SPATIAL ANALYSIS OF ASIAN STOCK MARKET LINKAGES

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CERTIFICATE

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DEDICATION

With great humility and respect I dedicate this thesis

To

My respected parents

Mr. & Mrs. Raja Mohammad Ilyas

Whom affection, love, encouragement and prayers enabled me to pursue my goals and to achieve success

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First and foremost praises and thanks to Almighty Allah, for His blessings throughout my research work which ease the path to complete this research successfully. I acknowledge my parents with deep sense of reverence and gratitude for their untiring efforts, guidance and support throughout my education period.

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ABSTRACT

This study examines the spatial dependence by employing spatial econometric technique to investigate whether economic channels and geographical distance matter for the determination of stock market returns. The empirical analysis is based on Asians stock market over a period from 1980 to 2016.We have estimated the Spatial Durbin Model (SDM) because it not only capture the spatial effects in returns but from explanatory variables as well, otherwise if we apply the OLS estimation it will produce the biased and inconsistent parameters due to ignorance of spatial dependence.

In our analysis market returns are not affected by the fundamental variables, but the weighted averages of other markets returns and fundamentals as well. 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 are included in the model which impact stock return, among them influential variables are exchange rate, GDP growth and interest rate. In case of exchange rate volatility (integration measure), only indirect effect is significant for the fundamental variable "changes in exchange rate". On the other hand when bilateral trade is used as an integration measure, then the direct effect is positive for GDP growth and negative for interest rate, while its indirect effect is positive only for GDP growth. In case of geographical distance direct effect is significant in case of GDP growth and interest rate.

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LIST OF ABBREVIATIONS

GDP	Gross Domestic Production
ML	Maximum Likelihood
SEM	Spatial Error Model
SLM	Spatial lag Model
SDM	Spatial Durbin Model
SWM	Spatial Weight Matrix
OLS	Ordinary Least Square
SR	Stock Returns
ER	Exchange Rate
INF	Inflation

CHAPTER 1

INTRODUCTION

1.1 Introduction

In the past few years, financial integration in developing countries has shifted the attention of researchers for identification of the association between stock market development and growth of the economy Deb & Mukherjee,(2008). Financial integration allow the investors to find not only the efficient capital market but risk minimising opportunities for investment as well. Sometimes financial dependence brings instability in economies Maher et al., (2017). Understanding co-movements of financial markets and externals shocks are important for financial investors as well as policy makers since these shocks effect the stability of financial system. Therefore it is necessary to figure out all the channels that cause co-movement among the stock market returns

The relationship among national stock markets has been analyzed since 1970s such as Granger & Morgenstern ,(1970) and Agmon, (1973). These studies generally found that the interdependence of share price movements is much less pronounced among countries than within a country. Later in 1987, when the world's financial markets crashed, the researchers studied the co-movement of stock markets. Since then, many practitioners as well as academicians became more interested in analyzing the co-movement between stock markets before, during and after the crash periods Jiang et al., (2017)

By 1980s it was believed that economic growth depends upon liberalization of domestic economy and positioning towards world trade. Mostly 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 miracle1993).

During the phase of 1970s and 80s these economies experienced high GDP growth after that basic deficiencies began to become apparent, weaknesses in macroeconomic policies led to the Thailand’s currency devaluation in 1997 and this led to financial instability in the region Berg, (1999).The economies of East Asian countries have shifted their attention to how they can strengthen their economic and financial fundamentals after this crisis. After the financial crisis and resulting decline in output experienced by emerging economies, a new issue has raised about finding the links between economic activity and

stock market performance. The empirical relationship between economic activity and stock returns has been deeply analysed in case of United States and other developed economies. However this issue is relatively unexplored in the case of emerging economies Mauro, (2003).

