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**TIME VARYING INTEGRATION
AMONGST THE
SOUTH ASIAN EQUITY MARKETS:
AN EMPIRICAL STUDY**

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Piyush PANDEY
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Time Varying Integration amongst the South Asian Equity Markets: An Empirical Study

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JEL Classification: C13, C52, F21, F36, G15

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Time Varying Integration amongst the South Asian Equity Markets: An Empirical Study

Abstract

In this paper, we examine the dynamic nature of equity market integration for the South Asian countries. The daily data for local equity indices is used from 6 January 2004 to 31st March 2015. Copula GARCH models have been employed to study the inter-temporal process of equity market integration. Empirical results show that the sample countries of the region exhibit very little or no levels of integration between them. Equity portfolio flows within the South Asian region reconfirm the findings based on price data that regional integration is strengthening over time. Further, trend analysis of the fundamental determinants of financial integration for the SAARC member states indicated that these countries have to work on their governance parameters, improve on their trade linkages and trade tariffs and develop their equity market infrastructure to achieve higher levels of financial integration as is observed by its neighbouring ASEAN+6 group members. The paper contributes to the International Finance literature, especially dealing with regional economic blocs by suggesting that South Asian member countries require collaboration in efforts of policy realignment and above all political commitment to make their alliance viable enough to enhance equity market integration

Keywords: stock market integration, SAARC, time varying copula, **panel data analysis**, capital market development

Time Varying Integration amongst the South Asian Equity Markets: An Empirical Study

Section 1: Introduction

The forces of economic globalization i.e liberalization, privatisation and deregulation are the dominant factors behind the growing acceptability and importance of economic regionalism around the world. Increased internationalization of global markets, initiating of economic and political reforms by the various countries, need for promoting foreign policy and security interests, opportunities for diversifying risk internationally are some of the few but important factors promoting regional cooperation and integration. In the Asian context, ASEAN² was set as an important economic bloc in 1969. This regional integration initiative helped the member countries in achieving sustained economic growth since the early 1980's leading to an increasing share in the global gross domestic product and a rise in their per capita income. Larger participation in the global trade has been the important parameter in the growth of emerging Asian economies. International financial market liberalization alongwith outward oriented strategies has significantly increased the degree of capital mobility in the Asian countries since 1990s (Guillaumin, 2009). The Asian countries have come out of the Asian Financial Crises of 1998 by strengthening their macroeconomic fundamentals and improving their fiscal conditions thereby promoting enhancing cross-border trade through export led growth model leading to improved efficiency and higher productivity.

In contrast, until the late 1970s, high protectionist trade policies by maintaining tariff and non-tariff barriers, heavy state intervention in economic activity, strict exchange rate controls, discouragement of foreign capital were some of the few measures being practiced in the South Asian¹ countries which led to a contraction in their economic growth. This heterogeneous and unique region encompassing small and big economies in different stage of their economic development was also embroiled in political conflicts which slowed its growth leading to high levels of poverty (home to 44% of world poor, Source: World Bank) amongst its large population and low levels of human development. Post the 1990's, the South Asian countries have embraced upon outward oriented strategies and have increasingly acknowledged that regional approaches are quintessential to accomplish their developmental challenges. The benefits accruing out of this regional cooperation are interconnectedness of economic systems of the countries, trade integration, closer financial linkages, expansion of the markets and the production base, enhanced intra-regional investments. Linking small and

large economies can help in tapping the economies of scale, multiply investment prospects, upgrading of infrastructure thereby leading to equitable growth. Financial openness offers many benefits- it leads to greater opportunities for risk sharing and consumption smoothing (Cochrane, 1991); (Townsend, 1994); improves capital allocation and potential for higher economic growth (Levine, 1997); provide welfare gains from international risk sharing (Obstfeld, 1994) equalizes rates of returns of various financial instruments, cheapens access to international capital markets, expand investor's opportunities for portfolio diversification and provide a platform for earning higher risk adjusted returns. Regional cooperation was formally initiated in South Asia with the formation of a trade bloc named as South Asian Association of Regional Cooperation (SAARC) in 1985. It is the most important umbrella association in South Asia and has embarked upon number of initiatives fostering regional integration- South Asian Preferential Trading Arrangement (SAPTA), South Asian Free Trade Area (SAFTA), and more recently the SAARC Agreement on Trade in Services (SATIS). With the ratification of the SAFTA agreement in 2004, the trade integration has all but begun in South Asia though the pace of economic reforms is far from desirable. But as critical as trade integration is, the policymakers of the region are convinced that an efficient, well-regulated and integrated capital markets are quintessential for facilitating savings, investments and economic growth within the region. An under developed and rigidly fragmented financial markets will be countercyclical for effective mobilization of financial resources within the region. Due to policy rigidities and poor technical and legal structures of equity market infrastructure, the economic agents in the country are often searching for higher profits outside their own geographical location of home country as the cost of financial intermediation is too high. As global economic gravity shifts to east and 21st century is believed to be "The Asian Century", the policymakers of this region are convinced to accelerate the regional coordination amongst them to emerge as a countervailing power to the west.

SAARC region is one of the least integrated in the world, albeit three decades since its creation. Economic and political differences have not permitted SAARC initiatives to achieve desired results and are major impediments in a way of realizing stronger integration among the SAARC countries. Given the increasing emphasis on closer regional co-operation across the world, it is an opportune time for the political leadership of the SAARC countries to steer their way through their political standoffs and embrace an open regionalism and institutional change which can help make South Asia an active partner in Asian economic integration and global economy. More specifically, the new political leadership in the biggest and most

dominant of the South Asian countries i.e India which came to power in 2014 wants to push for greater cooperation with its neighbours³ to help in further opening of the SAARC economies for the betterment of the lives of the people and reduce the regional poverty. Hence, this study intends to evaluate the state of financial integration of the South Asian countries focussing on the equity market segments using quantity based and price based approaches by applying contemporary econometric tools and techniques. Thus it aims to empirically evaluate the dynamic co-movements between the equity indices of the member countries of the SAARC region. We further study the trends of the fundamental determinants which drive the process of financial integration. This paper also suggests policy roadmap from the Indian perspective to further deepen the financial development and integration in the region. **The present study employs Copula Garch models on equity market price data and makes an important contribution to the existing literature by showing that the South Asian countries exhibit varying degrees of integration with the Asian benchmark. The data on equity portfolio flows reconfirms the increasing trend in regional integration for Asia. Further, trade integration and domestic capital market performance seem to be the fundamental drivers of financial integration in the region. We believe the present study would be instructive and complementary to the existing literature on financial integration and could provide strong arguments for expanding the ASEAN Economic Community region in the near future to a more economically viable East Asian Economic Community region. The empirical results presented in this paper have important implications for policy makers, portfolio managers and academia.**

