Global and Regional Financial Integration of Asian Stock Markets

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Abstract

Financial integration has been an issue of enduring interest in Asia especially in the aftermath of Asian financial crisis, 1997; and central to the empirical research on this topic is the question: "how financial integration is actually measured, and which type of financial markets can conveniently reflect the interconnection between Asia and the World". In an attempt to explore some of the dimensions of this complex structure of global and regional financial integration, this paper thus, measures the existence and the level of inter-linkages among the equity markets of Asia with the world and the Asian region by deploying the methodology of beta and sigma convergence.

Keywords: Financial integration, Asian economies, Beta convergence, Sigma convergence

1. Introduction

Financial integration can be defined as "the extent to which markets are connected" or "the degree to which participants in any market are enabled and obliged to take notice of events occurring in other markets" (Kenen, 1976). The importance of financial openness and integration in economic policy was first highlighted in 1960s with the emergence of the concept of Impossible Trinity - a trilemma in international economics theoretically developed by Robert Mundell and Marcus Fleming; which declares the openness of capital accounts as one of the three most desired goals of economic policy [(Fleming, 1962), (Mundell, 1963)]. However, it became the foundation of open economy macroeconomics with the effective liberalization of financial markets in 1980s around the world; and since then, financial integration has become a widely studied concept and it has been considered as a necessary and significant part of economic policy. In Asia, financial integration has been the issue of enduring interest, especially in the aftermath of Asian Financial crisis of 1997 within the context of the region's re-emergence from crisis, its outpaced growth performance, its largest holding of foreign exchange reserves, its growing role in global imbalance, its ongoing economic integration process, and the generation of substantial net savings by this region (domestic savings exceeds domestic investment) during the last few years; which in fact has resulted into making the financial markets of the developed economies the financial intermediaries for the emerging economies of Asia – a trend indicative of increasing financial linkages.

Though, there is abundant evidence establishing high level of trade openness - measured as the share of exports and imports to GDP - which has been enjoyed by the emerging economies of Asia over the last many years [(Cowen, Salgado, Shah, Teo, & Zanello, 2006), (Kim & Lee, 2008)]. However, it is largely believed that the integration of their financial markets with world has been sluggish in contrast (Takagi, 2009) despite the well documented benefits of integration - efficient allocation of capital, risk sharing and risk diversification, low probability of systematic risk, institutional development and more robust market framework [(Pauer, 2005), (Kose, Prasad, Rogoff, & Wei, 2006)]; and the most highlighted reason given for this sluggishness is the contagion effect of crisis which can have strong implications for the financial stability of these economies (Fung, Tam, & Yu, 2008).

Given this background, it is essential for economic policy makers to have knowledge of the progress and the development of financial integration that corroborate with their objectives of maintaining the stability of financial and economic system. In this study, we provide an analysis of both the existence and the evolution of the integration of equity markets of Asia with the world's stock market as an indicator of their financial integration during the time period of 1999 to 2009 – the period succeeded by the Asian financial crisis of 1997-99. The Asian economies being studied are: China, Hong Kong, India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, South Korea and Thailand; and we address the following questions in particular:

- Is there any evidence of global integration in financial markets of Asia?
- If yes, what has been the speed of financial integration there?
- And finally, have the emerging economies of Asia become more financially integrated with the world or with the region during the last decade?

There are many measures and indicators that have been deployed in literature to quantify the existence and the degree of financial integrations; which can broadly be characterized as *de jure measures* and *de facto measures*; with de factor measures further classified as *price based measures* and *quantity based measures* (Kose, Prasad, Rogoff, & Wei, 2006)[1]. Nonetheless, to measure the integration of Asian equity market (using daily returns of national stock indices) with the world's market (EUX as the representative of world benchmark) over the time period of 1999 to 2009; in this paper, we use two price-based measures of financial integration - Beta convergence and Sigma Convergence - that hold on the 'Law of one Price'.

The concepts of Beta convergence and Sigma convergence though originated from the growth literature (Barro & Sala-i-Martin, 1992); but they have been employed by a number of studies to assess financial integration using the indicators of notably money market, bond market, exchange rate market, real estate market and equity market; though these studies were limited to the European markets [(Adam, Jappelli, Menichini, Padula, & Pagano, 2002), (Vajanne, 2006), (Babecky, Frait, Komarek, & Komarkova, 2009), (Srivatsa & Lee, 2010)]. Empirically, the primary benefit of using *price based measures* like *Beta and Sigma convergence* is that they allow using high frequency data that is also accurate, reliable and easily available for a longer period of time- permitting an assessment of the dynamic evolution of financial market integration. Moreover, with reference to the law-of-one-price, price-based indicators also have a clear-cut interpretation, which is often lacking for quantity indicators when based on flow data (Adam, Jappelli, Menichini, Padula, & Pagano, 2002). The remainder of the paper is organized as follow. Section 2 sets out our measure of financial integration using the indicator of national equity returns. Section 3 provides description of data and comments regarding choice of appropriate stock market indices. Section 4 presents the results regarding existence, level, degree and the speed of financial integration of Asia during the last decade and provides a discussion of the trends being observed there; and section 5 concludes.

