Financial Markets Interdependence: A Quantile regression Approach of Volatility Spillover
(Evidence from South and East Asian countries)

By

Raja Muhammad Ahsan Ilyas

(MMS143023)

Master of Science in Management Sciences

Finance

Department of Management and Social Sciences Capital University of Science and Technology

Islamabad

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Supervised by:

Mr. Shujahat Haider Hashmi

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THESIS EXAMINING COMMITTEE

S No	Examiner	Name	Organization
(a)	External Examiner	Dr. M Syed Aamir Shah	AIOU, Islamabad
(b)	Internal Examiner	Dr. Junaid Ahmed	CUST, Islamabad
(c)	Supervisor	Mr. Shujahat Haider Hashmi	CUST, Islamabad

_____

Shujahat Haider Hashmi
Thesis Supervisor
June, 2017

_____

Dr. Sajid Bashir
Head
Department of Management and Social Sciences
Dated : June, 2017

_____

Dr. Arshad Hassan
Dean
Faculty of Management and Social Sciences
Dated : June, 2017

Certificate

This is to certify that Mr. Raja Muhammad Ahsan Ilyas bearing registration No. MMS143023 has incorporated all observations, suggestions and comments made by the external evaluators as well as the internal examiners and thesis supervisor Mr. Shujahat Haider Hashmi at CUST, Islamabad. The title of his thesis is ‘‘Financial Markets Interdependence: A Quantile Regression Approach of Volatility Spillover. Evidence from South and East Asian Countries.’’

Forwarded for necessary actions.

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Mr. Shujahat Haider Hashmi

(Thesis Supervisor)

Dedication

Dedicated from core of my heart to my beloved parents Mr. & Mrs. Cap(R) Raja M Ilyas Khan.

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All the praises are for the Allah Almighty; the most beneficent and the most merciful; who granted man with knowledge. All salutations are upon the Prophet (P.B.U.H.) whose teachings enlighten my thought and thrive my ambitions.

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May Allah bless them all.

Raja Muhammad Ahsan Ilyas

STATEMENT BY CANDIDATE

This thesis includes no material which has been already accepted for the award of any other degree or diploma in any university and confirms that to be the best of our knowledge the thesis includes no material previously published or written by another person, except where due references is made in the text of the thesis.

Raja Muhammad Ahsan Ilyas

MMS143023

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Abstract

This study investigates the relationship among developing (South Asian) and developed East Asian countries stock markets. Daily data of stock prices are used from Jan 1, 2000 to Dec 31, 2016. Three South Asian countries Pakistan, India and Sri Lanka and East Asian China and Japan are selected. This study is based on Efficient Market Theory developed by Fama (1970 & 1991), because the investors diversify their investment to invest in different countries. GARCH 1, 1 model is used to develop the volatility series and Quantile regression is used to check the financial markets interdependence. This study used three quantiles Bearish (0.05), Mean (0.5) and Bullish (0.95). The results show that there is interdependence among all these stock markets and there is also absolute interdependence between interdependence between Pakistan and Japan, Pakistan and India and Pakistan and Sri Lanka stock markets.

Key words: Volatility spillover, GARCH 11, Quantile regression, South and East Asian Countries.

Chapter 01

Introduction

It is observed that portfolio investment, foreign direct investment and different trade agreements are increasing in past few decades. By these activities, financial stock markets are integrating rapidly. This integration has started from geographically stock markets and then it captured global stock markets. Through the integration some countries have economically dominant on rest of the countries (Butt, 2016). Integration also provides many benefits like financial and economic development, increase in FDI and portfolio investment and also increase competitive behavior (Jan, 2012).

Mean returns and volatility spillover is used to measure the transmission of information between financial stock markets (Bhar and Nikolova, 2007). Volatility transmission is also transferring the economic shocks from one country to another. The emerging countries are influenced by developed countries by their economic dependence. These effects may positive or negative and investigated by many researchers in Latin America, Europe, Africa, Mena and BRICK.

Financial and economic literature discussed the financial market integration. The information easily transferred from one market to another due to financial integration. Susmel and Engle (1994), Theodossiou and Lee (1993), Cheung and Ng (1992) and King and Wadhwani (1991) studied this behavior and their results differ from country to country. Financial information is the source which creates volatility spillover between financial markets. But according to Khalil (2014) it's not essential that the geographical boundaries and monetary relationship between the stocks is the cause of volatility effect.