The rest of the paper is organized as follows: Section 2 deals with the trends and developments in the regional integration in the South Asian region. Section 3 gives an overview of the review of literature. Section 4 presents the data while Section 5 covers the methodology related to Price based and Quantity based approach to evaluate equity market integration amongst the SAARC members. Section 6 discusses the fundamental determinants of the equity market interdependence of this region while Section 7 provides summary and policy recommendations.

Section 2: Regional Integration in the South Asian Region-Trends and Recent Developments

South Asian Association for Regional Cooperation (SAARC) was established when the Heads of State of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka signed

SAARC charter in 1985. Afghanistan later joined SAARC as the eighth member at 14th Summit Conference held at New Delhi, India in 2007. The charter provides for strengthening cooperation not only among the member countries but also with other developing countries and international organizations. The formation of SAARC therefore paved the way for closer regional cooperation and integration in South Asia. South Asian countries have a combined population of 1.7 billion and GDP of \$2.589 trillion (World Bank Data, 2014). These countries are bound by ties of history, culture, religion and ethnicity. They display similarities in terms of their colonial rule legacy and planned approach to development after independence, but are heterogeneous in terms of their geography, demography and size of the economy. The integration among the South Asian region has been affected by conflicting neighbourhood, lack of political consensus and disparate growth rates of member countries. India being the largest economy in terms of its economic growth, population and territorial size among the SAARC members, enjoys the most prominent position in the region bordering every SAARC country.

SAARC countries took significant initiatives in achieving closer integration among the member nations. SAPTA (SAARC Preferential Trading Agreement), signed in 1993 at the 7th Summit held at Dhaka, Bangladesh, became the stepping stone to promote mutual trade and economic cooperation by working out trade and tariff policies in the seven member countries. To further strengthen the economic and trade integration, South Asian Free Trade Area (SAFTA) agreement was reached on 6th January 2004 during 12th SAARC Summit at Islamabad for progressively moving towards free trade area through free movement of goods and removal of trade barriers across eight SAARC countries. SAFTA proposed reducing of customs duties of all traded goods to zero by 2016. SAARC Agreement on Trade in Services (SATIS) was signed in 2010 at the 16th SAARC Summit held in Bhutan which proposed to boost intra-regional trade in services through undertaking liberalization in sectors like tourism, transportation, banking and insurance.

Besides summits of Heads of State and Prime Ministers, meetings of Finance Ministers of SAARC members are organized regularly for strategic planning of achieving deeper integration in financial matters. Inter-Governmental Group on Financial Issues was setup in the first meeting of SAARC Finance Ministers held in Pakistan in 1996, which chartered out a roadmap to subsequently strive towards formation of an economic union of South Asian countries. Recently, 7th SAARC Finance Ministers Meeting was organized in August 2015 in which Finance Ministers of all eight SAARC countries gathered at Kathmandu, Nepal to

emphasize the urgency for expediting the process of regional integration in trade, economic and financial sectors.

South Asian countries also took initiatives for strengthening financial cooperation and integration among them. A regional network of SAARC Central Bank Governors and Finance Secretaries called SAARCFINANCE was formed at the 10th SAARC Summit held in Colombo in 1998 to foster cooperation in macroeconomic policies; synchronize banking legislations and practices; collaborate among central banks and finance ministries; share ideas, information and experiences; undertake monetary and exchange cooperation; investigate global financial developments; and promote research on economic and financial issues among the SAARC member countries. For promoting the development of securities markets, encouraging cross border listings and achieving greater harmonization among the member countries, South Asian Federation of Exchanges (SAFE) was established in 2000 including stock, commodity and derivative exchanges of South Asian countries. Later in 2005, a forum of securities regulatory bodies of South Asian countries called South Asian Securities Regulators' Forum (SASRF) was formed to further enhance the cooperation and exchange of information among the regulators of these countries.

Section 3: Review of Literature

Financial integration among the major economic blocs has received considerable attention from researchers over time. The degree of financial integration of equity markets in European region has been assessed by various studies. Fratzscher, 2001 report a rise in the degree of equity market integration with European unification process and particularly after the adoption of Euro. Morana & Beltratti, 2002; Kim, Moshirian & Wu, 2005; Hardouvelis, 2006; Bartram et al., 2007; Bley, 2009; Cappiello et al., 2010; and Worthington & Higgs, 2010 also document increased equity market integration after the formation of common currency union. **Recently, Sehgal et al., 2015 found that large and relatively more important economies of EMU (Germany, France, Netherlands, Italy, Spain and Belgium) exhibit strong financial integration viz-a-viz smaller size economies.** Baltzer et al., 2008; Gilmore et al., 2008 and Mylonidis & Kollias, 2010 on the other hand, find evidence of integration in the equity markets to be lacking. The research on measuring the extent of regional financial integration in East Asia provides diverging views. Some studies (Cavoli et al, 2004; Kim, Lee and Shin, 2005; Lee, 2008; Kim and Lee, 2008; Jang, 2011) argue that there is limited extent of financial market integration while others (Lee, Huh and Park, 2011; Guillaumin, 2009;