2. Methodology

1.1 Beta convergence and Sigma convergence

Beta convergence and sigma convergence are the two concepts originated from growth literature; and the distinction provided is that: when the dispersion of income across a group of economies reduces over time, there is sigma convergence; and when there is negative partial correlation between growth in income over time and its initial level, this is labeled as beta convergence (Young, Higgins, & Levy, 2008). These concepts have been used by Adam et al (2002) as the indicators of financial integration that can summarize the convergence or divergence of financial markets over time.

Beta convergence addresses two issues. Firstly, whether integration occurs? And secondly, if it occurs, at which speed does it occur? A negative β signals the occurrence of convergence/integration and, the magnitude of β denotes the speed of convergence/integration. Beta convergence can be quantified by running the following regression

$$\Delta \boldsymbol{ER}_{i,t} = \boldsymbol{\alpha}_i + \boldsymbol{\beta ER}_{i,t-1} + \sum_{i=1}^{L} \boldsymbol{\gamma}_1 \Delta \boldsymbol{ER}_{i,t-1} + \boldsymbol{\varepsilon}_{i,t} \qquad \text{Equation 1}$$

Where $\boldsymbol{ER}_{i,t}$ in this setting is the excess return or return differential between individual country's index (i) and the benchmark index (BM) and $\Delta \boldsymbol{ER}_{i,t}$ is the difference of excess returns in two successive periods:

$$\boldsymbol{ER}_{i,t} = \boldsymbol{R}_{i,t} - \boldsymbol{R}_{BM,t} \qquad \text{Equation 2}$$

[1] (Baele, Ferrando, Hördahl, Krylova, & Monnet, 2004) also considered another category of the measures of financial integration: *News-based measures*

And $\boldsymbol{R_{i,t}}$ is the continousuly compounding return of each index obtained from following equation

$$\boldsymbol{R_{i,t} = ln\left(P_{i,t} / P_{i,t-1}\right)} \qquad \text{Equation 3}$$

The **β** coefficient in equation 1 can take values ranging from 0 to -2. The negative sign of the coefficient indicates the occurrence of integration and if this value is -1, it indicates the highest possible speed of convergence and integration where all return differentials generated in one period disappear immediately in next period. The extreme values such as 0 and -2 indicate no integration. When the value of **β** lies between 0 and -1 it indicates monotonous convergence and the returns between two markets converge after some period with a gradual unidirectional movement; however, if this value lies between -1 and -2, it would be an indication of oscillating or fluctuating convergence where in each successive period the magnitude of returns differential gradually diminishes but with alternative sign.

Sigma convergence explains how the overall degree of financial integration changes over time. The degree of financial integration increases when the cross-sectional dispersion measured by sigma convergence exhibits a downward trend over time.

$$\sigma_t = \sqrt{\left(\frac{1}{N-1}\right)\sum_{i=1}^{N}[((ER_{it}) - (\overline{ER_t}))^2]} \qquad \text{Equation 4}$$

The value of sigma is only positive. A high positive value indicates very low level of integration; whereas sigma=0 is the sign of full integration.

2 Data Description

We used, as benchmark index, "Merrill Lynch Major 11 International Index – EUX" considering it as a proxy for world market. There were some other choices, for example we could have used "MCSI World Index" or "S&P Global 1200 Index", for both are well known indices and have frequently been used as proxy of world stock market. MCSI is a composite of 1500 world's stocks, and thus, in our opinion, more inclined towards individual companies and sectors rather than on general state of economy which could possibly be seen by observing an overall index of that economy. S&P 1200 was an equally good choice but we prefer EUX which is a weighted average of 11 major national indices around the world. Table 1 below provides the structural details of EUX.

Table 1: Structure of Merrill Lynch Major 11 International Index –EUX

Underlying Indices	Country	Symbol	% Weighting
FTSE 100 Index	United Kingdom	FTSE	24.12%
XETRA DAX PF (Deutsche Borse AG)	Germany	GDAXI	12.64%
Nikkei 225	Japan	N225	12.42%
Swiss Market Index (Swiss Exchange)	Switzerland	SSMI	9.07%
All Ordinaries Index	Australia	AORD	8.66%
Compagnie des Agents de Change 40 Index (CAC 40)	France	PX1	7.88%
OMX Index (OM Stockholm AB)	Sweden	OMX	6.19%
Amex Hong Kong 30 Index	Hong Kong	HKX	6.05%
AEX-Index (Euronext Amsterdam NV (AEX))	Netherlands	AEX	5.06%
IBEX 35 Index (Mercado Continuo Espanol Sociedad de Bolsas SA)	Spain	IBEX	4.51%
MIB 30 Index (Milan Stock Exchange)	Italy	MIB30	3.40%