Portfolio investors and economic policy makers have interest about volatility spillover because its effects on economic performance may positive or negative. They also concerned about the smooth operation of financial institutions which may effects by volatility spillover. Mean return and volatility found in regional level and international level. Therefore, it is necessary for Portfolio

investors and economic policy makers to have knowledge about financial information across the border.

The international investors diversify their investment with the help of international portfolio managers. To diversify their investment it reduces the chance of risk. It creates contacts between different markets. This behavior creates volatility transmission between different markets. So this study based on Efficient Market Theory developed by Fama (1970 & 1991). It argues that the price set to the arrival of new information. The information about integration of market flows from one market to another, so unexpected movement creates volatility in market.

The main objective of this study is to investigate the interdependencies between South Asian (emerging) and East Asian (developed) financial stock market. Pakistan, Sri Lanka and India are selected in South Asian countries and China and Japan are selected in East Asian countries. The other South Asian countries like Afghanistan, Bhutan, Maldives and Nipal have very small economies and the stock return data of Bangladesh couldn't obtained. Therefore main markets of South Asia Pakistan, Sri Lanka and India are selected. Quantile regression approach is used in this study to obtain the objectives which is developed by Koenken (2005). It calculates the interdependence between financial markets in different circumstances, lower quantile (Bearish markets), mean quantile (balanced markets) and upper quantile (bullish markets).

1.1 Asian Stock Markets

Pakistan Stock Exchange

Pakistan has 3 stocks Karachi, Lahore and Islamabad. KSE is the leading among them. It developed in 1949 and located in Karachi. LSE founded in 1970 and ISE in 1989. There are 576 companies listed in KSE with the $ 12 billion amount of capitalization.

India stock exchange

Bombay stock exchange is founded in 1875. It is the first stock exchange of Asia. It has 5500 listed companies with $ 1.43 trillion of capitalization. Its indices BSE SENSEX is used in this study.

Sri Lanka stock exchange

CSE is the leading stock of Sri Lanka is founded in 1985. It has Rs. 3115.52 Bn amount of capitalization and 296 listed companies. Its indices are ASPI and S&P SL20.

China stock exchange

The Shanghai stock exchange is one of the biggest stock exchanges in china. It is formed in 1946 with the name of Shanghai securities. Letter in 1990 its name changed as Shanghai stock exchange. It has 1041 listed companies with the volume of $3.5 trillion capitalization at Feb. 2016.

Japan stock exchange

Tokyo stock exchange is one of the big stock exchanges in Japan. In terms of capitalization it is 2nd biggest stock exchanges market in the world. It is formed in 1878. It has 2292 listed companies and $3.9 trillion amount of capitalization.

1.2 Problem statement

Asian emerging and developed stock markets are the focus of investors across the border. In past few decades, South Asian and East Asian market records high growth. In this situation markets are consider under influenced by regional, domestic and international dynamics. This behavior about mean return and volatility spillover has serious concern and needs investigation. Thus, this study aims to investigate the volatility spillover between South Asian (emerging) and East Asian (developed) markets.

1.3 Research Question

- Whether the interdependencies exist or not in terms of volatility between South Asian (Pakistan, India and Sri Lanka) and East Asian (China & Japan) stock markets?

1.4 Research Objectives

The main objective of this study is to check interdependencies between Asian emerging and developed market period. Following are the specific objectives of this study.

- To analyze the interdependencies in terms of volatility between South Asian (Pakistan, India and Sri Lanka) and East Asian (China & Japan) stock market.

1.5 Significance of Study

This study is very beneficial for financial investors, portfolio manager, academies and financial institutions. Through this study the financial investors and portfolio manager may be able to select best portfolio in order of high stock return. It is also beneficent for the policy makers; they use information about volatility and interdependence between Asian stock market to make strong economic policies. For academia purpose, this study is very help full for researchers in research domain to have looked about volatility spillover and interdependence between Asian emerging and developed market.

