation of conditional variance is as $h_t = c + a_1\varepsilon_{t-1}^2 + b_1 h_{t-1}$. $a_{1\,I}$ is the measure of the autoregressive conditional heteroscedasticity (the ARCH effect), b_1 is the measure of volatility persistence (the GARCH effect).

Table 8 the results of GARCH (period Ⅱ - from 2003 to 2013)

dependent variable / independent variable	dCI_t	dID_t	dMY_t	dPH_t	dTH_t	dSG_t
C	0.0001	0.0016^{***}	0.0006^{***}	0.0010^{***}	0.0012^{***}	0.0007^{***}
dCI_{t-1}	-0.0124	-0.0034	0.0073	0.0139	-0.0369^{**}	-0.0186
dID_{t-1}	0.0172	0.0665^{**}	0.0302^{**}	0.0611^{***}	0.0730^{***}	0.0070
dMY_{t-1}	-0.0450	-0.0449	0.0607^{**}	-0.0466	0.0286	0.0384
dPH_{t-1}	-0.0477^{*}	0.0144	-0.0162	0.0404	0.0646^{**}	0.0068
dTH_{t-1}	0.0255	0.0196	0.0316^{***}	0.0665^{**}	0.0225	0.0238
dSG_{t-1}	0.0365	0.0527	0.0492^{***}	0.0994^{***}	-0.0006	-0.0265
GARCH parameters						
C	$3.87\times10^{-6***}$	$1.12\times10^{-5***}$	$1.21\times10^{-6***}$	$2.62\times10^{-5***}$	$2.04\times10^{-5***}$	$2.04\times10^{-6***}$
a_1	0.0639^{***}	0.1516^{***}	0.1033^{***}	0.1259^{***}	0.1043^{***}	0.0947^{***}
b_1	0.9266^{***}	0.8226^{***}	0.8909^{***}	0.7658^{***}	0.8162^{***}	0.8977^{***}

Notes: same as table 7.

4.6 *Robustness checking for the recursive cointegraion*

For checking whether the results of different data frequency will change the time-varying nature of convergence for these six stock markets, we also present the trace statistic of the recursive cointegration test for monthly data. Monthly recursive cointegration provides a longer term perspective on market integration. Figure 4 plots the scaled trace test statistics for monthly data. The upper line in figure 4 showing the monthly path is bigger than 5% critical value over much of the period before 2002, and it is same as the weekly result, that is, the cointegration existed between China and the ASEAN-5 stock markets before 2002 but it did not after 2002. Besides, we also presents the monthly recursive speed of adjustment coefficients α as figures A1 of appendix, and the monthly coefficients α are higher than the weekly ones, being similar with the finding of Narayan et al.(2014).

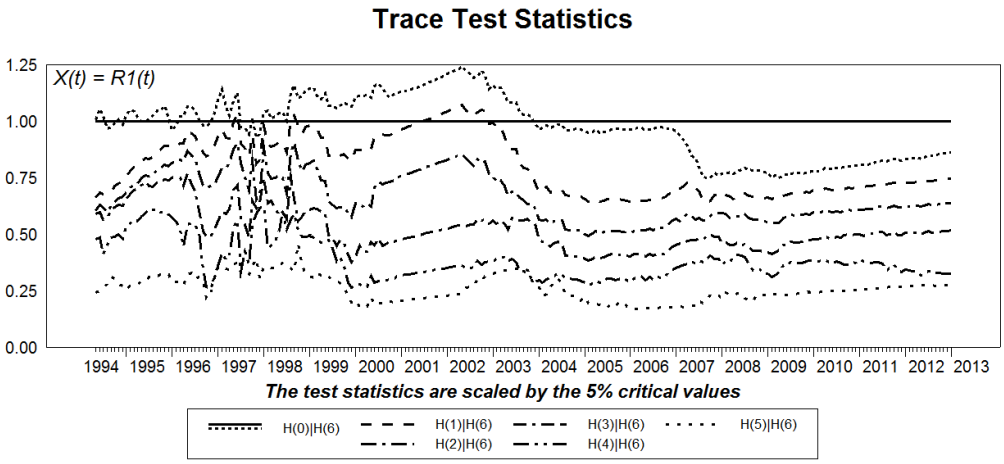

Figure 4 Recursive standardized trace statistics (Monthly data).