Source: New York Stock Exchange http://www.nyse.com/about/listed/mkt_indexes_other_us.shtml

Another important aspect that reinforces our decision to select EUX is that it has no separate representation of US and has lesser representation of Asia (Only Japan and Hong Kong) which not only removes the US Bias but also qualifies as a better benchmark of our data set which is primarily composed of ten Asian economies excluding Japan. For the data set of candidate countries under consideration, we take the following indices:

Table 2: National Indices-Data Description

Country	Index	Symbol Used for this study	Source	Series
China	Shanghai SE 180	SSE or _CN	Reuters EcoWin	ew:chn15560
Hong Kong	Hang Seng	HSE or _HK	Reuters EcoWin	ew:hkd15500
India	Bombay SE 100	BSE or _IN	Reuters EcoWin	ew:inr15510
Indonesia	Jakarta SE Composite	JSE or _ID	Reuters EcoWin	ew:idr15500
Malaysia	KLSE Composite	KLSE or _MY	Reuters EcoWin	ew:myr15500
Pakistan	Karachi SE 100	KSE or _PK	Reuters EcoWin	ew:pak15500
Philippines	Philippines SE All Share	PSE or _PH	Reuters EcoWin	ew:php15515
Singapore	SGX Straits Times	SGX or _SG	Reuters EcoWin	ew:sgd15500
South Korea	KSE KOSPI	KRE1 or _KR	Reuters EcoWin	ew:krw15500245
Thailand	SET	THB2 or _TH	Reuters EcoWin	ew:thb15500

Because the primary intention is to identify the convergence purely in stock market returns and not in total yield that contain returns possibly coming from dividends or foreign exchange or currency hedging, therefore, all candidate indices are prices return indices, reported in domestic currency and are based on closing daily quotes. We generate daily return series for all countries by taking natural log of the ratio of current index value to the previous day's value (Equation 3).

3 Results

3.1 Descriptive Statistics

Table 3 below provides the descriptive statistics of returns calculated through equation 3 for all countries including the benchmark index.

Table 3: Descriptive Statistics of Market Returns

	R_BSE	R_HKE	R_JSE	R_KLSE	R_KRE1	R_KSE	R_PSE	R_SGX	R_SSE	R_THB2	R_WLD
Mean	0.000602	0.000179	0.000484	0.000166	0.000177	0.000810	0.000305	7.86E-05	0.000244	0.000102	-4.97E-05
Median	0.000864	0.000000	0.000228	0.000000	8.63E-05	0.000411	0.000107	0.000000	0.000000	0.000000	0.000113
Maximum	0.154901	0.134068	0.076231	0.058505	0.227956	0.085071	0.077816	0.075305	0.094774	0.105770	0.185514
Minimum	-0.119364	-0.135820	-0.109540	-0.099785	-0.202466	-0.077414	-0.102460	-0.090950	-0.097525	-0.160633	-0.273669
Std. Dev.	0.018087	0.016656	0.015267	0.009947	0.019676	0.015717	0.011673	0.013340	0.017558	0.015239	0.013232
Skewness	-0.336042	-0.020115	-0.596467	-0.629585	-0.256554	-0.237724	-0.615980	-0.286980	-0.062055	-0.698846	-2.360029
Kurtosis	**8.504216**	**10.88093**	**8.685910**	**11.57175**	**16.91063**	**5.938571**	**9.090734**	**7.807171**	**7.372024**	**11.84022**	**90.02822**
Jarque-Bera	3450.192	6969.330	3787.330	8422.405	21742.50	994.3062	4332.898	2629.975	2146.546	8988.236	852355.8
Prob.	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	1.622232	0.481853	1.302746	0.446546	0.477659	2.181286	0.820166	0.211788	0.656424	0.275495	-0.133741
Sum Sq. Dev.	0.880687	0.746798	0.627447	0.266342	1.042212	0.665014	0.366824	0.479049	0.829893	0.625122	0.471298
Obs	2693	2693	2693	2693	2693	2693	2693	2693	2693	2693	2693

It is important to observe that the value of Kurtosis which indicates the presence of fat tails, is highest for benchmark index (EUX) and is counterintuitive to the widely accepted believe saying that emerging markets are more prone to unexpected rate events. Here it is clear to us that though there is a high possibility of extreme events in emerging markets too, still benchmark EUX index, which is supposed to be a less risky being a diversified portfolio of 11 indices, has rather higher tendency of experiencing rare fat tail risks.

3.2 Beta Convergence

Estimates of beta convergence (equation 1) are obtained by using OLS iteratively (rolling regression) for the window of 65 days with an increment of 65 days in each iteration to obtain average daily beta convergence coefficient for each quarter (each 65 days period) of the period 1999 to 2009 for the total of 42 quarters and are presented in figure 1.