1.6 Organization of Study

This study contains four sections. The second section is Literature Review, in which this study explores by all this by reviewing previous studies. Third section is Research Methodology, in which all the variables name, data collection methods and methodology includes. Fourth section is Results & Analyses contains the results tables and results analyses. Fifth and last section of this study is Conclusion in which the final remarks are concluded by reviewing the results and compare it with previous studies.

Chapter 02

Literature Review

A lot of studies have been conducted on volatility spillover by many researchers for a long time. During the past few decades the financial literature has focused on volatility transmission between developing stock markets (Hume et al., 1990; Kearney, 2000; Bensafta and Semedo, 2011; Bekrios, 2013). After reviewing the financial literature, we found that in global integration in equity markets are also shuffled by equity market factors that have major concern with investor and academia.

Darrat & Benkata (2003) investigated the interdependence between Istanbul (ISE) and UK, USA, Germany and Japan stock markets. The results show that Istanbul stock has significant impact to its counterpart stock markets UK, USA, Germany and Japan.

Li (2007) also examine the relationship between China, Hong Kong and USA stock markets. The results show that there is no relationship between China and USA stock markets. But there is a weak relationship of volatility between China and Hong Kong.

Neaime (2012) studied to investigate the economic relationship between MENA stock and international and regional markets. The results provide the evidence of problems in MINA market. According to results Saudi stock market is the leading stock market in MENA. Egypt is also leading countries in non GCC stock markets, and the MENA stocks have a strong financial relationship with United State, United Kingdom and France markets.

Bekiros (2013) utilized vector auto-regression and different multivariate GARCH Model to dissect the instability overflows among the United States, the European Union and the BRIC stock markets and shows that the BRICs have turned out to be all the more universally incorporated and that infection is further substantiated since the United States economic emergency.

Bensafta and Semedo (2011) concentrated the multivariate progression of profits for different national stocks. Contingent mean of market returns are demonstrated utilizing a VAR determination while their restrictive differences are displayed by a multivariate GARCH. Furthermore, there is practically unidirectional transmission of unpredictability from the US stocks to different stocks.

Gileko and Fedorova (2014) studied the internal and external relationship between Global and BRIC markets by using GARCH in mean model. Transmission of vitality is also measured by stochastic volatility models between the stock markets. But the GARCH models are consider as mare reliable to market transmission. Many studies are used to investigate the relationship by these types of models. In So et al. (1997) used stochastic volatility model to analyses the volatility transmission in 7 Asian equity markets. And the result shows that there is volatility transmission in these markets. Wongswn (2006) also used this SV (stochastic volatility model) to investigate the return of US, Korea, Japan an90d Thailand.

Edwards and Susmel (2001) study shows the result that high unpredictability has a tendency to be connected to global emergencies. Edwards and Susmel (2003) also used this technique to investigate the volatility transmission between stocks.

Lee et al. (2004) studied the volatility and return of Asia and USA markets and found the volatility spillover between USA and Asia. Hamao (1990) investigate the short term relationship of volatility spillover between USA, UK and Tokyo. Shiller et al. (1991) reported that Japanese market members are affected to invest in US. Bennett and Kelleher (1988) and Hamao, et al. (1990) argued that USA returns are the cause of volatility spillover between the major stocks.

Rivas et al. (2006), investigated the response of US stock to EU stock by using VAR model, and argued that changing depends on the investment portion from EU to US. Furthermore, Hunter (2003) investigated the interdependence of developing stocks of Mexico, Chile and Argentina by using B-B nonparametric causality test. Cakan and Ozdemir (2007) also used this methodology to investigate the links between UK, Franc, US and Japan and find out that there is strong relationship between USA and other countries.

Peiro et al. and Dornau (1998) investigated the volatility transmission among the German, USA and Japan by using linear causality test and Jung and Baur (2006) studied the effect of volatility spillover between USA and Germany stocks. After some time, it is observed that both market effect each other at the same time. Some studies conducted on lead-lag connections among Asian stocks and interdependence with developing stocks. According to Phylaktis and Ravazzolo (2003) there is no relationship between Asia-pacific countries stock, Japan and USA.

Stulz (1996), Karolyi (1994) and Karolyi (1995) studied the US and world economic volatility. But ignore the regional markets volatility spillover. Ng (2000) mainly focused on vitality spillover and return in Asian markets. Result showed US markets shocks affect the Asian economy. So he investigates the global and regional vitality transmission, and founds that there is weak relations ship between Japan and rest of Asian countries.

