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SPATIAL ANALYSIS OF ASIAN STOCK MARKET LINKAGES

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Abstract

This study examines the transmission mechanism driving Asian stock market linkages by employing spatial econometric techniques. In the context of financial markets, defining a weighted distance matric is not a simple matter. Besides the geographical distance, economic channels such as exchange rate volatility and bilateral trade also provide the stock market linkages. The empirical analysis is based on the Asian stock market over a period from 1980 to 2019. The Spatial Durbin Model is used because it captures the spatial effects in returns and from explanatory variables. Otherwise, the estimation through OLS will produce biased and inconsistent parameters due to ignorance of spatial dependence. Results show that among the three integration measures (exchange rate volatility, bilateral trade, and geographical distance), the important link is bilateral trade, while the geographical distance is least in explaining the impact on stock returns. Fundamental variables that included in the model, impact the stock return and among the most influential variables are GDP growth and interest rate. In investment decisions, investors should not ignore the market dependence structure of the region; otherwise, ignoring these spillover effects would underestimate the results.

Keywords

Economic integration, Spatial Econometrics, Direct and Indirect effect.

JEL Classification: C23, G01, G15.

1. Introduction

Economic globalization and regional integration are essential characteristics of world economies. Rapid economic reforms around the world,characterized by liberalized financial sectors, have accelerated the process of globalization [Seghal et al., (2017)].

Financial integration in developing countries has shifted researchers attention for identifying the association between stock market development and growth of the economy [Deb & Mukherjee, (2008)]. Financial integration allows the investors to find not only the efficient capital market but also risk-minimizing investment opportunities. Sometimes financial

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dependence brings instability in economies [Maher et al., (2017)]. Understanding co-movements of financial markets and external shocks are essential for financial investors and policymakers since these shocks affect the financial system's stability. Therefore, it is necessary to figure out all the channels that cause co-movement among the stock market returns.

By the 1980s, it was believed that economic growth depended upon the liberalization of the domestic economy and positioning towards world trade. Most Asian economies are aware of these realities and have experienced high economic growth termed as East Asian miracle by World Bank (research report on East Asian miracle,1993). According to [Berg et al., (2008)], during 1970s and 80s, these economies experienced high GDP growth; after that, fundamental deficiencies became apparent, weaknesses in macroeconomic policies ultimately led to Thailand's currency devaluation in 1997, which led to financial instability in the region.

The policy makers of East Asian countries have shifted their attention to how they can strengthen their economic and financial fundamentals after this crisis. Asia-Pacific is leading the recovery in world trade. The statistical data showed that trade growth in Asia increased from 1.4% (2015) to 1.7% (2016), whereas trade volume growth in Asia was 61% compared to the 52% to global trade volume during the same period. The growth in Asian economies is also clear from the fact that in the past,FDI in this region primarily came from Western countries, while FDI within the region was only 36% during the phase of 2006-09. However, during a post-crisis period (2010-15), this increased to 52%. Asia's total FDI inflow in 2016 was $443b, while outflow was $363. The share of FDI within the region also raised from 47.6% (2015) to 55.3% (2016). As a result, Asia has become the second-largest receiver of FDI in the global economy (World Investment Report Economy, 2017).

The market capitalization of 60 major stock markets in the world is around $76.3 trillion (2016) and among them, Asia has led 17 stock exchanges with a market capitalization of $23.05 trillion. These facts explained above show the importance of the Asian region in world business. The more robust integration should get reflected in dynamic interactions between financial markets in Asia, particularly the co-movements in stock markets [Sehgal et al.,(2019)]. Hence, the dynamics of stock market links in the Asian region are of critical importance not only for policy makers but also for market participants.

The present study explores the financial and economic integration and how different linkages affect the stock returns by employing spatial analysis. Through the spatial econometric approach, we can link the stock market integration of different countries to their closeness or distance as defined by various economic and integration measures. We show that stock market interdependence can be present very well with the approach of spatial econometrics, and it provides a beneficial understanding of how financial markets are connected.

Understanding co-movements of financial markets and externals shocks are important for the stability of financial system. Therefore it is necessary to figure out all the channels that cause co-movement among the stock market returns including the spatial effects. Previous literature has over looked the spatial effect of the economic and financial integration that has impacts on stock returns. So this research study will focus on " to what extent stock market co-movements are affected by countries economic and geographical linkages through spatial analysis in case of Asian region."