In recent years, international financial market has become more integrated. This is due to the gradual elimination of restrictions and relaxation over capital movements, allowing for free flow of funds through markets. Recognizing these advantages of diversification, the measurement of international correlations and linkages of stock markets across developed and emerging markets has been the focus of numerous studies in the finance literature. However the degree to which portfolio investors can effectively reduce risk, depend upon the stability of stock market returns and on co-relation, which measure the amount of similarity in the movement of financial markets Singh et al., (2010). The issue of integration between International equity markets has been focused in many investigations because an optimal portfolio decision depend upon the estimation of expected return and variance. Investor and portfolio managers can benefit it by analysing the co-movement among the equity markets Johnson et al., (2002).

The stronger integration should get reflected in dynamic interactions between financial markets in Asia, particularly the co-movements in stock markets Sehgal et al., (2019). Asian economies, on the other hand, are increasingly integrating with western markets, which gained prominence during the global financial crisis in years 2007-09 Syriopoulos, (2007).

The market capitalization of 60 major stock markets in the world is around $76.3trillion (2016).Asia has main 17 stock exchanges with market capitalization of $23.05 trillion. The facts explained above show the importance of Asian region in the world business.

Hence dynamics of stock market links in Asian region are of critical importance not only for policy makers but for market participants as well.

The present study aims to explore the financial and economic integration and to what extend different linkages affect the stock returns by employing spatial analysis. Through 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 interdependences can be present very well with the

approach of spatial econometrics and this technique provides a very useful understanding of how financial markets are connected.

1.2 Problem Statement

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 also focus on the spatial effect analysis specifically in case of Asian region.

1.3 Objectives of the Study

This study will focus the following objective:

- To what extent stock market co-movements are affected by countries economic and geographical linkages through spatial analysis in case of Asian region.

1.4 Significance of the Study

This study will benefit the policy makers, planners and financial investors to understand the co-movement of stock returns for the stability of financial system. Capturing the spatial dependence will help to know which spatial entities (economical or geographical) are most affected and can be used by future researchers.

1.5 Organization of the Study

The reminder parts are organized as follow:

Literature review which contains reflection and analysis of previous studies related to the topic become a part of chapter two. Third chapter comprises on theoretical frame work and econometric methodology. Chapter four contains analysis of this research study. Chapter five gives results and policy implications.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The analysis of spillover and understanding of dependencies among the financial markets and finding the linkages that carry these effects fetch the attention of researchers and policy makers. They address the issue to find out the important linkages that play their roles in transmission of shocks ultimately effect the economic conditions and stock returns.

2.2 Existing Literature on stock Market Integration

Many studies existed in the literature that focused on the interactions among international stock market. Bekaert & Harvey, (1995) estimated the degree of integration between major emerging markets and world equity markets from 1969 to 1992, result showed that number of emerging markets exhibit time varying integration. The study done by Karolyi & Stulz, (1996) on co-movement of stock return of Japanese and U.S shares, that were traded in United States, found that neither interest rate shocks nor macroeconomic announcement effect the co-movement between U.S and Japanese share returns but in contrast ,stock returns co-movements exhibits day-of-the-week effects. More light sheds on interactions of stock market by Asgharian & Nossman ,(2011) by analysing the risk spill-over effect from U.S and regional market to different equity market of European countries by developing a stochastic volatility model.

Majority of work done on exploring the degree of dependence among the stock markets at international level. An issue which is more important and need to be explore in this frame work is extend of integration of the equity market which depend upon how countries are financially or economically integrated.

2.3 Role of Geography in Stock Market Linkages

Previous studies suggested that the geographical proximate countries have more financial dependencies. Haile & Pozo, (2008) research on 37 advanced and emerging countries, using a panel probit model, to check the contagious effects and transmissions channels

for the spread of currency crisis. Results of the study showed that currency crisis faced by countries due to weak macro-economic conditions and contagion. In the most cases considered, contagion works through trade channel. Estimated results showed that the probability of crisis in a country increases as number of neighbours countries in crisis increases, implying the presence of neighbourhood effect.

The understanding of exchange rate co-movement before and during Asian financial crisis is studied by Orlov, (2009).The cospectrol methodology was used to check whether a contagion effect was present in foreign exchange markets or not. Test results showed 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. Fazio, (2007) explored that 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.