Huyghebaert and Wang, 2010; Boubakri and Guillaumin, 2015, [Sehgal et al., 2016](#)) report strengthening financial market integration in East Asian countries. Several studies have analysed the impact of NAFTA (North American Free Trade Agreement) on equity market integration among the three North American countries. Ewing et al., 1999 document that the stock markets of North American countries are still segmented and NAFTA has not resulted in increasing the integration in the regional stock markets. Contrary to this, Atteberry and Swanson, 1997; Gilmore and McManus, 2004; Aggarwal and Kyaw, 2005 and Lehrech and Sylwester, 2015 attribute formation of NAFTA to the increased integration in the stock markets of North America. Chen et al., 2002 and Barari, 2004 investigate interdependencies among the stock markets of Latin American countries and found evidence of linkages among them. Diamandis, 2009 found that the Latin American stock markets and the US stock market are only partially integrated. Lahrech and Sylwester, 2011, on the other hand, found increase in the degree of comovement between Latin American and US stock market returns. Bley & Chen, 2006, Espinoza et al., 2011 and Basher et al., 2014 analysed the interactions among the stock markets of Gulf Cooperation Council (GCC) and found evidence of increasing integration among the markets. On the other hand, Arouri and Nguyen, 2010; Marashdeh and Shrestha, 2010 report weak linkages within the stock markets of GCC and with the global markets. Yu and Hassan (2008) investigate financial integration in Middle East and North Africa (MENA) region and the impact of global market integration on MENA stock markets. They find long term relationship between non-GCC countries of MENA region and US stock markets and between GCC and non-GCC countries.

While the literature on financial integration for major regional blocs is extensive, only a handful of studies have assessed regional financial integration of SAARC countries. Narayan, Smyth and Nandha, 2004 examine dynamic linkages between the stock markets of Pakistan, Bangladesh, India and Sri Lanka and find that the stock prices in Pakistan are dependent on movements in stock prices in Bangladesh, India and Sri Lanka in the long run. Mohsin & Rivers, 2011 estimate the degree of financial integration in South Asian countries. Their results reveal increased integration with the initiation of liberalization process in South Asia. Bhunia and Das, 2012 study the linkages between Indian stock market and select South Asian countries. The results indicate no significant interdependence among the equity markets in long run. More recently, Ali, Hussain and Islam, 2014 explore the relationship among equity markets of India, Bangladesh, Sri Lanka and Pakistan. No relationship was found among the equity markets of these countries in both long as well as short run. Their results are in sharp contrast to the study by Prakash and Kumar, 2014 who estimated stock market linkages

among major SAARC countries and found significant cointegrating relationship among each of the markets, implying existence of market linkages in long run and short run. Latif et al., 2014 investigate financial integration between India and Pakistan and find long run equilibrium relationship between the equity markets of India and Pakistan.

This paper is based on two strands of literature. First set of literature is based on how to measure financial integration. Two broad categories of measures of financial integration have been in vogue: price based and quantity based measures⁴. On the price based measures, there is a heavy empirical literature on assessing the level of financial integration using the traditional beta and sigma convergence (Adam et al., 2002; ECB, 2004; Rizavi et al., 2011). Early investigations into the linkages between the two markets used the Value at Risk models to study comovement of stock market returns. Contemporary literature has moved on to modern time series approaches such as dynamic co-integration approach (Mylonidis and Kollias, 2010) and MGARCH models (BEKK model, DCC models and its extensions mainly Asymmetric DCC-GARCH of Cappiello et al., 2004 and Threshold DCC-GARCH of Pesaran et al., 2007) to study the dynamic process of integration⁵. Recently, copula based models have been used to study the asymmetric nature of dependence between financial market returns (Patton, 2006; Rodriguez, 2007). The copula-GARCH (C-GARCH) model is a multidimensional GARCH process that uses a copula function to model the interlinkages. The application of the C-GARCH model has recently attracted increased academic attention (Peng and Ng, 2011; Yang and Hamori, 2013; Basher et al., 2014; Yang et al. 2015, Sehgal et al., 2016). The quantity based measures assess the degree of integration based on cross country equity portfolio holding of assets and securities. The second set of literature is related to the fundamental drivers of stock market integration. Given our empirical investigation is exploratory in nature; we strive to include as many fundamental drivers as possible after a thorough review of empirical literature on market integration (Refer table 1 for the variables and their reference study). As for the SAARC region in particular, Arora and Ratnasiri, 2014 found trade, income level and political stability as the major determinants influencing South Asian financial integration.

The paper fills important research gaps not covered by previous literature on equity market integration for the SAARC region in the following ways: a) this is the first study to assess financial integration in six out of eight SAARC countries for the data spanning 6th January 2004 (SAFTA agreement was reached) to 31st March 2015. b) the studies on equity market integration in South Asian region are very limited in their scope as they primarily employ the

price based measures while we make use of the latest econometric methodology (Copula Garch model) for the price based measures to evaluate the extent of integration and also support our analysis by quantity based measures which are a first for this region c) we identify the trends of the fundamental determinants of financial integration and suggest a suitable policy framework for India for achieving better equity market integration.

Section 4: Data

We begin our analysis on the daily stock market benchmark index closing prices retrieved from Bloomberg for SAARC member countries for the period 6 January 2004 to 31st March 2015. The starting date has been selected keeping in mind the date when the SAFTA agreement (6 January 2004) was reached which was a landmark event in the process of regional cooperation in South Asia. **Table 2** The benchmark indices which were selected for the various SAARC countries are: Nifty50 index of National Stock Exchange of India, KSE100 index of Karachi Stock Exchange; Pakistan, Nepal Stock Exchange Index (NEPSE), Maldives Stock Exchange Index (MASIX), DSE General (Dhaka Index) of Bangladesh, S&P Srilanka 20 Index (SPLK20UP). Dhaka Index was discontinued on 31 July 2013 and the benchmark index now used in empirical literature for Bangladesh is Dhaka Stock Exchange Broad Index (DSEX) which is available from 28 July 2013. Hence we perform the splicing process to get the values of the Dhaka Index till 31st March 2015. The values of the closing prices of Srilankan benchmark index are available from 17 December 2004. Thus we have covered 6 South Asian countries in our study of the total 8 who constitute the SAARC as no data was available for Afghanistan and Bhutan. As returns of the local equity indices would have been impacted by local currency movements against the US dollar, hence to capture the true market movements, all price indices are denominated in the local currency. The MSCI USA is included as a proxy for global factor as in prior research (Baele et al., 2004; Bartram, et al., 2007, Gupta et al., 2015). We take the natural logarithm of the daily closing values. Daily returns are then computed as the first difference of the log-transformed series. For the quantity based measures, we construct the annual portfolio equity inflows for each SAARC member countries from the SAARC region as well as ASEAN+6 region⁶ for the period 2004 to 2014. Similarly we construct portfolio outflows from each SAARC member country to the SAARC and the ASEAN+6 regions. The portfolio flow data was sourced from IMF-CPIS (International Monetary Fund-Coordinated Portfolio Investment Survey) database. The quantity based measures have been constructed for the same 6 countries (Bangladesh, India, Maldives, Nepal, Pakistan and Srilanka) that were a part of the empirical analysis performed