The remainder of the paper is organized as follows section 2 presents literature review. Section 3 presents theoretical frame work. Section 4 presents econometric method used in this paper. Section 5 presents data and selected variables. Section 6 contains empirical analysis and section 7 concludes.

2. Literature Review

No of studies focused on the interaction among the international stock market. [Bekaert & Harvey, (1995)] estimated the degree of integration between major emerging markets and world equity markets and reported that several emerging markets exhibit time-varying integration. The study was also done on co-movement of stock return of Japanese and U.S shares traded in the United States [Karolyi & Stulz, (1996)]. More light sheds on the interaction of the stock market by [Asgharian & Nossman, (2011)] by analyzing the risk spillover effect from the U.S and regional market to different equity markets of European countries by developing a stochastic volatility model. The majority of work has been done on exploring the degree of dependence among the stock markets at the international level. A more critical issue that needs to be explored in this framework is to analyze the equity market's integration depends upon how countries are financially or economically integrated.

Previous studies suggested that the geographical proximate countries have more financial dependencies. As explored by [Haile & Pozo, (2008)] on 37 advanced and emerging countries, using a panel probit model, checks the contagious effect and transmission channels to spread currency crisis. The stud indicated that the probability of crisis in a country increases as the number of neighbor countries in crisis increases, implying the presence of neighborhood effects .The understanding of exchange rate co-movement before and during the Asian financial crisis in primarily Asian countries was studied by [Orlov, (2009)],the cospectrol methodology was used to check the contagion effect was present in foreign markets or not.It was reported that cospectral densities are several orders of magnitudes smaller for geographical distant countries during crisis period relative to the geographical proximate countries. This could be such that geographical close economies have same sets of fundamentals and have more interdependence in form of trade and investments.The countries located in same geographical location have more contagion effect. Thus spatial dimensions could help us in the explanation of financial crisis that originated in Mexico, Asia, and Russia etc. [Fazio, (2007)].

Further, [Coval & Moskowitz,(1999)] investigated investor's portfolio, results suggest that asymmetric information between local and non local investors may drive the preference for geographically proximate investments, and the relation between investment proximity and firm size may shed light on several well documented asset pricing anomalies. A gravity model was applied by [Flavin et al,. (2002)] to check the correlation between national stock market (dependent variable) and trade, GDP, and geographical distance (independent variables) and found that geography (role of space) matters in case of examining equity market linkages. [Portes & Rey, (2005)] also used a gravity model to analyze the cross-border equity flows. It is suggested that the geography of information is the primary determinant of the pattern of international transactions [Portes & Rey,(2005)]. Rolling gravity model was employed by [Bayoumi *et al*. (2007)] to examine the correlations of financial market prices to measure contagion with distance. The results indicated that distance matters in basic linkages such as trade, creditors, and structure of the institutions and propagation of crisis that depend upon the extent to which countries are linked through these measures. International trade linkage can play a more important role during a currency crisis than macroeconomic or financial linkages [Glick & Rose (1999)].

(VAR) model, Granger causality test, co-integrating Vector Error Correction Model (VECM) are popular models for studying linkages in financial markets.[Cheung *et al*. (2010)] used these approaches to check the global inter-dependencies and spillover effects. The results were consistent with contagion theory, as inter dependencies among the international stock market become more robust in the crisis. These methodologies have their merits, but none of them consider the spatial aspect of the issue. [Calvet *et al*., (2006)], among others, argue that there is at best a weak link between financial volatility and the standard macroeconomic variables. Thus, to explain market co-movements and predict the spread of a financial crisis, a fruitful research avenue may be found in the pragmatic approach of looking at how physical and financial distances among the major financial centers affect financial inter dependencies. The contribution made by [Tam, (2014)] in the literature by using a novel econometric technique to check linkages between East Asian countries and shock transmission through spatially-augmented error correction technique followed by a reformulation of the model in a spatially-augmented VAR framework. Findings showed that there exist both effects, spatial as well as temporal in the Asian region, crisis are conducive to increased cross-border linkages especially in case of china, and Japan is a dominant driver of market linkages in the region. [Arnold *et al*., (2011)] modeled stock return using spatial lag models of different orders to forecast risk measures. [Frexedas & Vaya, (2005)] use spatial techniques to identify channels of equity market co-movements and linkages. The main finding are in each crisis the markets more closely controlled by governments show similar channel of contagion, common money lenders are among the main and most persistent channel of contagion. Fernandez (2011) used the capital asset pricing model in a spatial version to discover spatial dependency along with the risk of an investment. A dynamic panel model with spatial error (spatial moving average SMA) was suggested by [Weng & Gong (2016)] to estimate spatial and temporal dependencies among global stock (Asia Pacific, Europe, and Latin America. The analysis on spatial co-relation of volatility spillover and its influencing factors across G20 financial markets done by [Zhang *et al*., (2020)] through the GARCH-BEKK model results showed that spatial linkages of volatility spillover are time-varying, and emerging markets are more sensitive to shocks than developed markets