2.4 Impacts of Physical Distances

Further Coval & Moskowitz, (1999) investigated investor's portfolio, results suggest that asymmetric information between local and nonlocal 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 applied by Flavin *et al*., (2002) to check the correlation between national stock market and trade, GDP and geographical distance and found that geography (role of space) matters in case of examining equity market linkages. The cross country stock market correlation increases with opening hour's timings and sharing of common border. A gravity model was also used by Portes & Rey, (2005) analyse the cross-border equity flows and it is suggested that geography of information is the main determinant of the pattern of international transactions.

Rolling gravity model used by Bayoumi *et al*., (2007) to examine the correlations of financial market prises to measure contagion with distance. The logic is supported by results that distance matters in basic linkages such as trade, creditors and structure of the institutions and propagation of crisis that depend upon the extend at which countries are

linked through these measures. For example Glick & Rose, (1999) point out that international trade linkage can play a more important role during currency crisis as compared with macroeconomic or financial linkages.

(VAR) model, Granger causality test, co-integrating Vector Error Correction Model (VECM) are popular models for study of linkages in financial markets. Cheung *et al*., (2010) used these approaches to check the global interdependencies and spillover effects and results were consistent with contagion theory that as interdependencies among international stock market becomes stronger in the crisis. These methodologies, clearly, 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 pragmatic approach of looking at how distances both physical and financial among the major financial centres affect financial interdependencies

Ignoring spatial dependency could lead to inefficient and biased estimates, invalid inference procedures and as a result wrong conclusions (Lesage 2008).

2.5 Spatial Stock Market Linkages of Asian Countries:

Contribution made by Tam, (2014) in the literature by using 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 frame work. 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) model stock returns 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 capital asset pricing model in a spatial version to discover spatial dependency along with risk of an investment .A dynamic panel model with spatial error (spatial moving average SMA) 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 GARCH-BEKK model, results showed that spatial linkages of volatility spillover is time varying and emerging markets are more sensitive to shocks than developed markets.

2.6 Conclusion

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

If spatial and spillover effect are not account for them as they could lead to inconsistent and biased estimates (Le Sage, 1998). So we contribute in the existing literature by analysing through various spatial linkages, at what level changes in fundamental variables effect country's own stock returns but its impact on other stock markets as well specifically for Asian countries .

CHAPTER 3

DATA AND METHODOLOGY

3.1 Introduction

This chapter discusses the methodology and the data of the study. The section 3.2 presents the theoretical framework of stock returns by discussing the factors that influence the stock returns such as exchange rate, unexpected inflation, GDP growth and interest rate. Section 3.3 focuses on the spatial econometrics. Section 3.4 comprises on the construction of spatial weight matrix. The spatial models and their possible spatial effect is explained in section 3.5. Section 3.6 explain their estimation. The connectivity among the stock returns of different countries is diagnosed through spatial econometric technique, discussed in section 3.7. Last section 3.8 comprises on the data of the study.

3.2 Theoretical Framework

There exists some co-movements between stock returns and macroeconomic variables, this idea was first implemented by Chen, Roll and Ross, (1986) for US stock returns. For this study some explanatory variables are part of the model, the relationship between macroeconomic variables and stock returns and how we compute them is discussed in detail.

3.2.1 Exchange Rate Changes

The exchange rate, which is defined as price of domestic currency for foreign currency. It is one of the factor that captures the effect of foreign sector on the stock returns. Both theory and empirical findings indicate the relationship exist between exchange rates and stock market prices. Several hypotheses observe that exchange rates and stock market prices are linked. For instance, Dombusch & Fischer, (1980) proposed that exchange rate changes impact on the competitiveness of companies because exchange rate volatility impacts on the income values and costs of operations because many firms borrow in terms of foreign currencies for investment and day to day operations**.** A devaluation of domestic currency, makes a country's exports more competitive, and hence more demand for local exports by foreigners. This ultimately

leads to increase in firm's profits and stock prices, and increase of the domestic currency produces contrary results.