5. Conclusions and Suggestions

This paper investigates the time-varying, long run relationship between the Chinese and ASEAN-5 stock markets. To examine the implications of the time-varying behavior of these linkages among these six stock markets, we apply a two-step testing procedure, the cointegration tests with structural breaks and recursive cointegration. The results of the GH (1996) and AK (2007) show there are some structural breaks of cointegration among China's and the ASEAN-5 stock markets, the breaks are on Oct. 1995, Nov. 2004, January 2007, respectively. Hence, when analyzing the relationship of cross-border stock market development between China and the ASEAN-5, there is the possibility of time-varying cointegration among these six stock markets.

Next, we use the recursive cointegration technique to trace the pictures of the possible dynamic linkages among China and the ASEAN-5 markets. The results of the recursive trace statistics show that these six stock markets had at most one cointegrating vector between 1994 and 2002. Overall, regional financial integration among China and the ASEAN-5 has been increasing, but remains limited.

Furthermore, the recursive coefficients of the error correction terms allow for some interesting observations. First, the coefficient estimates of these six stock prices are negative during much of the period, which shows that these six stock prices will decrease in response to a positive deviation from a long-run equilibrium. Second, the coefficients of ECTs are statistically significant and negative in China and Indonesia during much of the period, but the coefficients of other countries are insignificant. These results indicate that all of the adjustment of this cointegration fell on the Chinese and Indonesian stock markets. Finally, according to the estimating magnitude speed of adjustment coefficient, China and Indonesia seem to return to equilibrium after a shock faster than the other four countries studied. This may be attributable to the fact that China and Indonesia are the two largest economies out of the six and are thus the major drivers of East Asian economic and financial integration.

Overall, our empirical evidences show that regional financial integration among China and the ASEAN-5 has been increasing, but remains limited. However, for the longer-term future, integration among China and the ASEAN-5 stock markets will cause a greater and more diversified market and pool of investors. According to the results of our empirical results, we may give some suggestion as following:

First, it's worth noting for investors, many of these stock markets had serious corporate governance issues, which needed comprehensive reforms at many levels. Hence, to develop a comprehensive framework to enhance corporate governance standards, it is important to get supports from the government, corporate sector, industry and regulators.

Second, for governments and regulators, stock market integration will improve the efficient allocation of capital, which is caused by the fact that savings can flow more easily and at cheaper cost to investment under liberalisation. The policy makers should execute sequenced liberalisation and integration process. Moreover, using harmonisation and mutual recognition agreements, China and ASEAN-5 markets could improve their regulatory standards by benchmarking with international standards and adopting best practices.

Third, integration will also speed the development of the less developed capital markets because they can benefit from the experiences of the advanced markets and hasten their adoption of international standards. Nevertheless, care has to be taken that regional integration is not an obstacle to the efforts of each individual market to develop themselves, and it should be executed in a systematic and complimentary way, which will confirm that domestic and regional efforts improve efficiently and in tandem. (Singh, 2010)

Finally, there will also be differences in perceived cost and benefits towards integration. Some markets, for large countries like China and Indonesia, may be sizeable enough, which can make them not pursue integration and just focus their efforts on building their own domestic capital markets. For countries like Malaysia and Philippines, however, the markets could benefit from greater liberalisation and to take the challenges of international competition and globalisation. Especially, for Singapore, having the most developed market in the region and various types of financial products, there is a high potential of higher presence of foreign financial intermediaries with Singapore as the main beneficiary. Hence, the improvement of policy coordination efforts is required and explicit goal setting is needed for the short, medium and long-term. (Singh, 2010)

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Appendix

Table A1 Results of NP's Unit Root Test with two endogenous structural breaks (Monthly data)