2.1 Literature Gap

The above discussion shows enormous literature to explore those linkages that transmit shocks and their consequent impact on returns. Still, little work is done in the case of Asian regions that employ spatial analysis (Spatial Durbin Model) on the importance of financial and economic integration for the stock market co-movements. Due to the dynamic nature of this approach, it is possible to investigate transmission mechanisms in returns and macroeconomic variables from one country to another country.

If spatial and spillover effects are not accounted for, they could lead to inconsistent and biased parameter estimates [LeSage, 1998]. So we contribute to the existing literature by analyzing various spatial linkages to show that at what level changes in fundamental variables affect a country's stock returns and its impact on other stock markets, specifically for Asian countries.

3. Theoretical Framework

To determine to the extent of stock market co-movements are affected by countries' economic and geographical linkages (each link separately), a model is constructed with three integration measures i.e., exchange rate volatility, bilateral trade, and geographical distance. In this framework, fundamental variables impact stock returns, such as changes in the exchange rate, interest rate GDP growth, and unexpected inflation. The relationship between macroeconomic variables and stock returns and how we compute them is discussed in detail.

3.1 Exchange Rate Changes

The exchange rate, defined as the price of domestic currency for foreign currency is one of the factors that captures the effect of the foreign sector on the stock returns. The exchange rate movements, either upwards or downwards, determine the stock prices. The relationship between stock return and exchange rate shows that change in exchange rate positively impacts stock return [Ahmad et al, 2010]**.**

3.2 Unexpected Inflation

An essential factor in the valuation of financial assets is unexpected inflation. Evidence showed that stock prices are influenced by unexpected inflation because this presents a situation of economic shock and its effect depends on its source. [Amihud, (1996)] observe a negative relationship between unanticipated inflation and stock prices**.**

3.3 GDP Growth

GDP growth can be used as a proxy to analyze economic activities and a significant growth rate of a country's GDP indicates the good economic condition of an economy [Asgharian et al.,(2013)]. The growth in equities indicate that business is going well and bring huge profit. The analysis done on the relationship between GDP growth and stock returns revealed that

GDP affects the returns significantly and exhibits a positive influence on stock return [Singh et al., (2011)].

3.4 Change in Interest Rate

In literature, the state of economic opportunities is best depicted by interest rate. An efficient market is a priority for investors. In an inefficient market, the investor loses their confidence in the market. When the interest rate rises, investors and consumers cut off their spending and switch capital from the share market to the bank and cause a reduction in demand and price of a share and vice versa [Alam & Uddin, (2009)].

Based on the above discussion, the model for stock return determination can be written as

$$y_{i=\alpha+x_i\,\beta+\varepsilon_i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where i is an index for the cross-sectional units (spatial units), y is the dependent variable (stock returns), and x_i is the independent variable (changes in exchange rate, unexpected inflation, GDP growth, changes in interest rate) while ϵ is an error term.

3.5 Integration Measures

Three bilateral measure are used to check the closeness of financial markets (spatial dependency) to each other. Selection is based on the essential linkages with stock returns included exchange rate volatility, bilateral trade, and geographical distances.

3.6 Exchange Rate Volatility

Association of risk with unanticipated movement in exchange rate is called exchange rate volatility. Less volatility in exchange rates increase the chances for investments in foreign markets which results in more financial integration. The study on the outcome of exchange rate volatility on stock returns was done by [Sekmen, (2001)], results showed that exchange rate volatility negatively impact stock returns. When we take standard deviation of the log changes that occur in bilateral exchange rate every year, we can easily compute exchange rate volatility.

3.7 Bilateral Trade

The trade impact analyzed by [Walti, (2011)] on-demand and the supply side of the economies, bilateral trade significantly impacts the stock returns. When aggregate demand rises in one country to meet this increased demand, imports rise, so the trading partner increases its output, fostering the business cycle activities between countries.