Figure 1: Beta Convergence Coefficients – Time Varying Value

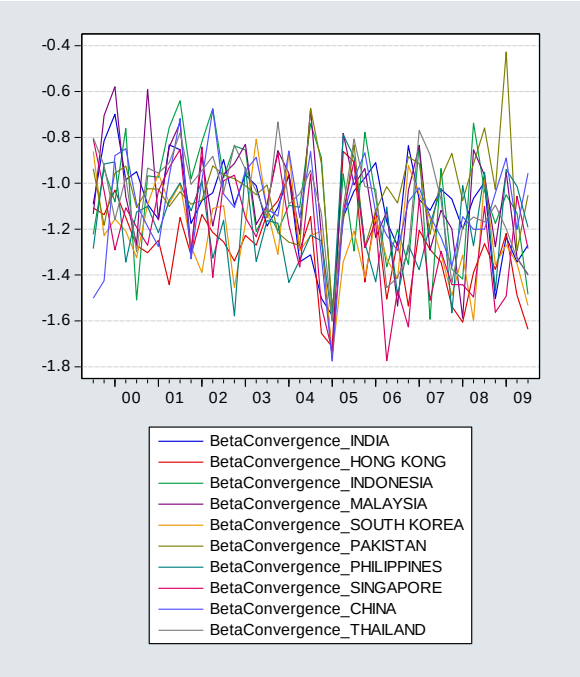
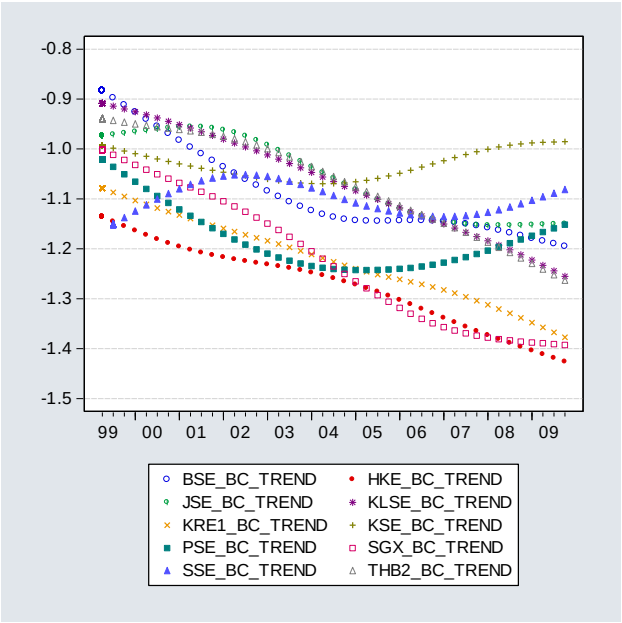


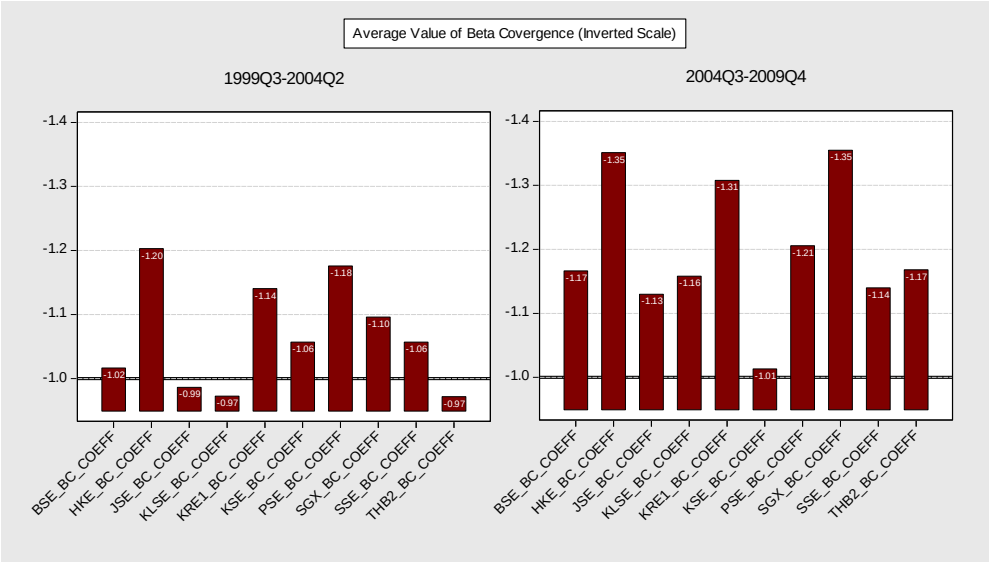
Figure2 below provides the smoothed series (long term trends) in beta convergence coefficients obtained through Hodrick Prescott filter.

Figure 2: Beta Convergence – Lo ng Term Trend



For further investigation we divide ours sample in two periods, from 1999Q3 to 2004Q2 and from 2004Q3 to 2009Q4 and figure 3 represents the mean values of each country's beta convergence coefficients on an inverted scale where the height of each bar is indicating absolute value of coefficients.