3.2.2 Unexpected Inflation

An important factor in the valuation of financial assets is an 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. A negative relationship is observed by Amihud, (1996) among unanticipated inflation and stock prices. Theoretically, there is a claim that higher inflation is caused by higher inflation uncertainty, with the direction of causality going from inflation uncertainty to inflation. Thus the assumed negative relation is between inflation uncertainty and stock returns. This is due, first, to the fact that higher inflation uncertainty increases the required risk premium, leads to a higher discount rate, and lowers the discounted present value of expected future cash flows, thus resulting in a fall in stock prices. Second, economic activity is adversely affected by inflation uncertainty and, since stock returns lead economic activity, there is a negative relation between stock returns and inflation uncertainty. Azar, (2014)

3.2.3 GDP Growth

For economic activities, GDP growth can be used as proxy, that's why its exhibits a positive influence on stock returns Asgharian et al., (2013). Multiple theories observed the empirical relationship between stock return and GDP growth. The stock prices reflect the present discounted value of dividends which, itself is linked with GDP growth.(passive informant hypothesis).This relationship between year's stock returns and next year's economic growth also strengthens. Mauro, (2000)

The growth in equities indicates that business is going well which bring huge profit. The significant growth rate of country's GDP indicates good economic condition of an economy. The analysis done on the relationship between GDP growth and stock returns by singh et al., (2011) and the findings revealed that when GDP grows more people want to invest, corporate earnings rise and this bring positive impact on returns .

3.2.4 Change in Interest Rate

In literature the state of economic opportunities are best picturized by interest rate. Efficient market is first priority for investors. In an inefficient market, investor losses their confidence about the market. When interest rate rises, both investors and consumers cut off their spending and switch capital from share market to bank. This will cause reduction in demand and price of share and vice versa Alam & Uddin, (2009). The relationship between stock returns and changes in interest rate is explained in financial theory. Interest rates influence stock returns via two primary channels First, movements in interest rates have a direct effect on the discount rate used in equity valuation. Second, interest rate changes affect firms expectations about future cash flows by altering the cost of financing, mainly in the highly indebted companies Martinez *et al*., (2014)

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

$$y_i = \alpha + x_i \beta + \varepsilon_i \qquad (1)$$

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

3.3 Spatial Econometrics

Spatial econometrics is a sub dimensional field of econometrics which deals with spatial interaction effect among different geographical regions. Spatial dependence shows a scenario in which dependent variables at one location depend on observation of same variable being observed at another location Anselin, (2001). The important point in spatial econometrics is that it investigate the spatial spillover and its magnitude as well.

3.3.1 Spatial Panel Data Econometrics

Recent literature of spatial econometrics has great interest on the specification and estimation of econometric relationships based on spatial panel data. Spatial panel data refers to data which containing time series observations of a number of geographical units. In general, panel data set is more descriptive, since it deals more variation and less co-linearity among the variables. Panel data uses greater availability of degree of freedom for results, and therefore increase efficiency in estimation Baltagi, (2008).

3.3.2 Standard Model for Spatial Panel

A linear regression model is used with spatial specific effects but without spatial interaction effects of the data as discussed under equation 1. By incorporating spatial interaction effect in our model in equation 1, the general nesting model (GNM) will be:

$$y_{ti=\rho\sum_{j=1}^{N} W_{ij\,y_{jt}} +\alpha+X_{ti}\beta+\sum_{j=1}^{N} W_{ij\,x_{jt}\,\theta} +\varepsilon_{ti}\cdots} \quad (2)$$

$W_{ij\,y_{jt}}$ Presents the interaction effect of the dependent variable of neighbour units. $W_{ij\,x_{jt}}$ presents the interaction effect of the independent variable of neighbour units, where W is a non-negative spatial weight matrix, describing the arrangement of the spatial units in the sample. X_{ti} is $1\times K$ vector of exogenous variables. $\beta\ and\ \theta$ are unknown parameters. Error term ε_{ti} independently and identically distributed with zero mean and constant variance.