A measure of bilateral trade can be calculated by taking the trade among country i & j, as a proportion of total trade of country i with rest of the countries.

$$F^{BT}_{ij,t} = \frac{exp_{ij,t} + exp_{ji,t}}{\sum_{k=1}^{k=N} exp_{ik,t} + \sum_{k=1}^{k=N} exp_{ki,t}} \text{..} (2)$$

expij is the annual export in the US dollar from country j to i in a nominal term, where FBT ij; denotes trade value among country i & j, relative to i's country total trade value.

3.8 Geographical Distance

A country's economic relations and business cycles are affected by its geographically close countries, and ultimately, it impacts the stock returns [Fernandez-Avilas et al., (2012)].Here the description of weight (W) matrix is very important since we are working on integration measures through market are interconnected. W is representing an N×N spatial weight matrix (in case of cross sectional data) of binary numbers, in which one is assign for neighbour, and zero is assign to prevent a region to the neighbour of itself [LeSage & Pace, (2009)].The weight matrix W is formed through matrix C, showing for any pair of markets in a sample how much close market j is to market i, according to different measures that define the proximity or distance between countries. The countries that share geographical closeness show more strong financial linkages and trade, [Orlov,(2009)].For measurement of geographical closeness, for each pair of countries, the distance between capital cities is used as discussed under equation (3)

$$Cij = 1 - \frac{maxjFij - Fij}{maxjFij - minFij} \text{..........................} (3)$$

SDM is special case of spatial autoregressive (SAR) model [LeSage and Pace, (2009)]. It contains not only the spatially lagged dependent variable but the spatially lagged explanatory variables also. It is a general model that includes all possible interaction effects by which different spatial models can take by imposing restrictions on parameters.

Expression for SDM is given by:

$$y = \rho Wy + X\beta + WX\theta + \varepsilon \text{.............................} (4)$$

WY = A matrix of spatially lagged dependent variable that is stock return.

WX = A matrix of spatially lagged explanatory variables. y depends on own-regional factors from matrix x, plus the same factors averaged the n neighbouring regions [Bekti & Rahayu,(2013)].Explanatory variables are exchange rate volatility, unexpected inflation, interest rate and GDP growth while three integration measures are part of analysis i.e., bilateral trade, exchange rate volatility and geographical distance.

4. Econometric Model

Spatial econometrics is a sub-dimensional field of econometrics that deals with spatial interaction effects among different geographical regions. Spatial dependence reflects a situation in which the values of dependent variables at one location depend on the observation of the same variable at another location [Anselin, (2001)]. The simplest model is a linear regression model that takes the form

$$Y = \alpha + X\beta + \varepsilon \text{......................................} (5)$$

The regression model shown in equation (5) is known as the OLS model commonly estimated by the ordinary least square (OLS) method [Elhorst, 2013]. OLS is not best suited for the models which incorporated spatial effect because it makes the implicit assumption that outcomes for different regions are independent of each other [Elhorst, (2013)].

Different spatial models are used in the existing literature of spatial econometrics to treat three types of spatial dependencies: endogenous spatial dependence among the dependent variable, exogenous spatial dependence among the independent variable, and spatial interactions among stochastic error terms [Elhorst, (2013)]. These types of dependencies are captured through Spatial Lag Model (SLM), Spatial Lag of X (SLX), and Spatial Error Model (SEM), which are commonly used in the existing literature of spatial econometrics.

4.1 <u>Spatial Error Model (SEM)</u>

Error terms over the different spatial entities are generally dependent on each other due to omitted variables that are themselves spatially correlated. SEM incorporates a spatially autoregressive process in the error term, as appeared in equation (6).

$$Y = X\beta + \mu \text{ .... } (6)$$

Where $\mu = \gamma W\mu + \varepsilon$

Here Y is a vector of N observations on the explained variable; W is a $N \times N$ spatial weights matrix; γ is a spatial auto regressive parameter; X is a matrix of observations on the independent variables, with $K \times 1$ associated regression coefficient vector β, μ is distributed normally and an independent error term with a constant variance.

4.2 Spatial Lag Model (SLM) / Spatial Autoregressive Model (SAC)

The general form of SLM is expressed as

$$y = \rho Wy + X\beta + \varepsilon \text{ .... (7)}$$

Where Y is a vector of N observations on the dependent variable; W is a $N \times N$spatial weights matrix; ρ is spatial auto regressive parameters; X is a matrix of observations on the independent variables, with $K \times 1$associated regression coefficient vector β, ε is a vector of $N \times N$ residuals, ϵ is an independently and normally distributed error term with a constant variance.