Figure 3: Beta Convergence – Country Mean for Two Sample Periods



From these three figures we can answer few questions we raised in the introduction of this article. Coefficient of beta convergence is always negative and highlights the fact that the process of convergence has always been there in Asian economies for the negative value forces any divergence between the returns of Asian economies and benchmark index to disappear in subsequent periods. However from figure 2 and figure 3 it is also observable that in more recent time periods (2004 to 2009) the value of convergence coefficient increases and moves significantly farther from the ideal convergence value of (-1). So apparently the degree of convergence parameter has been increased but this high degree can not necessarily be an indication of increased financial integration, rather it can contribute in reducing the overall level of convergence because beta convergence is just a *necessary* and not the *sufficient* condition of overall convergence.

3.3 Sigma Convergence

Increasing trend in beta convergence which forces its value to surpass the ideal threshold of -1, forces us to look at the second indicator of convergence i.e. Sigma convergence. Sigma convergence indicates the overall level of convergence achieved at one point of time with reference to chosen benchmark.

We estimate different concepts of sigma convergence by changing reference point to have an in-depth picture of international as well as regional integration in Asian markets.

Figure 4: Sigma Convergence – Global Integration

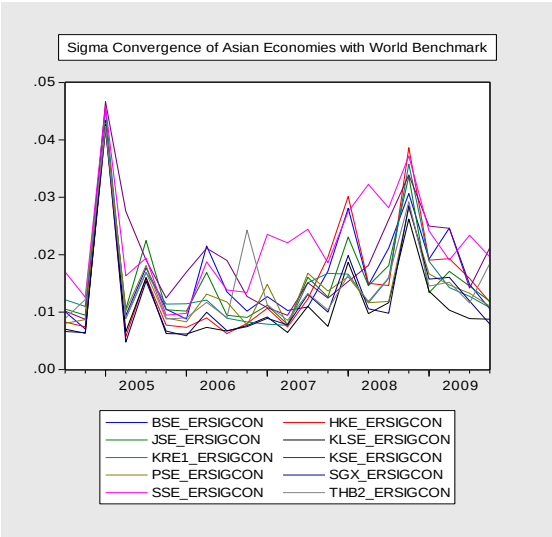
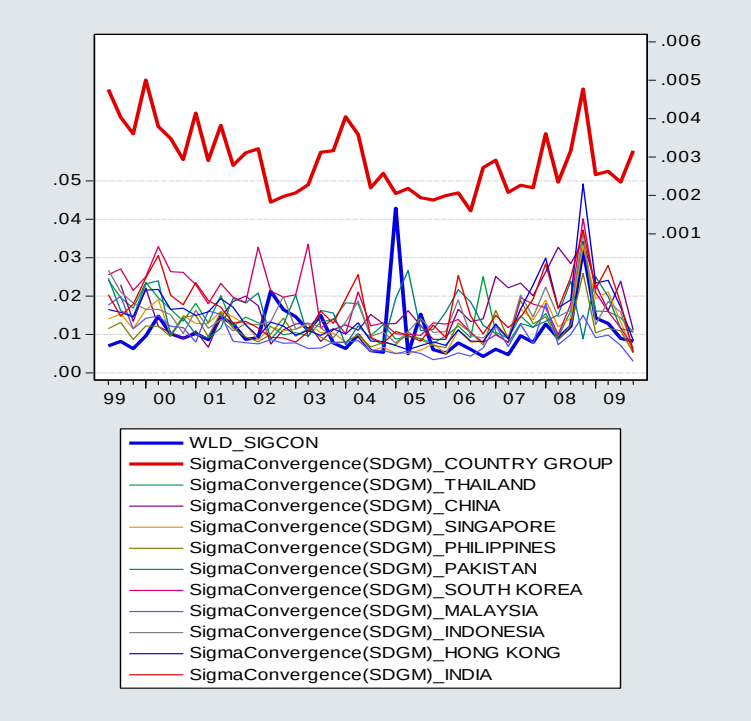


Figure 4 provides the convergence of each Asian markets with the benchmark index EUX and is calculated as the dispersion of excess returns (ERSIGCON) over the period of 10 years. Almost in all countries an increasing trend of dispersion can be observed, however at the time of market crash of 2004 and 2008 there are strong signs of regional as well as international contagion when all markets move almost with one to one correlation with each other.

In figure 5 we provide three different concepts of sigma convergence. The bold blue line (WLD_SIGCON) is the time varying coefficient of benchmark index's dispersion with its own quarterly mean returns. The bold red line named as "Sigma Convergence (SDGM) Country Group" is the dispersion between group average returns of Asian economies with the quarterly group mean return, calculated iteratively for each quarter and the rest of the values are same concept calculated for individual country, i.e. dispersion of each country's returns with the group mean.