Where

$$\varepsilon_{ti} = \sum_{j=1}^{N} W_{ij\,\varepsilon_{ti}} + \upsilon_{ti} \quad (3)$$

$W_{ij\,\varepsilon_{ti}}$ = A vector of spatially lagged error terms

In general equation (1) and (2) can also be written as

$$Y_t = \rho W Y_t + X_t\beta + WX_t\theta + \varepsilon_t \quad (4)$$

WY = A matrix of spatially lagged dependent variable.

WX = A matrix of spatially lagged explanatory variables.

$\beta\ and\ \theta$ are unknown parameters. Error term ε_{ti} independently and identically distributed with zero mean and constant variance.

3.4 Weight (W) matrix and Normalizing W matrix

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). Where each column represents one region. W might be normalized in such a way that the elements of each column sum to one. There is a point

that the column elements of a spatial W matrix shows the impact of a particular unit on all other units, while the row elements of spatial W matrix display the impact on a specific unit by all other units. Therefore, column normalization has the effect, the impact of each region on all other regions is equalized, while row normalization has the effect, the impact of a particular region on all other regions Elhorst, (2014). 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. Taking Fij, a measure of the proximity/closeness between countries i and j, the components of ith row and jth column of C are given as:

$$Cij = 1 - \frac{maxjFij - Fij}{maxjFij - minFij} \quad (5)$$

Contrary, if Fij is taken as a measure of distance among the countries i and j, the elements of the ith row and the jth column of C are expressed as:

$$Cij = 1 - \frac{Fij - minjFij}{minjFij - maxjFij} \quad (6)$$

By this definition of contiguity, when country j is at shortest distance from country i then Cij =1 and Cij = 0 indicates whether country j is on considerable distance from country i. Following this, through row standardization W (interpreted as average of a neighbours) is then found from C. by considering the power of the spatial weight matrix, where W is a contiguous neighbour of first order. The W^2 will reflect contiguous neighbour of second order, those which are neighbours to first order neighbours Anselin (1988,) Le Sage and Pace, (2009).