using the price based measures as no data was available for Afghanistan and Bhutan. Finally, for the fundamental determinants of financial integration, a comprehensive set of factors was constructed (Refer table 1) belonging to 3 broad set of categories i.e Macroeconomic, Trade and Market based category. The data for these factors was sourced for the SAARC member countries subject to their data availability from 2004 to 2015. These variables were predominantly of annual frequency except for volatility of forex rate, volatility of domestic market index return, domestic growth opportunities and local stock market conditions which were of daily frequency. The daily data was averaged over the year and it was not annualized as even a common scaling factor of 250 trading days would not have led to a change in its relative position across the sample.

Section 5: Evaluating Stock Market Integration in SAARC Region

Price Based Measures

The summary statistics of sample index return series are presented in table 3. The annualized mean returns⁷ were positive for all sample countries with the highest being for Bangladesh as 42.5%. The annualized volatility⁷ in these returns ranged between 17.23% (Nepal) to 50.44% (Maldives). Majority of the sample markets were negatively skewed and all of them show an excess kurtosis thereby implying fat tails and sharp peaks. The Jarque Bera statistic for all markets is statistically significant, thereby indicating that the return distributions are non-normal. The results of Ljung-Box Q-statistics up to 12 lags in levels clearly state the presence of serial correlation for all sample return series. As a pre-cursor to the time-series analysis, we also conducted the unit root tests for stationarity. The Augmented Dickey–Fuller (ADF) as well as the Phillips–Perron test results⁸ suggest that all sample series are integrated to order 1 i.e I(1). Table 4 reports the pairwise Pearson, Kendall’s tau and Spearman’s rho correlations for the sample countries. Pearson’s correlation shows linear association between the variables while nonparametric rank correlations tests, such as Kendall's tau and Spearman's rho, are although useful to test for non-linearity in associations but are relatively insensitive to the observations at the tails. Results for the Pearson’s correlation show that the sample return series are predominantly uncorrelated (correlation measure around 0) with each other. The non-parametric tests of association confirm the same implying that the movement of equity market index returns in these countries are relatively independent to that of others in the region.

5.1 Methodology

Multivariate normality assumption is not suitable for measuring the association of equity market returns between two countries, especially with respect to their asymmetric co-movements or contagion effects (Longin & Solnik, 2001; Poon et al., 2004). A copula-based measure can specify the dependence structures while accounting for non-linearity without the constraint of normality assumption. Also, based on Sklar's Theorem (Sklar, 1959) which helps in separating the marginal and joint distributions, the copula method makes the estimation process more flexible. Patton (2006) extended this methodology by adding a time-varying specification to capture the dependence over time. Let $R_{\text{country } i,t}$ and $R_{\text{country } j,t}$ be random variables that denote country i 's stock index returns and country j 's stock index returns respectively at period t , with marginal conditional cumulative distribution function $U_{\text{country } i,t} = G_{\text{country } i,t}(R_{\text{country } i,t}|\Phi_{t-1})$ and $U_{\text{country } j,t} = G_{\text{country } j,t}(R_{\text{country } j,t}|\Phi_{t-1})$, where Φ_{t-1} denotes past information. Then the conditional copula function $C_t(U_{\text{country } i,t}, U_{\text{country } j,t} | \Phi_{t-1})$ can be written using the two time varying cumulative distributive functions. Extending Sklar's theorem, bivariate conditional cumulative distributive function of random variable $R_{\text{country } i,t}$ and $R_{\text{country } j,t}$ is:

$$F(R_{\text{country } i,t}, R_{\text{country } j,t} | \Phi_{t-1}) = C_t(U_{\text{country } i,t}, U_{\text{country } j,t} | \Phi_{t-1})$$

5.1.1 Marginal Specification

We investigate the integration of each sample country's stock index returns with each other by combining the copula functions, described above, with a GARCH-type model of conditional heteroscedasticity. In this paper, we adopt EGARCH(1,1) model (Nelson, 1991) for modelling of conditional volatility to capture the asymmetric impacts of shocks or innovations on volatilities and to avoid imposing nonnegativity restrictions on the values of GARCH parameters. EGARCH(1,1) model is chosen as the preferred model in the interest of parsimony of parameters (see Kim and Wang, 2006). The mean equation used for country i 's returns and Asian benchmark returns is as follows:

$$R_{\text{country } i,t} = \mu + R_{\text{country } i,t-1} + R_{\text{usa},t-1} + \varepsilon_t$$

If $\varepsilon_t = \sigma_t z_t$ where z_t is standard Gaussian, then EGARCH (1,1):

$$\text{Ln}(\sigma_t^2) = \omega + \alpha (|z_{t-1}| - E[|z_{t-1}|]) + \gamma z_{t-1} + \beta \text{Ln}(\sigma_{t-1}^2)$$

Here, R_{usa} is the return of the USA index and is used as a global factor. It is well known that many financial time series are non-normal and tend to have a fat tail behavior (Mandelbrot,

1963). Thus a GARCH is formulated after factoring in the mean spillover effects from the US which proxies for global effects (see Dungey, Fry, & Martin, 2003, Samitas & Kenourgios, 2007). The lagged US returns proxy for global factor and capture the global mean spillover effects. In order to better capture the skewed and fat tails characteristic, Bollerslev (1987) suggests the use of the conditional Student-t distribution for the error term. We further obtain the standardized residuals from this marginal specification.

5.1.2 Copula Models for Dependence

Having estimated each of the marginal distribution, we now apply the probability integral transform to convert the standardized residuals of the marginal distribution into Uniform (0, 1) distributions. To describe the symmetric and asymmetric dependence structure between the uniform distributions of each sample country returns with that of the other, the study uses two Elliptical (Gaussian and Student t) and two Archimedean's (Clayton and Gumbel) family of copula models. Because the nature of copulas can be either static or time-variant, hence we include both for our empirical analysis.