This approach is too limited, and our focus has to shift to the Spatial Durbin Model (SDM).

4.3 Spatial Durbin Model (SDM)

SDM is a particular case of spatial auto regressive (SAR) model [LeSage and Pace, (2009)]. It contains not only the spatially lagged dependent variable but the spatially lagged explanatory variables also. It is a general model that includes all possible interaction effects by which different spatial models can take by imposing restrictions on parameters.

Expression for SDM is given by:

$$y = \rho Wy + X\beta + WX\theta + \varepsilon \text{.................………….. (8)}$$

WY = A matrix of the spatially lagged dependent variable that is the stock return.

WX = A matrix of spatially lagged explanatory variables y depends on own-regional factors from matrix x, plus the same factors averaged the n neighbouring regions [Bekti & Rahayu, (2013)].

Since SDM contains the spatial interaction both in the spatially lagged dependent variable and spatially lagged explanatory variables, further analysis is based on SDM because it includes all types of spatial interactions.

5. Sample Selection

Data comprises nine equity markets, namely China, India, Indonesia, Korea, Japan, Malaysia, Pakistan, Philippines and Singapore. The direction of trade is used for the collection of data on bilateral trade. This database comprises the values of annual imports and exports of goods for all counties under study. Values of import and export are used in US dollars at current prices. In this study, the data are collected from IFS on Exchange rate, interest rate, inflation and GDP. Geographical distances are measured from the world shape file. Annual data is used for the sample period from 1980 to 2019.

6. Empirical Analysis

In this section, we empirically analyze the spatial econometric models by using the panel data from 1980 to 2019, including nine equity markets of the Asian region. This analysis mainly focuses on SDM since it includes all types of spatial interactions. The first step involves estimating the impact on stock returns of different countries through the OLS technique. In the second step, detection of spatial effect in the data is to be done; if the hypothesis of no auto correlation is rejected, then the third step is to estimate the results through SDM.

6.1 Results Based on OLS

Table 6.1 displays the estimates of OLS regression. Here stock return is the dependent variable. Changes in Exchange rate, interest rate, GDP growth and unexpected inflation are independent variables. Regression results show that GDP growth significantly and positively while interest rate significantly but negatively affects the stock return at 10 percent and 5 percent significance level, respectively. One percent change in interest rate leads to a 0.06 percent decrease in stock returns while remaining variables insignificantly impact stock returns.

Table 6.1 OLS Estimates

ln_sr	Coefficients	t-value	P-value
dln_er	0.118	0.99	0.325
un_inf	-0.001	-0.45	0.65
gdp_grth	0.005	1.78	0.076 *
i_rte	-0.006	-2.17	0.031 **
Constant	0.025	1.24	0.215
Bayesian crit (BIC)	-127.255		
Akaike crit. (AIC)	-145.873		
Number of obs	306		
R-Square	0.034		
Prob > F	0.032		

6.2 Results Based on Spatial Analysis

The econometric approach enables us to relate the stock market integration of different countries to their distance as defined by different financial and economic measures. Weights matrices are constructed based on exchange rate volatility and bilateral trade distance, while geographical distance is measured through the Euclidean distance between the coordinates.

Table 7.2 displays the results of SLM, SEM, and SDM estimated based on a weighted matrix. The first column contains all the independent variables. In contrast, coefficients values of these variables for SLM and their t and P-values are shown in the second, third, and fourth columns, and the same estimated SEM and SDM are shown in the last six columns, respectively. All variables display their expected signs of coefficient. Rho (ρ**)** is the coefficient of spatial autocorrelation in the SLM, which is significant with a lower p-value exhibited the model's positive autocorrelation (spatial dependence). Still, it shows dependency only in explanatory variables. Lambda (λ) is the coefficient of spatial autocorrelation in the SEM model with a high coefficient value, significant with lower p-value exhibited the positive autocorrelation (spatial dependence) in the model. These positive values of ρ indicate the presence of spatial effect in the data, which makes the OLS biased and inconsistent that's why Ordinary least-squares cannot be used to produce consistent estimates for spatial regression models. SDM explains 0.06 percent of the variation in stock returns.