Glezakos et al (2007) globally investigated the interdependence among U.S., Europe and Asian stock markets. They found that all the stock markets are influenced by UK, USA and German stock markets. And Athens financial market also affects the German and USA financial market.

Subran anian (2005) conducted a study to investigate the relationship between 5 Asian developing economies (Hong Kong, Japan, Tokyo, Shanghai and Korea) during the period of 20000 to 2008. The results suggest that there is no advantage given by diversification of globally.

Sharma (2011) also investigated the relationship of 7 Asian developing and US stock market. Asian countries are China, Japan, Hong Kong, Malaysia, India, S Korea and Philippines. Time period is used in this study of 2002 to 2007. The results showed that there is significant relationship between developing and developed financial markets.

Khan (2011) contributed, that the relationship between USA stock and 22 emerging and developed countries these countries are China, Japan, Hong Kong, India, England, Australia, Norway, France etc. during the period of 1999 to 2010 and daily data is used. He used co-integration technique. The results showed that there are only six countries which have no relationship found the countries are Korea, China, Spain, Malaysia and Australia.

Hussan et al (2012) studied the relationship among Pak, China, Japan, and Korea and found that there is very week relationship among these markets. He use GARCH model to investigate from the period of 2000-2010 and monthly data was used.

Ali et al (2011) studied on emerging and developed stock markets (Pakistan, US, UK, China, Japan, Taiwan, Malaysia, Singapore). And the techniques use are Unit rot test, CO-integration and ganger causality from the time period of 1998-2008. The results suggest that there is no relationship between Pak and rest of other countries stock market.

Kim (2005) conducted research to find out the relationship between emerging market of South Asia and world developed markets from the period of 1997-2003. The selected countries are Pakistan, India, Sri Lanka, USA, UK and Japan. According to results there is significant relationship between India and UK, USA and Japan. And there is no relationship with Pakistan and Sri Lanka.

Examining co movements crosswise over stock markets is a fundamental problem for portfolio supervisors, speculators and strategy makers and the procedure of global incorporation of budgetary markets has gotten much consideration in researches.

Earlier, Grubel (1968) and Levy and Sarnat (1970), studied the potential gains linked with global diversification. Both proved that U.S investors could achieve a better risk-to reward ratio by globally diversifying their stock portfolios. Levy and Samat (1970) furthermore seen that a stock portfolio weighted towards nations displaying frail ties with the U.S economy expanded the extent of enhancement.

The diversification is benefited, movement of information cross border financial stock markets and attract the investors to invest in global financial markets. Gagonon and Karolyi (2006) argued that due to economic shocks the process of linkages between financial markets is increased.

According to Kanas (1998) and Koutmos and Booth (1995) the process of interdependence between main financial stock markets are increased after the financial crises Oct. 1987. Yilmaz (2010),

Chiang (2007), Boubaker and Jaghoubi (2011) and Zhou et al (2012) argued that the financial crises of Asia 1997, volatility is increased in this period among Asian Financial markets.

Karolyi and Stulz (1996) studied stock market integration. And the result showed that macroeconomic declaration and shocks in the stock exchanges and treasury bills markets had no quantifiable possessions on the co-movements between the USA and Japan Financial market. But they argued that shocks in wide market based indices, such as S&P 500 and Nikkei Stock Average, impacted both the determination and power of the relationship.

Furthermore, Eun and Shim (1989) argued that the USA financial market influenced by 9 other financial markets globally and Hamao et al (1990) argued that the significantly transmission of volatility spillover from USA financial stock market to UK and Japan financial stock markets, from UK to USA and Japan financial stock market but no transmission from Japan financial stock market to USA and UK financial stock markets. However, after some time the study of Bae and Karoly (1994), the argued that there is strong volatility transmission between USA and Japan financial stock market.

The EU region provides lot of financial literature on volatility transmission among the main financial stock markets. Kanas (1998) studied that there is significant impact of spillover between France and Germany, France and UK, and volatility spillover effects from U.K to Germany. moreover, Billio and Pelizzon (2003) and Bartram et al (2007) studied whether the opening of the Euro improved the interdependence among the Euro zone's financial stocks. Billio and Pelizzon (2003) investigated that the impact of the Germany financial stock improved in EU domain after the Euro launched and Bartram et al (2007) studied a market dependence increase in major EU financial stock markets in the result of the Euro introduce.