3.5 Spatial Econometrics Models and Possible Spatial Interaction Effects

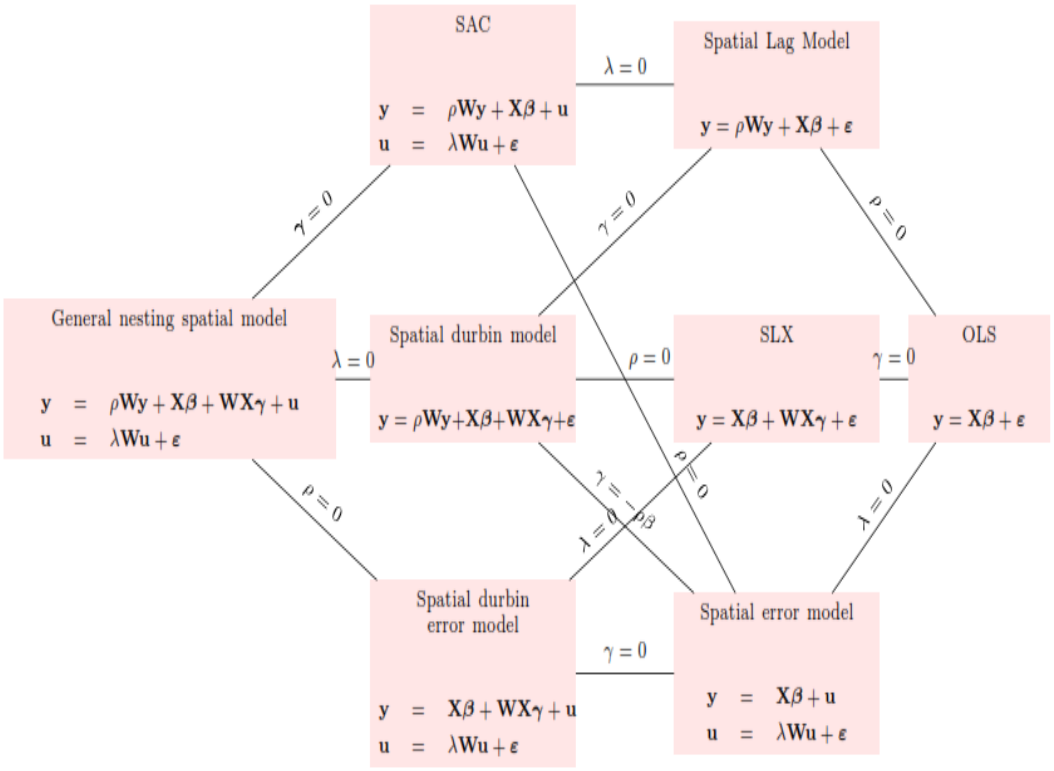

Figure 3.1: Classification of Linear Spatial Dependence Models. This figure has been derived from Elhorst (2014).

The above table shows different types of models among them simplest model is linear regression model that takes the form

$$Y = \alpha + X\beta + \varepsilon \qquad (7)$$

The regression model shown in equation 7 is known as OLS model commonly estimated by ordinary least square (OLS) method. OLS is not best suited for the models which incorporated spatial effect because it makes the implicit assumption that outcome for different regions are independent to each other Elhorst, (2013). In the presence of spatial autocorrelation OLS estimation of spatial error model provide unbiased but inefficient estimators but for model specification contains spatially lag dependent variable (SAR), OLS estimator not only losses the property of unbiased but also inconsistent Elhorst, (2003).

In the existing literature of spatial econometrics different spatial models used which 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 term Elhrost, (2013). These types of dependencies be captured through Spatial Lag Model (SLM), Spatial Lag of X (SLX) and Spatial Error Model (SEM) which are commonly used in existing literature of spatial econometrics.

3.5.1 Spatial Error Model (SEM)

Error terms over the different spatial entities are dependent on each other's generally due to omitted variables which are themselves spatially correlated. SEM incorporates a spatially autoregressive process in the error term as appeared in equation (8).

$$Y = X\beta + \mu \tag{8}$$

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 spatial autoregressive 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 independently error term with a constant variance.

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

The general form of SLM is expressed as

$$y = \rho Wy + X\beta + \varepsilon \tag{9}$$

Where Y is a vector of N observations on the dependent variable, W is a $N \times N$spatial weights matrix, ρ is spatial autoregressive coefficient, 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. We will shift our focus to SDM due to the limitation of the above stated models.

3.5.3 Spatial Durbin Model (SDM)

SDM is special case of spatial autoregressive (SAR) model Le Sage 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:

$$y = \rho Wy + X\beta + WX\theta + \varepsilon \qquad (10)$$

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.

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

3.5.4 Direct and Indirect (or Spillover) Effects

Simultaneous feedback (direct and indirect effect) is a key feature of spatial regression model which arise from dependence relations.

1. The direct effect, if a specific explanatory variable in a particular region changes, will not change the dependent variable of that region itself but also the dependent variable in other regions as well. First is called direct effect and second is an indirect (or spillover) effect. It should be kept in mind that every diagonal element of the matrix represents a direct effect and every off-diagonal element represents spillover effects.

2. Direct and spillover effects are different for different regions in the sample. The reasons of direct effects are different in the diagonal elements of the matrix that are different for different regions. Spillover effects are different because both elements of off-diagonal matrix are different.

3.6 Models and Their Estimation

Ordinary least-squares cannot be used to produce consistent estimates for spatial regression models. A number of different approaches have been proposed for estimating the parameters of spatial regression models, including: maximum likelihood estimation Ord, (1975), an instrumental variables generalized moments (IV/GM) approach suggested by Kelejian and Prucha, (1998).we move to Maximum Likelihood estimation technique, a great deal of public domain software allows these models to be estimated in a relatively straightforward manner (Anselin, 2006 ; LeSage, 1999 ; Pace, 2003). First we start our estimation technique from non-spatial model and then we extend it by incorporating the spatial interaction effects in dependent and independent variables, which is called Spatial Durbin Model.