Static Copula Models

- a. Gaussian Copula: Following (Patton, 2006), the dependence parameter of Gaussian process is

$$\begin{aligned} C_{\text{Ga}}(\mathbf{u}, \mathbf{v}; \rho) &= \int_{-\infty}^{\Phi^{-1}(u)} \int_{-\infty}^{\Phi^{-1}(v)} \frac{1}{2\pi\sqrt{1-\rho^2}} \exp\left(-\frac{x_1^2 - 2\rho x_1 x_2 + x_2^2}{2(1-\rho^2)}\right) dx_1 dx_2 \\ &= \Phi_{\rho}(\Phi^{-1}(u), \Phi^{-1}(v); \rho) \end{aligned}$$

Where u and v are cumulative distribution functions of standardized residuals, subjected to a uniform distribution between 0 and 1, ρ is Pearson's linear correlation, Φ^{-1} is the inverse cumulative distribution function of a standard normal distribution.

- b. T- Copula: The dependence parameter of t copula follows from (Fernandez, 2008):

$$\begin{aligned} C(\mathbf{u}, \mathbf{v}) &= \int_{-\infty}^{T_v^{-1}(u)} dx \int_{-\infty}^{T_v^{-1}(v)} dy \frac{1}{2\pi\sqrt{1-\rho^2}} \left[1 + \frac{x^2 - 2\rho xy + y^2}{v(1-\rho^2)}\right]^{-\frac{v+2}{2}} \\ T_v(x) &= \int_{-\infty}^x \frac{\Gamma(\frac{v+1}{2})}{\sqrt{\pi v} \Gamma(\frac{v}{2})} \left(1 + \frac{z^2}{v}\right)^{-\frac{v+1}{2}} dz \end{aligned}$$

T is the student t distribution with degrees of freedom v and Pearson's correlation ρ . In comparison to Gaussian copula, t copula captures the tail dependence

- c. Gumbel Copula: The dependence parameter (Gumbel, 1960) which can capture the upper tail dependence:

$$C_{Ga}(\mathbf{u}, \mathbf{v}; \theta) = \exp(-((- \ln \mathbf{u})^\theta + (- \ln \mathbf{v})^\theta)^{\frac{1}{\theta}})$$

Where $1 \leq \theta < +\infty$; upper limit in Gumbel copula is ∞

- d. Clayton Copula: The dependence parameter (Clayton, 1978) captures the lower tail dependence:

$$C_{CL}(\mathbf{u}, \mathbf{v}; \theta) = (\mathbf{u}^{-\theta} + \mathbf{v}^{-\theta} - \mathbf{1})^{-1/\theta}$$

Where $0 \leq \theta < +\infty$;

Time Varying Copula Models

Time varying copulas can be considered as dynamic generalization of a Pearson correlation or Kendall's tau but it is difficult to find causal variables to explain such characteristics (Patton, 2006). In practice though, time varying copulas are operationalized to follow autoregressive moving average (ARIMA) (p,q) process.

- a. Time varying Gaussian Copula (Patton, a2006) uses a coefficient ρ_t to study the dependence dynamics defined as:

$$\rho_t = \tilde{\Lambda}(\omega_N + \beta_{N1} \cdot \rho_{t-1} + \dots + \beta_{Np} \cdot \rho_{t-p} + \alpha_N \cdot \frac{1}{q} \sum_{j=1}^q \Phi^{-1}(\mathbf{v}_{t-j}))$$

Where $\tilde{\Lambda}(x)$ is a logistic transformation which is defined as $\tilde{\Lambda}(x) = (1 - e^{-x})(1 + e^{-x})^{-1}$

- b. Time varying T copula (Patton, b2006) uses the following to study the dependence process:

$$c. \rho_t = \tilde{\Lambda}(\omega_T + \beta_{T1} \cdot \rho_{t-1} + \dots + \beta_{Tp} \cdot \rho_{t-p} + \alpha_T \cdot \frac{1}{q} \sum_{j=1}^q T^{-1}(\mathbf{u}_{t-j}; \text{DoF}) \cdot T^{-1}(\mathbf{v}_{t-j}; \text{DoF}))$$

Where T^{-1} is the inverse function of the student t-distribution with given degrees of freedom (DoF)

- d. Time varying Gumbel copula studies the dependence using θ_t corresponding to $\tau_t = 1 - 1/\theta_t$ defined as:

$$\tau_t = \Lambda(\omega_G + \beta_{G1} \cdot \tau_{t-1} + \dots + \beta_{Gp} \cdot \tau_{t-p} + \alpha_G \cdot \frac{1}{q} \sum_{j=1}^q |\mathbf{u}_{t-j} - \mathbf{v}_{t-j}|)$$

Where $\Lambda(x) = (1 + e^{-x})^{-1}$

- e. Time varying Clayton copula uses θ_t corresponding to $\tau_t = \theta_t / (2 + \theta_t)$ to find the dependence defined as:

$$\tau_t = \Lambda(\omega_C + \beta_{C1} \cdot \tau_{t-1} + \dots + \beta_{Cp} \cdot \tau_{t-p} + \alpha_{C1} \cdot |\mathbf{u}_{t-1} - \mathbf{v}_{t-1}| + \dots + \alpha_{Cq} \cdot |\mathbf{u}_{t-q} - \mathbf{v}_{t-q}|)$$

The Elliptical copula models (Gaussian and Student t) are most popular in Finance literature due to the ease with which they can be implemented. Gaussian copula is symmetric and has

no tail dependence whereas Student t copula can capture extreme dependence between variables. The Gumbel copula exhibits greater dependence in the upper tail than in the lower, whereas the Clayton copula exhibits greater dependence in the negative tail than in the positive tail.

5.1.3 Estimation of Copula Parameters

Parameters are normally estimated in two steps, first for the marginal and second for the copula. The approach is similar to the Inference function for Margin (IFM) method. IFM method is superior to Exact Maximum Likelihood (EML) as the latter needs expensive computation more so for higher dimensions. In IFM method, parameters of the marginal distributions can be estimated before those of the copula functions whereas the EML method requires both to be estimated simultaneously.