In contrast, the linear model explains 0.03 percent shows that allowing for spatial correlation substantially increases the model's explanatory power in addition to the linear model. SDM also nests SAC after imposing the restriction $\theta=0$ and SEM with restriction $\theta=-\rho\beta$. Since our estimated results have both the effect of SEM and SAC, so further analysis focuses on SDM.

Table 6.2 Spatial Analysis Results

Determinants	1			2			3		
	SAC/SLM			**SEM**			**SDM**		
ln_sr	**Coef.**	**t-Value**	**P > t**	**Coef.**	**t-Value**	**P > t**	**Coef.**	**t-Value**	**P > t**
dln_er	**0.044**	**0.510**	**0.610**	**0.039**	**0.43**	**0.671**	**0.025**	**0.250**	**0.804**
un_inf	**0.000**	**0.130**	**0.898**	**0.001**	**0.510**	**0.608**	**0.001**	**0.450**	**0.650**
gdp_grth	**0.004**	**1.58**	**0.114**	**0.005**	**1.470**	**0.141**	**0.004**	**1.280**	**0.201**
i_rte	**-0.003**	**-1.790**	**0.073**	**-0.004**	**-1.610**	**0.107**	**-0.004**	**-1.800**	**0.072**

ρ	**0.733**	**11.830**	**0.000**				**0.502**	**11.130**	**0.00**
λ				**0.514**	**11.490**	**0.000**			
R-Square	**0.0573**			**0.0299**			**0.0658**		
Observations	**306**								

6.3 SDM Results Estimated based on Exchange Rate Volatility, Bilateral Trade, and Geographical Distance.

The ρ is significant with lower p-values in all the integration measures indicated the presence of spatial effect in the data. From the table, it is clear that at 5 and 10 percent level of significance, when the volatility of exchange rate is used as an integration measure, it is found that the direct impact (the effect of change in independent variables on the dependent variable of the same region "i") of all explanatory variable are not significant, suggesting this will not have any impact on stock returns. However, the indirect effect **(**If a specific explanatory variable in a certain region changes, will not change the dependent variable of that region itself but also the dependent variable in another region. The first is called direct effect, and the second is called an indirect effect**)** of positive and significant changes in the exchange rate in neighbouring regions. This suggests that when the exchange rate strengthens in a particular region, it positively impacts the stock returns of other regions. The total effect (sum of direct plus indirect effect) from changes in the exchange rate is positive and significant, comprised mainly of the indirect effect.

Table 6.3 also depicts the results when bilateral trade is used as an integration measure. Here the direct impact is significant only for GDP growth and interest rate, which means that GDP growth is significantly positive while interest rate negatively impacts stock returns. GDP growth indirectly significantly affects stock returns. The total impact is positive only for GDP growth**,** which is mainly compromised by the indirect effect. GDP growth is an influential variable that impacts the neighboring region's dependent variables.

In the case of geographical distance, the direct impact, GDP-growth, is significant and positive while interest rate significant and negative affect the stock returns. The indirect effect is insignificant, showing none of them impact on stock return. The total effect is comprised of direct effect only.

Comparing the R-square of the three measures, bilateral trade explains 11 percent and exchange rate volatility 8 percent while the geographical distance 7 percent and the least explanatory power of the model. This implies that bilateral trade has the highest value of R-square, i.e., 11 percent variation independent variable, captured by the independent variable.