3.7 Integration Measures

Three bilateral measures used to check the closeness of financial markets (spatial dependency) to each other, selection is based on most important linkages that effect stock returns included exchange rate volatility, bilateral trade and geographical distances.

3.7.1 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.

3.7.2 Bilateral Trade

The trade impact analysed by Walti, (2011) on demand as well as supply side of the economies, bilateral trade significantly impact the stock returns. When in one country aggregate demand rises to meet this increased demand imports rises, so trading partner increased its output hence foster the business cycle activities between countries. However the impact of trade on supply side is not clear.

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.

$$F^{BT}_{ij,t} = \frac{exp_{ij,t} + exp_{ji,t}}{\sum_{k=1}^{k=N} exp_{ik,t} + \sum_{k=1}^{k=N} exp_{ki,t}} \quad (11)$$

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

3.7.3 Geographical Distance

A country economic relations and business cycles are effected by its geographical close countries and ultimately it impact the stock returns Fernandez-Avilas et al., (2012).The countries which share geographically closeness show more strong financial linkages and in trade as well shown by Orlov, (2009). For measurement of geographical closeness, for each pair of country, distance between capital cities is used as discussed under equation (5)

3.8 Data Description and Variable Construction

Annual data is used for this study the sample period from1980 to 2016.

3.8.1 Data Description

Data comprises observations on 9 equity markets, namely China, India, Indonesia, Korea, Japan Malaysia, Pakistan, Philippine and Singapore. Direction of trade is used for the collection of data on bilateral trade. This dataset comprises the imports and exports values (annual) 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, inflation, interest rate and GDP. Geographical distances are measured from world shape file.

3.8.2 Construction of variables

The changes in exchange rates is computed by taking standard deviation of log difference of real effective exchange rate on yearly basis .The variable of bilateral trade is constructed under the formula discussed in equation (14) and geographical distance is measured through the equation (4).

3.8.3 Estimation Software

Software STATA is used to estimate the regression models used in this study.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

In this section the researcher empirically analyze the spatial econometric models, by using the panel data from 1980 to 2016 including 9 equity markets of Asian region. This analysis mainly focus on SDM since it include all types of spatial interactions. The first step involve the estimation of the impact on stock returns of different countries through OLS technique. At second step detection of spatial effect in the data is to be done, if the hypothesis of no autocorrelation is rejected, then third step is to estimate the results through SDM.

4.2 Results Based on OLS

Table 4.1 displays the estimates of OLS regression. Here stock return is 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 affect the stock return at 10 percent and 5 percent level of significance respectively. One percent change in interest rate leads to 0.06 percent decrease in stock returns while remaining variables are insignificantly impact stock returns.

Table 4.1 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		

**** p<.01, ** p<.05, * p<.1*

4.3 Results Based on Spatial Analysis

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

Table 4.2 displays the results of SLM, SEM and SDM estimated on the basis of weighted matrix. First column contains all the independent variables while coefficients values of these variables for SLM and their t and P-values are shown in second, third and fourth columns and same estimated results of SEM and SDM are shown in the last six columns respectively. All variables display with their expected signs of coefficient. Rho (ρ**)** is the coefficients of spatial autocorrelation in the SLM which is significant with lower p-value exhibited the positive autocorrelation (spatial dependence) in the model but it shows dependency only in explanatory variables. Lambda (λ) is the coefficient of spatial autocorrelation in SEM model with 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 and this make 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 variation in stock returns while linear model explain 0.03 percent shows that allowing for spatial correlation substantially increase the explanatory power of the model 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 focus on SDM.