5.1.4 Goodness of Fit Tests

Besides the log likelihood ratios, in order to check the quality of the overall fit of the family of copula models, goodness of fit test of (Genest et al., 2009) which is based on a comparison of the distance between the estimated and the empirical copula: $C_n = \sqrt{n} (C_n - C_{\theta_n})$.

The test statistic is based on Cramer-Von Mises distances defined as: $S_n = \int C_n(u)^2 dC_n(\mathbf{u})$

Large values of the statistic S_n leads to rejection of the null hypothesis that the Copula C belongs to the class C_0 . A multiplier approach is used to find the p-values associated with the test statistics (Kojadinovic and Yan, 2011). The highest p-value indicates that the distance between the empirical and the estimated copulas is the smallest and that the copula in use provides the best fit (Aloui et al., 2013).

5.2 Empirical Results

5.2.1 Price Based Measures

Table 5 presents the results of the marginal specification of the return series for each sample country. The coefficient of the lagged US returns acting as a proxy for global factor to capture mean spillover effect was found to be significant for only India and Maldives. This indicates the interlinkages of the equity market movements of USA index returns with these countries. The EGARCH (1,1) estimation shows that long run volatility persistence (measured by coefficient β) was statistically significant for all the sample countries. The

asymmetric effect of news on volatility factor (measured by coefficient γ) is negative for all countries and even statistically significant (for India, Maldives and Pakistan) thereby justifying the use of EGARCH (1,1) model. The Auto Correlation Function (ACFs) of the standardized residuals and squared standardized residuals, obtained from the mean equation (not presented due to brevity of space), indicate that the standardized residuals are approximately i.i.d (identically and independently distributed). They are therefore more suitable to copula estimation than the raw return series. We turn to estimate the copula functions wherein firstly we consider the standardized residuals and transform it into vector of uniform variates using cumulative distributive function.

Results from the unconditional copula models (refer [table 6](#)) suggest that the dependence parameter between sample equity market returns are around 0 implying almost no association. The biggest economy of the region i.e India has the highest dependence parameter of 0.032 with Nepal while the lowest parameter of -0.023 with Srilanka. The highest dependence parameter in the SAARC region is between the equity markets of Pakistan and Srilanka (0.082) while the lowest is for Nepal and Maldives (-0.0413). The low values of the dependence parameters in the SAARC region can be attributed to its poor regional trade intensity (total trade within SAARC members/ total trade with the world). It can be clearly seen that the regional trade intensity (refer Figure 1) is the lowest for SAARC member group compared to other regional economic blocs and has infact remained stagnant over the period of study. Bekaert et al. (2005) and Goetzmann, Li, and Rouwenhorst (2005) claimed that capital market integration and increased trade are embedded with predictions about the association between markets. For the unconditional copula models, T copula seems to be the best fit (lowest log likelihood values, refer [table 6](#)) amongst the copula family of models for majority of the sample country pairs.

Figure 2 depicts the results relating to the conditional copula models which show time varying dependence measure between each sample country's benchmark equity index returns with the other. We have charted the best fit conditional copula model so selected from the goodness of fit test (Refer [table 7](#)) against its corresponding unconditional copula parameter to study its inter temporal dependence. Stronger co-movements between the two sample equity markets reflect greater levels of integration and hence, an increase in dependence parameter (as a measure of co-movement) among financial markets may signal increased convergence (Kuper & Lestano, 2007). The goodness of fit test selects clayton copula model amongst the different family of copula models used in this study for majority of the sample

country pairs (except Bangladesh and Maldives; India and Nepal; Maldives and Pakistan; Maldives and Srilanka and Pakistan and Srilanka). Clayton copula models the lower tails dependence and the parameter ranges from 0 to ∞ . Within the SAARC region, the highest time varying dependence amongst the country pairs using the clayton model (as selected by goodness of fit test) is shown by equity market indices of Srilanka and Nepal while the lowest time varying dependence is shown between India and Srilanka. Amongst the Elliptical family of selected copula models, the time varying dependences between Pakistan and Srilanka seem to be the highest. The levels of dependences are around 0 for all the pair of sample countries implying little or no integration between them.

5.2.2 Quantity Based Measures

Quantity based measures supplement the price based measures for assessing and monitoring the changes and trends in the equity market integration. Thus we examine the cross border equity holdings of the sample countries to assess whether there is a shift to investment within/from SAARC region or the broad ASEAN+6 region. Figure 3 shows the annual values of portfolio equity inflows from the SAARC and ASEAN+6 member groups into the sample countries. Figure 4 shows the annual values of portfolio equity outflows from sample countries to the SAARC and ASEAN+6 member groups. Not surprisingly, the quantum of portfolio equity inflows seems to be attracted to the largest economy of the SAARC region i.e India for the period under study. The trend has all but increased over time and has only strengthened post the global economic crises of 2008 which implies that there is mutual confidence in the macroeconomic and fiscal strength of India. However, these equity investments into India are emanating from the larger ASEAN+6 region as the same from the SAARC countries is zero across the period. As for the remaining SAARC countries individually, portfolio equity investments from SAARC region remains muted and the bulk of the flows is dominated by the larger ASEAN+6 member countries. India seems to predominantly be the only source of equity portfolio inflows into Nepal and Maldives even from the larger ASEAN+6 region. As for the remaining 3 sample countries in the South Asia region, Srilanka seems to be attracting the equity portfolio flows from the SAARC region predominantly from India both before the pre and post global crises periods. Srilanka also received heavy portfolio investments from Pakistan in the pre crises periods which virtually dried out during recent years. Pakistan also received portfolio equity inflows from Bangladesh only in 2014. Regarding the portfolio equity outflows, there are no outflows to the SAARC or the larger ASEAN+6 region from Srilanka, Maldives and Nepal over the

period under study which can be attributed to the internal instability in these countries which lead to their tepid economic growth and development. Pakistan seems to be heavily invested in SAARC region (though only in Srilanka) before the global crises of 2008 but has shifted its investments to larger ASEAN+6 region for few years after the crises. Bangladesh seems to be the latest member to invest in the larger ASEAN+6 region in all these years by investing in Srilanka and Pakistan in 2014. Though the portfolio equity outflows from India are considerably higher to larger ASEAN+6 group region but India also seems to be invested in SAARC in predominantly all members' countries except Pakistan across the study period which can be attributed to its political standoffs with Pakistan.