Table 6.3 Estimates of SDM

Determinants	**Ex.Rate Volality**			**Trade**			**Geog. Distance**		
ln_sr	**Coef.**	**t-Value**	**P > t**	**Coef.**	**t-Value**	**P > t**	**Coef.**	**t-Value**	**P > t**
ρ	**0.538**	**10.850**	**0.000**	**0.584**	**12.460**	**0.000**	**0.502**	**11.130**	**0.000**
θ									
dln_er	**0.466**	**2.310**	**0.021**	**- 0.136**	**-0.880**	**0.380**	**-0.01**	**-0.010**	**0.996**
un_inf	**- 0.003**	**-0.500**	**0.616**	**- 0.007**	**-1.040**	**0.300**	**-0.02**	**-0.610**	**0.541**
gdp_grth	**0.002**	**0.360**	**0.722**	**0.007**	**1.460**	**0.144**	**0.03**	**0.670**	**0.501**
i_rte	**0.007**	**1.380**	**0.169**	**0.003**	**0.400**	**0.691**	**- 0.001**	**-0.410**	**0.684**
Estimated *βs*									
Direct Effect									
dln_er	**0.102**	**0.870**	**0.384**	**0.024**	**0.200**	**0.839**	**0.031**	**0.250**	**0.802**
un_inf	**0.001**	**0.310**	**0.758**	**- 0.001**	**-0.390**	**0.693**	**0.001**	**0.260**	**0.795**
gdp_grth	**0.003**	**0.940**	**0.345**	**0.006**	**1.890**	**0.059**	**0.006**	**1.710**	**0.087**
i_rte	**- 0.004**	**-1.530**	**0.126**	**- 0.004**	**-1.710**	**0.088**	**- 0.005**	**-2.060**	**0.040**
Indirect Effect									
dln_er	**0.969**	**2.270**	**0.023**	-0.255	**-0.660**	**0.512**	**0.028**	**0.080**	**0.935**
un_inf	**- 0.003**	**-0.340**	**0.732**	**- 0.016**	**-0.940**	**0.345**	**- 0.002**	**-0.410**	**0.680**
gdp_grth	**0.006**	**0.610**	**0.540**	**0.021**	**1.960**	**0.050**	**0.010**	**1.220**	**0.223**
i_rte	**0.009**	**0.960**	**0.337**	**0.000**	**0.000**	**0.998**	**- 0.007**	**-1.090**	**0.277**

Total Effect									
dln_er	**1.071**	**2.140**	**0.032**	**-0.232**	**-0.490**	**0.622**	**0.059**	**0.140**	**0.892**
un_inf	**-0.003**	**-0.250**	**0.801**	**-0.017**	**-0.910**	**0.364**	**-0.002**	**-0.250**	**0.799**
gdp_grth	**0.009**	**0.790**	**0.430**	**0.027**	**2.170**	**0.030**	**0.015**	**1.630**	**0.104**
i_rte	**0.005**	**0.530**	**0.594**	**-0.004**	**-0.250**	**0.801**	**-0.011**	**-1.600**	**0.110**
R-Square		**0.082**			**0.1082**			**0.0658**	
Observations					**306**				

7. CONCLUSION

To determine to what extent stock market co-movements are affected by countries' economic and geographical linkages (each link separately), a model is constructed with three integration measures i-e exchange rate volatility, bilateral trade, and geographical distance. In this framework, fundamental variables impact stock returns, such as changes in the exchange rate, interest rate GDP growth, and unexpected inflation. Data comprises of 9 Asian countries from 1980 to 2019. The spatial econometric technique is used to check the role of space, direct, and spill over effect in the model.

The first analytical step involves the model estimation through OLS, in which the significant and positive values of ρ indicate the presence of spatial effect in the data. The spatial results indicate the spatial dependency both in lag and error terms, so SDM is suggested.

The estimated results in the case of exchange rate volatility showed the presence of spatial effects, the positive effect of changes in the exchange rate on stock returns.It has insignificant direct and significant indirect effect because when exchange rate changes in region "i" it impacts the stock return of neighbouring countries and the total effect is only comprised from indirect effect. Further, the remaining variables are all insignificant.

On the other hand, in the case of bilateral trade, there also exist spatial effects, where GDP growth positively and interest rate negatively affect the stock return of the country. In the case of direct effect, which indicates that the growth of a country positively impacts its returns and the increase in interest rate adversely impacts. In contrast, in the case of the indirect and total effect, only GDP is significant, indicating that country "i" GDP has a spill over effect on neighbouring country stock returns. In the case of geographical distance, the direct effect is significant in the case of GDP growth and interest rate, and there is no spill over effect in the neighbouring region.

Finally, our results show that all the linkages capture the dependencies between the stock markets. The high value of the rho indicates that correlation between markets may be due to solid global co-movement of returns. The value of rho shows that the critical link in bilateral trade. Secondly, comparing the value of the R-square of different measures suggests that bilateral trade best fits the data by explaining the variation in stock returns. The reason might be that trade has a substantial impact on the business cycle synchronization across the country.

7.1 Policy Implications

This research study has policy implications for financial investors to explore the linkages (economic and financial) that are important for the transmission of effect from one region to another and the impact on co-movement of stock returns. Furthermore, the policymakers have to ensure the stability of the financial system, this information is essential. Analysis of this issue can help better understand the linkages between markets that are essential for risk spill over and contagion effect.

The second implication of this research study is for researchers to analyse the direct and indirect effect separately on macroeconomic variables along with stock returns among the different regions.

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