Table 4.2 Spatial Analysis Results

Determinants				**1**			**2**			**3**
				SAC/SLM			**SEM**			**SDM**
ln_sr	**Coef.**	**t**	**P>t**	**Coef.**	**t**	**P>t**	**Coef.**	**t**	**P>t**	
dln_er	0.044	0.510	0.610	0.039	0.430	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	1.580	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	-0.533	-2.730	0.006	0.514	11.490	0.000				
R-squared		0.0573			0.0299			0.0658		
Observations 306										

4.4 SDM Results Estimated on the Basis of Exchange Rate Volatility, Bilateral Trade and Geographical Distance

The results that obtained from alternative neighbourhood matrix i.e. exchange rate volatility and Bilateral trade while geographical distance is measured from the equation as discussed in chapter 3 under equation (5), shown in table 4.4.

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 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 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 particular region changes, will not change the dependent variable of that region itself but also the dependent variable in other region.

First is called direct effect and second is called an indirect effect) of changes in exchange rate in neighbouring regions is positive and significant. This suggests that when exchange rate strengthens in particular region it has a positive impact on stock returns of neighbouring regions. The total effect (summation of direct and indirect effect) from changes in exchange rate is positive and significant, comprised mostly of the indirect effect.

Table 4.3 also depict 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 significantly and positively while interest rate negatively impact on stock returns at 10 percent level of significance, which is in accordance to our theory singh et al., (2011) that when the GDP of any country increase it bring positive impact on stock returns and when there is an increase in rate of interest of any country both business community and consumer switch their capital from share market to banks so it bring negative impact on stock returns, Alam & Uddin, (2009). GDP-growth indirect significantly affect stock returns. The total impact is positive only for GDP-growth which is mostly compromised from indirect effect which means GDP-growth is influential variable that impact on neighbouring regions dependent variables.

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

The θ captures the impact accomplished by entering an average of the explanatory variables from neighbouring regions, created using the matrix product *WX*. Among the three integration measures, θ *is sig*nificant only in case of exchange rate volatility and insignificant for other variables.

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

Table 4.3 Estimates of SDM

	Exch rate vol.			Trade			Geog. Distance		
ln_sr	**Coef.**	**t**	**P>t**	**Coef.**	**t**	**P>t**	**Coef.**	**t**	**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 ßs									
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_grwth	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-squared	0.082			0.1082			0.0658		
Observations	306								

CHAPTER 5

CONCLUSION AND RECOMMANDATIONS

5.1 Conclusion

In order 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 are included that impact on stock returns, such as changes in exchange rate, interest rate GDP growth and unexpected inflation. Data comprises of 9 Asian countries from 1980 to 2016. In order to check the role of space, direct and spillover effect in the model, spatial econometric technique is used.

The first analytical step involve 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 term so SDM is suggested.

The estimated results in case of exchange rate volatility showed the presence of spatial effects, positive effect of changes in exchange rate on stock returns and found insignificant direct and significant indirect effect, due to the fact that when exchange rate changes in region "i" it impact the stock return of neighbouring countries and total effect is only comprise from indirect effect and further the remaining variables are all insignificant.

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

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

5.2 Recommendations

Enhancing the financial integration requires strong macroeconomic foundation and stable financial system. Hence Asian policy makers first recognise the importance of improving their macroeconomic fundamentals. By promoting the capital flows in the region, countries will improve investment environment and increase financial integration. Trade (being strongest link) between different countries should be encouraged by eliminating barriers to cross border transactions in order to strengthen financial ties between them. Advance Asian economies with strong financial markets, such as Singapore China and Korea can assist the countries that are behind in term of financial growth in order to get the good returns in the region .The integration process is influenced by corporate governance and the efficiency of the institutions. Hence, developing economies must focus on improving their governance laws as well as their institutional structures.

Policy maker must design policy frame work taking in to the account the economic and geographical linkages in order to minimize the adverse economic and financial shock. The linkages that play important role in transmission mechanism between markets need more policy coordination. In order to get higher returns economies must take in to account the regional cooperation and integration.

5.3 Policy Implications

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

The second implication of this research study is for researchers to analyse the direct, indirect effect separately on macroeconomic variables and in stock returns among different region

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