The results from the price based analysis on the basis of static copula models show that albeit after decades of its formation the SAARC regional bloc has not come out of its political standoffs and embraced regionalism to bring dynamism into this region. The dependence parameter between the SAARC member nations are virtually 0 confirming little financial integration in the region. Economic and financial integration are mutually enforcing each other while empirical evidence seems to suggest that economic integration provides a channel for financial integration (Phylaktis and Ravazzolo, 2001). Even after operationalization of SAFTA agreement in 2006, regional trade intensity is the lowest for SAARC group compared to major regional economic blocs of the world for the period under study. The charts from the dynamic copula models support the preliminary findings of the unconditional models as the dependence parameter seem to be peaking towards the time of the great economic crises in 2008 but the co-movements are very low for all the country pairs. The results based on quantitative indicators reconfirm that the quantum of equity portfolio inflows into SAARC members individually are from larger ASEAN+6 region. While India receives no equity inflows from SAARC region, Srilanka seems to be attracting the maximum inflows from the SAARC region (predominantly India). With the exception of portfolio equity outflow to SAARC region from Bangladesh in 2014, there seems to be no portfolio flows from Bangladesh, Maldives, Nepal and Srilanka into even larger ASEAN+6 region for the period under study which can be attributed to the state of their economy due to political conflicts. Therefore, SAARC member countries require collaboration in efforts and commitment to make their alliance viable enough to steadily progress towards regional integration to catch up with major regional blocs like European Union, NAFTA and neighbouring ASEAN.

Section 6: Fundamental Determinants of Financial Integration

After estimating the time-varying dependence measure for the sample SAARC countries, in this section we investigate the fundamental determinants of stock market integration. We consider the exhaustive list of potential determinants of financial integration that have been covered by prior studies which were summarized in Table 1. These fundamental determinants are primarily divided into Macroeconomic, Trade and Market based categories. These determinants (variables) potentially play an important role in explaining the intertemporal behaviour of equity market integration measured by the time varying copula parameter provided by the best fit copula model selected on goodness of fit test. But, since our equity market dependences are close to 0 between SAARC member countries, hence we are unable to perform the panel data analysis (as absence of financial integration implies no dependent variable to be explained by explanatory variables) to confirm the role of significant variables driving integration in this region. We would rather analyse the trends for these variables for the SAARC countries individually and compare the same with the member countries comprising the larger ASEAN group i.e ASEAN+6. ASEAN group is selected as it is the neighbouring regional economic bloc in Asia with a much longer history (created in 1967) and having a wider membership base (10 members ASEAN which extends to ASEAN+3/ASEAN+6). Sehgal et al. (2016) observe dependences of the ASEAN+6 bloc members with the Asian benchmark thereby confirming varying degree of financial integration of the sample countries. Thus analysing and comparing the trends of these fundamental determinants for the two regional blocs will help to show how important these variables are for the given control groups (one where dependences are observed i.e ASEAN+6 and one where they are absent i.e SAARC).

Table 8 shows the average values across time for the fundamental determinants of financial integration for the various SAARC and ASEAN+6 member countries for comparison. For majority of these determinants, the values are not much different for the SAARC and ASEAN+6 member nations. We compare the trend of only those variables for which there is a significant difference between the two group members. For the Macroeconomic category, significant differences are observed for the trends in the governance indicator (refer Figure 5) for SAARC member countries viz-a-viz ASEAN+6 member countries. The governance indicators are all in negative for the SAARC member countries (except Bhutan) but the same for ASEAN+6 members (Singapore, Malaysia, Japan, South Korea, Australia, New Zealand) which have high integration with the Asian benchmark (Sehgal et al., 2016) are positive. International financial integration is very closely associated with development of a sound

institutional, legal and investment environment reflected by the Governance factor (Vo and Daly, 2007). Integration in equity markets is promoted by an increase in Trade Linkages and Trade Openness (Huoy and Goh, 2007; Ng et al., 2013). For the Trade category, the trend analysis for the total trade as a % of GDP variable (refer Figure 6) shows except for Maldives and Bhutan, all South Asian countries have the value as less than 100% in comparison to many ASEAN+6 countries which have a large total trade position (Singapore, Malaysia, Thailand, Vietnam). For the trade tariff variable (refer Figure 7), except for the concerted trade policy commitment and contingency measures undertaken by World Trade organization (WTO) in 2009 to arrest the contraction in total trade due to great economic recession of 2008, the levels of trade tariffs (as % duty) is around 10-20% for SAARC member nations. In contrast, low tariff rates (less than 10%) are prevalent amongst majority of the ASEAN+6 member countries which help in facilitating intra-regional trade thereby promoting integration. Well developed and actively functioning financial markets attract foreign investors who are motivated to diversify their portfolio and increase their investments thus contributing to financial integration (Vo and Daly, 2007). For the Market category, the trend analysis for market capitalisation as a % of GDP (refer Figure 8) shows that except for India, sample SAARC countries have values less than 50% while majority of ASEAN+6 member countries have corresponding values close to 100%. This shows that the SAARC member states have to work on their governance parameters, improve on their trade linkages and trade tariffs and develop their equity market infrastructure to achieve higher levels of financial integration.

India enjoys a unique place in the South Asian region as its GDP is 8 times (Source: IMF, 2014) the size of Pakistan (second biggest economy in South Asia) and the only country in the region which shares common borders with all other nations except Afghanistan. Hence the regional cooperation in South Asia will not succeed without the active participation and sincere commitment of India. Figure 9 shows the trade intensity of India with respect to other country (total trade of country_i with India / total trade of India) for the SAARC and ASEAN+6 countries. It clearly shows the fault lines as India trades higher with the ASEAN+6 members than the SAARC members (roughly 10 times higher, refer figure 9). This is counterintuitive as India provides overland transit to Bangladesh, Nepal and Bhutan for their bilateral trade and maritime transit to Nepal and Bhutan for its international trade.