Figure 5: Sigma Convergence – Regional Integration



All these representations of sigma convergence indicate the results which are confirmatory with the values of beta convergence obtained in previous section. There is a decreasing trend in dispersion from 1999 to 2004 after which dispersion seems to be increasing gradually. This increasing dispersion (decreasing level of integration) reinforces the fact that despite increasing response of individual countries to the global factors that is evident from the increasing trend of beta convergence coefficient, the overall level of integration in Asian stock market returns, both on international as well as regional level, is something yet to be achieved.

4. Conclusion

In line with the methodology proposed by (Adam, Jappelli, Menichini, Padula, & Pagano, 2002) to use the concepts of beta and sigma convergence which are actually borrowed from the growth literature, in determining the level of financial integration, we apply it on the selected economies of Asia for the period ranging 1999 to 2009. Our results show that the process of convergence in returns has been existed in all Asian economies throughout the period and its degree has no doubt been increasing gradually. However in most of the cases instead of getting closer to the ideal level of -1, it has been surpassed and moved farther from that level which caused the overall divergence instead of convergence. This observation is also supported by the evidences obtained from the different representations of sigma convergence which indicate the attained level of convergence at one point or block of time period. Almost all representations of sigma convergence confirm that there was a decline in cross section dispersion from 1999 to 2004 which surely does indicate the increased level of financial integration of Asian markets, globally and regionally, but that decreasing trend in dispersion visibly changed its direction after 2004 and has been showing an increasing trend till now which one could not be taken as a signal of convergence.

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Appendix – Tables and Figures

Appendix Table 1: Descriptive Statistics Beta convergence (1999Q3 to 2009Q3)

	BSE	HKE	JSE	KLSE	KRE	KSE	PSE	SGX	SSE	THB
Mean	-1.096674	-1.281275	-1.066076	-1.062893	-1.223737	-1.028842	-1.190576	-1.225508	-1.102537	-1.070873
Median	-1.075245	-1.263051	-1.050157	-1.058959	-1.228089	-1.025444	-1.179350	-1.191892	-1.112035	-1.041016
Maximum	-0.698795	-0.861077	-0.640461	-0.579249	-0.807751	-0.427392	-0.788304	-0.807082	-0.677597	-0.732635
Minimum	-1.576155	-1.713598	-1.593006	-1.763827	-1.752124	-1.539449	-1.599252	-1.773854	-1.775165	-1.600974
Std. Dev.	0.191604	0.198440	0.254795	0.264342	0.204356	0.185841	0.206026	0.252735	0.214467	0.207904
Skewness	-0.491522	-0.207354	-0.356861	-0.365013	-0.106928	0.354445	-0.167483	-0.264087	-0.576631	-0.560403
Kurtosis	3.190200	2.747882	2.267894	3.001944	3.006271	5.203289	2.256296	2.227229	4.001126	2.741604
Jarque-Bera	1.712690	0.402390	1.785856	0.910445	0.078197	9.151555	1.136551	1.496745	3.984287	2.260083
Probability	0.424711	0.817753	0.409455	0.634307	0.961656	0.010298	0.566501	0.473136	0.136403	0.323020
Sum	-44.96363	-52.53228	-43.70910	-43.57861	-50.17321	-42.18254	-48.81361	-50.24584	-45.20403	-43.90581
Sum Sq Dev	1.468483	1.575145	2.596819	2.795076	1.670452	1.381471	1.697875	2.554995	1.839838	1.728961
Obs	41	41	41	41	41	41	41	41	41	41