Lot of literature has been counted on the regional financial stock markets interdependence. The results of these studies showed that the geographically closed to one another have strong relationship.

Janakirmanan and Lamba (1998) studied that financial stock markets in the Pacific-Basin domain impact each other and Al-Deehani and Moosa (2006) watched huge relationship among three main financial stock markets in the Middle East. Janakirmanan and Lamba (1998) recommended that their discoveries were identified with home inclination, while Al-Deehani and Moosa (2006) contended that the expanded relationship among the nations in their review was because of the foundation of a typical exchanging stage that encouraged cross-fringe venture. Besides, Johansson and Ljungwall (2008) saw short-run dynamic linkages among the Greater China's securities exchanges, regardless of huge administrative hindrances that constrained cross-outskirt ventures, and recommended geographic vicinity as a conceivable clarification.

Granger (1981) proposes that if all factors of a vector time arrangement prepare display a unit root, there might exist of direct mixes without a unit root, and the presence of straight mixes can, thusly, be deciphered as a sign of long-run co coordination connections between the factors of the vector time arrangement handle.

Levy and Samat (1970) are said to be co-integrated on the off chance that they display a comparable to stochastic float. For the most part three strategies, including the Engle-Granger two-stage technique, the Phillips Ouliaris co mix test, and the Johansen trial of co integration, are utilized to test for co incorporation. The Johansen trial of co mix, created by Johansen (1988) and (1991), is favored by financial specialists since this test just incorporates one stage of estimation and takes into account a few co integrating connections.

According to Ghosh et al (1999) there is co-movement of some financial markets with Japan stock market, some with USA market. Jhnson and Soenen (2002) studied the degree of relationship of twelve Asia pacific stocks with Japan and find out that China, New Zealand and Australia are strong relationship with Japan stock market. Moreover, Alaganar and Bhar (2002) studied about volatility spillover between Australia and USA stock. The results suggest that there is significant flow of information from USA to Australia. Worthington and Higgs (2004) also find out the volatility spillover among 9 Asia stocks.

Many studies conducted on china stock market and its relationship with Australia stock exchange. The correlation of risk and volatility is one of the most important to work on volatility. So, according to Baele (2005) it is necessary to collect information about market for investors, policy makers, etc. Engle and Ng (1993) investigated the Japan's stock market. He found that the news has a significant effect on volatility, bad news effect more than good news. This behavior also studied by DeSantis and Imrohoroglu (1997) and Dornbusch et al. (2000). Pan and Hsueh (1998) investigate the transmission of news internationally and found that the global markets are much interdependent.

A few imperial studies use volatility to investigate the risk about asset (Merton 1980). For example, Kanas (1998) work on this approach, and found the volatility movement among London, Parries and Frankfurt.

Karolyi and Stulz (1996) studied to determine the volatility spillover effect. The developments which potentially affect first or second minutes can be arranged into nearby (peculiar), territorial (from a neighboring nation) or worldwide (from abroad) news. Moreover, volatilities may respond in a hilter kilter way to such stuns, so that positive and negative stuns can have an alternate effect. The determination of the stuns is likewise a vital normal for the transmission procedure, as stuns might be momentary or they may continue for quite a while (Scheicher, 2001).

Many studies focused on world developed stock markets like USA, G7, Canada, Japan & UK. Bekaret and Wu (2000) and Hamao et al.(1990) studied on Japan and USA volatility spillover and found that there are tranimission of volatility spillover between USA stock market to Japan stock market. As opposed to the consequences of most reviews, Lin et al.(1994), and McAleer and Veiga (2005) found that both the USA and Japan markets encounter positive and huge overflows from the other market. That is, cross-nations' association in returns and volatilities exist. Lin's et al.(1994) comes about propose that daytime returns in New York or Tokyo can altogether impact the overnight returns in the other market, while there is no proof of slacked return overflows from New York daytime to Tokyo daytime and the other way around.