Section 7: Summary and Policy Suggestions

In this paper, we examine the extent of financial integration amongst the equity market segments of the SAARC member countries. Daily stock market index closing price data was used for the 6 of the 8 SAARC member countries for the period of 6 January 2004 to 31st March 2015 as data for Afghanistan and Bhutan was not available. Our empirical analysis is based on Copula Garch approach to capture the dynamic process of financial integration by investigating the return co-movement of the sample country's equity index with each other. The results obtained from both static and time varying copula models show that the dependences between the equity markets of SAARC member countries are close to 0 indicating very little level of financial integration in the region. This can be attributed to the low regional trade intensity in the SAARC region which is infact the lowest amongst all the major regional economic blocs of the world. The results based on quantity based indicators reconfirm that the quantum of equity portfolio inflows for individual SAARC members are much greater from ASEAN+6 group than from the SAARC group. Though India seems to receive equity portfolio flows only from the larger ASEAN+6 group and none whatsoever from the SAARC region but it is itself invested in the SAARC group members. This can be attributed to the fact that contrary to groupings in other regional blocs, India is the largest country in the region, not only in terms of geographical territory and population, but also in terms of size of the economy (3rd largest economy in terms of PPP in the world, Source: World Bank). With the exception of Pakistan prior to the global financial crises of 2008 and Bangladesh in 2014, none of the other South Asian countries (Bangladesh, Maldives, Nepal and Srilanka) act as a source of equity portfolio investment into even the larger ASEAN+6 member group. This may be attributed to their hostile internal political situations and increasing mistrust with each other. The trends of the fundamental determinants of financial integration of the SAARC member countries were compared with its **neighbouring regional economic bloc in Asia which has a much longer history and a wider membership** base i.e ASEAN+6. From a comparative analysis, one could see that financial integration in the SAARC members lagged their ASEAN+6 counterparts owing to poor governance quality, lower trade linkages, higher trade tariffs and less sophisticated equity markets with relatively weaker institutional and regulatory architecture.

Regional integration will be bolstered as the policymakers of the region prepare to improve their macroeconomic fundamentals, strengthen the regional institutional frameworks, enhance trade policy cooperation, undertake capital market development and effectively manage cross-border portfolio investments. Thus to revitalize the regional cooperation in the region,

India should take a lead to reduce the high customs duty, facilitate port clearance, improve communication and transportation and removing regulatory constraints at the borders thereby creating an enabling connectivity infrastructure and trade facilitation regime. Further trimming of the SAARC sensitive list outside of SAFTA and removing of non-tariff barriers will boost intra SAARC trade which will act as a key for an integrated region. The SAARC member countries may be expected to foster a stable political environment to ensure clean and transparent governance while taking due regards to each other's security concerns. **The SAARC members may coordinate among themselves to allay the mistrust between them by encouraging more people to people contact and promote various socio-cultural events to help develop social cohesion and imbibe shared cultures.** As demonstrated by Capannelli et al. (2009) in order to increase financial integration within the region, it will be necessary to develop and strengthen the regional institutions. These strong regional institutions will provide platform to help develop mutual cooperation in new areas like energy trade, commerce, river basin management. India can provide its financial support and technical expertise for building and operating equity market infrastructure in other SAARC member countries. **The member countries can coordinate to subsequently form a SAARC Disclosure Standards Scheme and a SAARC Corporate Governance Scorecard to further enhance cooperation in the integration of equity market segments. The former would help in the cross border offerings of securities while the later would ensure better transparency. The formation of a dedicated SAARC Development Fund (SDF) will extend assistance for the economic and infrastructure sector of the region which lags behind in infrastructure development and connectivity rendering lack of integration.**

The study has important implications for the policy makers, portfolio managers and academia. For the global policy makers, the study is of particular relevance in the light of growing number of regional co-operation initiatives worldwide for achieving political influence, enhanced linkages amongst economies as well as developing a coordinated response to global risks including financial contagion. As the global economic gravity shifts to the east and the 21st century is believed to be the "Asian century", the study would provide policy directions to Indian policymakers who want to project India as a strategic player in the region having geopolitical ambitions. **The portfolio managers can treat SAARC region as a heterogeneous bloc providing diversification opportunities within the region (Returns per unit of risk is highest for Bangladesh and Nepal viz-a-viz India inspite of them being uncorrelated) unlike the more integrated European Monetary Union (Sehgal et al., 2015).**

From the academic point of view, firstly the literature is very limited on the regional financial integration in the South Asian region and hence this study brings out a comprehensive analysis of the state of equity market integration in this region. Secondly, the study highlights the dynamic process of financial integration in the region and further identifies its key determinants wherein concerted efforts of policy realignment of SAARC members are quintessential to enhance financial integration. The paper contributes to the literature by measuring the progress of financial integration in the equity market segments for the SAARC members' countries and outlines the thrust areas which can help in increasing regional integration.

Notes:

1. In this paper, South Asia refers to the eight member countries of the South Asia Association for Regional Cooperation (SAARC) - Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, and the Maldives.
2. ASEAN was created with the signing of Bangkok Declaration in 1967 by Indonesia, Malaysia, Philippines, Singapore, and Thailand. Subsequently the ASEAN bloc grew with the addition of Brunei, Vietnam, Laos, Myanmar and Cambodia (in the order of their entry).
3. The new polity in India in 2014 firstly played host to all heads of states of the other SAARC member countries including of Pakistan who were invited to attend the swearing in of the new government. Subsequently, the new polity has announced a slew of measures like- building a SAARC satellite, starting a SAARC development bank, mobilizing a SAARC development fund which shows its increased priorities to revitalize the SAARC bloc.
4. For a survey of the literatures and various indicators, see (Cavoli et al., 2004; Baele et al., 2004; Poonpatpibul et al., 2006).
5. For survey of literature using these indicators, see (Yu et al., 2010; Gupta et al., 2015).
6. The 2nd East Asian Summit (EAS) was held Cebu in January 2007 wherein ten ASEAN members and six countries including China, Japan, South Korea, India, Australia, and New Zealand participated. Japan regards this ASEAN+6 (EAS group) as an appropriate group for East Asia's trade and investment cooperation.
7. Annualization has been done assuming 250 trading days in an year
8. Unit root test results are not reported due to brevity of space. These are available on request from the authors.

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