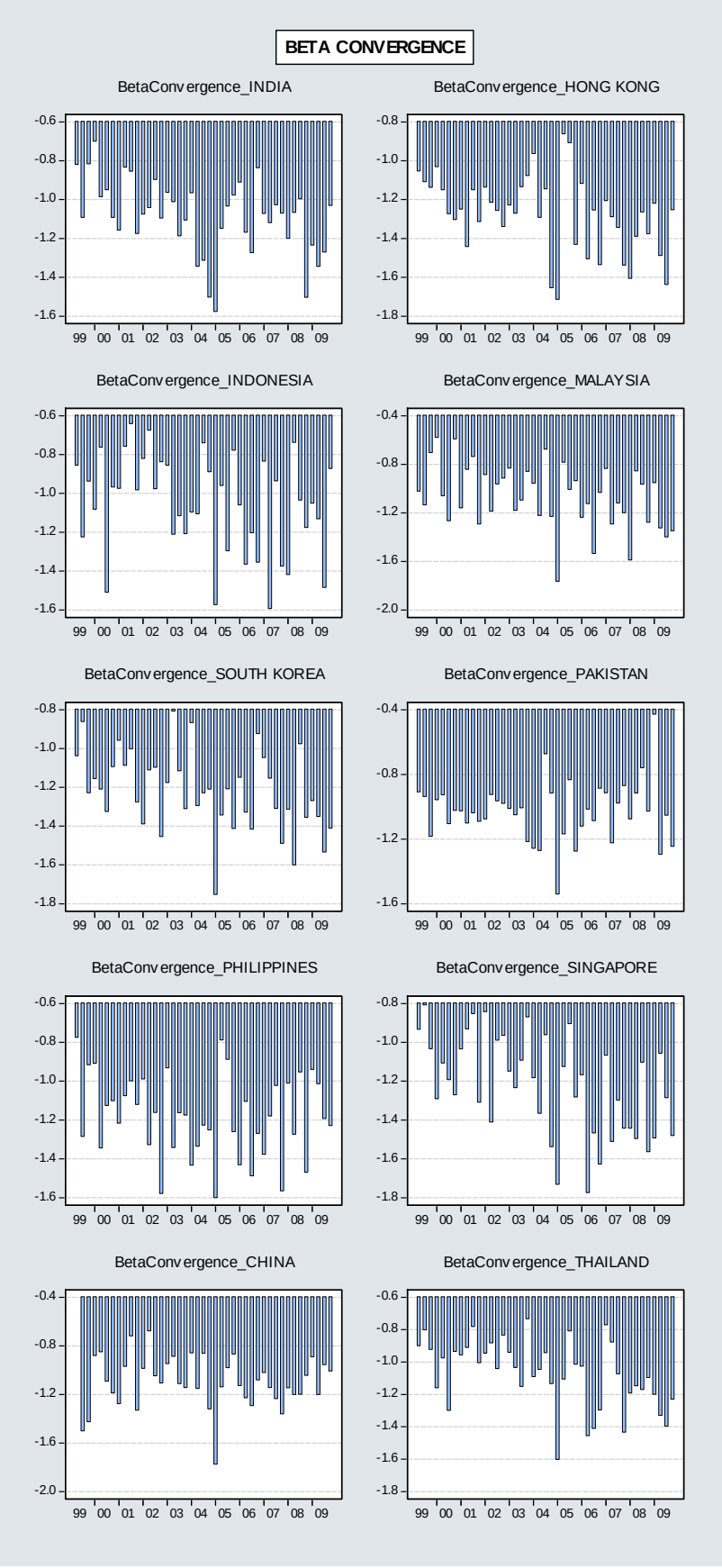
Appendix Table 2: Descriptive Statistics Beta convergence (1999Q3 2004Q2)

	BSE	HKE	JSE	KLSE	KRE	KSE	PSE	SGX	SSE	THB
Mean	-1.016603	-1.203011	-0.986406	-0.972647	-1.140612	-1.056957	-1.175929	-1.095987	-1.056973	-0.971846
Median	-1.026101	-1.221052	-0.974768	-0.959500	-1.135266	-1.031440	-1.161903	-1.099330	-1.068834	-0.949983
Maximum	-0.698795	-0.963173	-0.640461	-0.579249	-0.807751	-0.924067	-0.907454	-0.807082	-0.677597	-0.732635
Minimum	-1.343195	-1.441866	-1.508865	-1.293202	-1.453942	-1.270871	-1.578651	-1.410201	-1.500946	-1.298909
Std. Dev.	0.151586	0.115255	0.214057	0.219225	0.178183	0.106115	0.182513	0.184381	0.220260	0.138259
Skewness	0.068099	0.106653	-0.431248	0.262393	0.231611	-0.682199	-0.308089	-0.016213	-0.246919	-0.417652
Kurtosis	2.866505	2.694806	3.007549	1.976726	2.302812	2.464275	2.456761	1.843402	2.468649	3.013663
Jarque-Bera	0.030309	0.115536	0.619963	1.102074	0.583872	1.790484	0.562319	1.115642	0.438509	0.581598
Probability	0.984960	0.943869	0.733461	0.576352	0.746816	0.408509	0.754908	0.572455	0.803117	0.747666
Sum	-20.33207	-24.06021	-19.72813	-19.45294	-22.81223	-21.13915	-23.51859	-21.91973	-21.13946	-19.43692
Sum Sq Dev	0.436590	0.252392	0.870586	0.913132	0.603236	0.213947	0.632909	0.645929	0.921774	0.363194
Obs	20	20	20	20	20	20	20	20	20	20