Panel A: Level									
		M1				M2			
No.	Country	Test statistics	TB1	TB2	k	Test statistics	TB1	TB2	k
1	China	-3.15	1999M05	2008M09	0	-2.131	2008M05	2008M09	5
2	Indonesia	-2.734	1998M07	2008M09	1	-2.929	1998M07	2008M09	1
3	Thailand	-2.372	2002M05	2008M09	0	-3.264	2002M05	2008M09	0
4	Malaysia	-0.5141	1998M07	1999M03	4	-0.5086	1998M08	1999M03	3
5	Philippines	-1.826	1998M07	1998M09	2	-1.703	1998M09	2008M09	2
6	Singapore	-2.922	1997M09	2008M09	0	-1.841	1998M09	2008M09	0
Panel B: First Difference									
		M1				M2			
No.	Country	Test statistics	TB1	TB2	k	Test statistics	TB1	TB2	k
1	China	-9.886***	2008M04	2008M08	4	-9.916***	2008M04	2008M08	4
2	Indonesia	-14.55***	1998M06	2008M08	0	-12.45***	1998M06	2008M08	1
3	Thailand	-16.44***	2002M04	2008M08	0	-16.34***	2002M04	2008M08	0
4	Malaysia	-10.36***	1998M06	1999M02	3	-8.628***	1998M07	1999M02	2
5	Philippines	-15.99***	1998M06	1998M08	0	-16.51***	1997M12	1998M08	0
6	Singapore	-16.58***	1998M08	2008M08	0	-16.84***	1998M08	2008M08	0

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

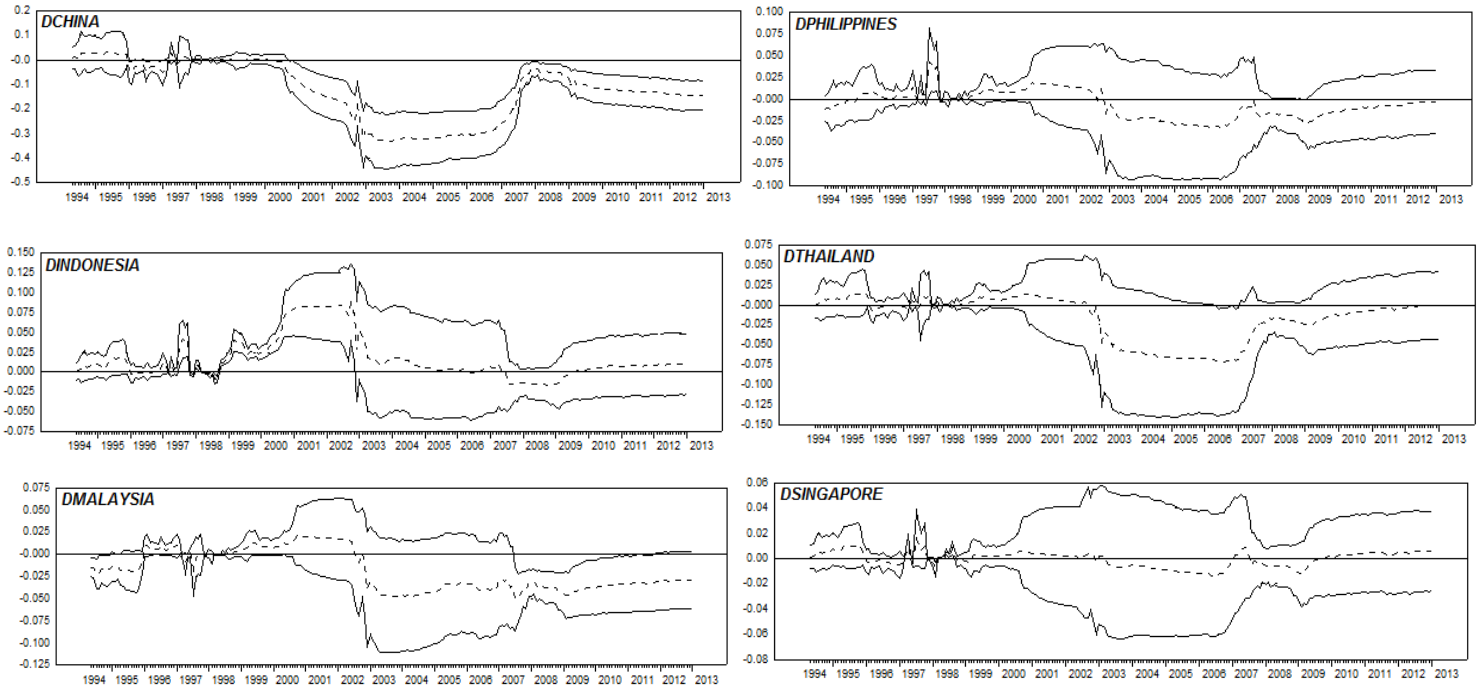

Figure A1 The recursive speed of adjustment coefficients α