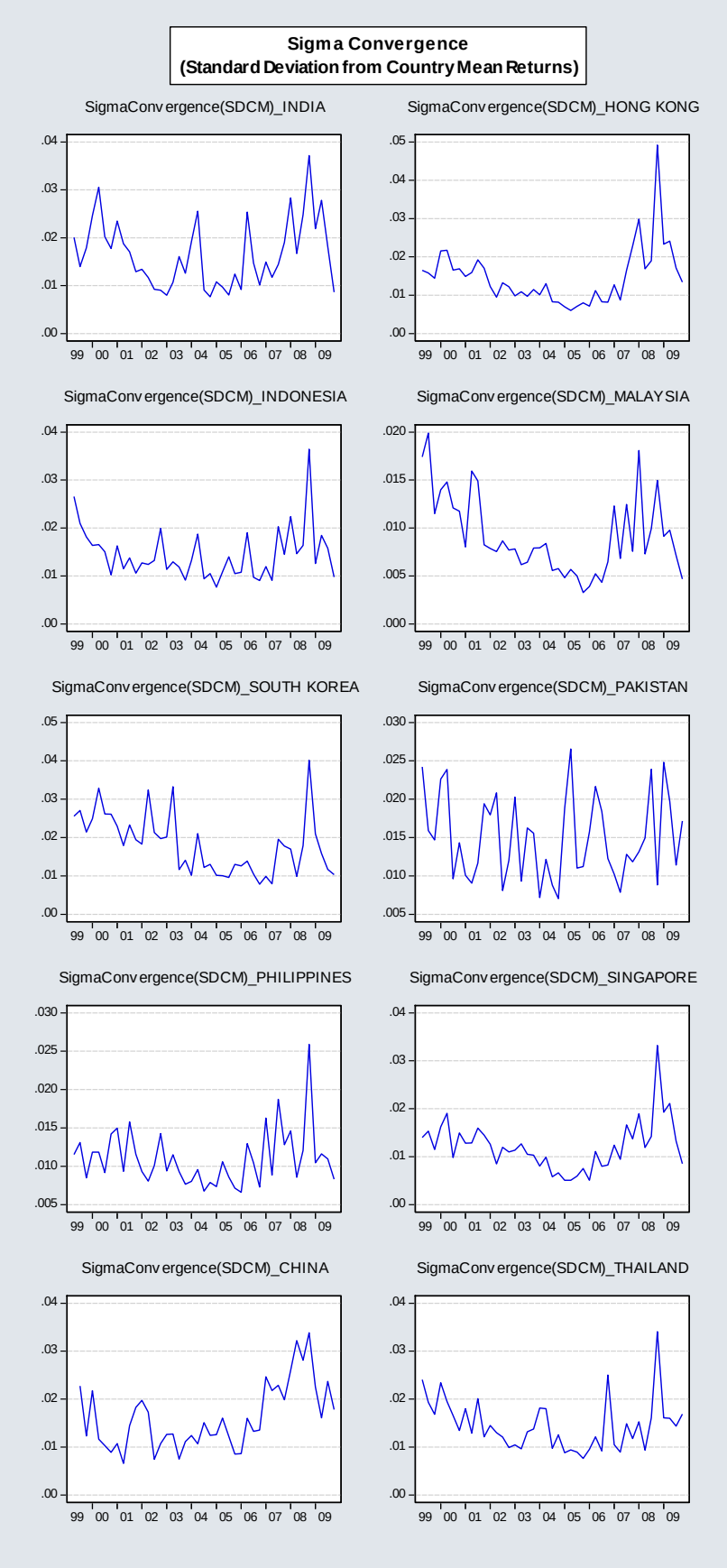
Appendix Table 3: Descriptive Statistics Beta convergence (2004Q3 2009Q3)

	BSE	HKE	JSE	KLSE	KRE	KSE	PSE	SGX	SSE	THB
Mean	-1.172931	-1.355813	-1.141951	-1.148841	-1.302904	-1.002066	-1.204525	-1.348863	-1.145932	-1.165185
Median	-1.147950	-1.375377	-1.131244	-1.124047	-1.313512	-1.014593	-1.226332	-1.441826	-1.143192	-1.146829
Maximum	-0.836383	-0.861077	-0.737603	-0.675862	-0.922336	-0.427392	-0.788304	-0.904025	-0.862049	-0.770374
Minimum	-1.576155	-1.713598	-1.593006	-1.763827	-1.752124	-1.539449	-1.599252	-1.773854	-1.775165	-1.600974
Std. Dev.	0.197680	0.232763	0.271881	0.279636	0.199675	0.238397	0.229847	0.250400	0.204572	0.221681
Skewness	-0.451177	0.467655	-0.069822	-0.381717	-0.144383	0.120092	-0.028610	0.138622	-1.155518	-0.047732
Kurtosis	2.500131	2.580525	1.825202	2.564621	2.997368	3.665842	2.051170	1.977802	5.388180	2.323367
Jarque-Bera	0.931097	0.919420	1.224694	0.675839	0.072968	0.438405	0.790609	0.981534	9.663756	0.408578
Probability	0.627791	0.631467	0.542077	0.713253	0.964173	0.803159	0.673475	0.612157	0.007972	0.815227
Sum	-24.63156	-28.47206	-23.98097	-24.12566	-27.36098	-21.04339	-25.29502	-28.32611	-24.06457	-24.46889
Sum Sq Dev	0.781548	1.083574	1.478391	1.563929	0.797405	1.136659	1.056589	1.254007	0.836997	0.982850
Obs	21	21	21	21	21	21	21	21	21	21

Appendix Figure 1: Beta Convergence Time Varying Coefficients



Appendix Figure 2: Sigma Convergence – Dispersion from Country Mean Returns



Appendix Figure 3: Sigma Convergence – Dispersion from Group Mean Returns