Booth (1997) studied the transmission of volatility among UK, USA and Japan. And found that there is spillover from USA to UK market the Japan stock market followed by USA stock market. USAN and UK financial stock market hove spillover impact on Japan financial stock market. They also used the GARCH method on the USA stock market. GARCH model is also used by Karolyi (1995) to investigate the volatility and return of USA and Toronto stocks. And found that the size and steadiness of return developments that start in both markets and that transmit to different markets depend vitally on how cross-advertise flow in unpredictability are demonstrated. A similar methods are additionally utilized by Baele (2005and find out that both Euripon union and USA stuns' overflow force has expanded generously over the 1990s because of globalization and in addition provincial combination.

Financial literature also interested in developing stock markets to invesrigate the transmission of stocks in Asian and European stock markets. Bala and Premaratne (2003) investigated the volatility transmission among USA, UK, Japan and Hong Kong by GARCH model. And the results show that the Singapore financial stock market has high volatility to USA, UK, Japan and Hong Kong. Shields (1997) also use GARCH method to study the return of Budapest and Warsaw markets. Scheicher (2001) used VAR method to conduced study on volatility spillover among Chexh Republic, Polan and Hungry. The results suggest that EU big stock markets are influenced by western stocks ad Hungery and Poland as well.

De Santis and Imrohorglu (1997), Aggaraval et al.(1999) andBekaert and Harvey (1997) studied volatility spillover in Asian, and Latin American markets, Mediterranean and Asia. The primary review investigates the powers that decide why unpredictability is diverse in different developing markets. It observes that more open economies as far as world exchange have fundamentally brought down volatilities. Also, their outcomes recommend that unpredictability is emphatically impacted by world figures completely incorporated markets, while it is more probable affected by nearby considers divided capital markets. Aggaraval et al. (1999) found out that times of high unpredictability in these developing markets are connected with imperative occasions in every nation as opposed to worldwide occasions. Bekaert and Harvey's (1997) and De Santis and

Imrohorglu's (1997) thinks about bolster the centrality of stuns transmitting starting with one market then onto the next.

By using EGARCH and GARCH method Leon et al. (2000) studied the unsystematic risk on Tobago and Trinidad Financial markets to estimates return and volatility. They found that the return for financial companies react more than market and volatility create more affects.

Kim and Langrin (1996) took note of that as controls on capital developments, including repatriation of the venture continues, is casual, it gets to be distinctly less demanding for outside and local speculators to move resources into and out of these little developing markets. The creators utilize GARCH models to analyze the subject of whether there is expanded instability overflow from created markets to the securities exchanges of Trinidad and Tobago and Jamaica therefore of the progression of their outside trade markets. The outcomes propose that unpredictability overflows expanded after the advancement of the trade showcase in Jamaica, yet not for Trinidad. The purpose behind this was contended to be that the obstructions to passage to the share trading system in Jamaica were all the more restricting that in Trinidad.

Global portfolio enhancement is advantageous just if comes back from worldwide securities exchanges are not fundamentally corresponded (Harrison and Moore 2009). Bekaert (1995) found that the developing business sector returns are higher, and more unsurprising, with higher instability that created markets and connections with created markets were low, in this manner speaking to appealing supporting open doors for speculators in created markets. Securities exchange co movement likewise gives a measure of the level of market incorporation between the nations (Kim and Langrin 1996). Strategy creators are likewise keen on whether securities exchanges display co development on the grounds that in a universe of progressively changed capital streams, the level of securities exchange co development can effect on the solidness of the global money related framework (Harrison and Moore 2009). At last, investigating value instability can give showcase members an evaluation of the hazard connected with different budgetary items and consequently encourage their valuation alongside the advancement of various supporting methods (Ng, 2000).

According to Ross (1989) the presence of unpredictability spillover suggests that one huge stun expands the volatilities in its own advantage or market, as well as in different resources or markets also. Unpredictability and its progressions flag the stream and entry of new data. On the off chance that data comes in bunches, resource returns or costs may display instability regardless of the possibility that the market impeccably and momentarily acclimates to the news. Consequently, contemplate on instability overflow can help seeing how data is transmitted crosswise over value markets. As a result, current writing has progressively centered around the overflow impact and instability (Beirne, et.al., 2010; Like Kim, 2009; Park, et.al., 2010; Mukherjee and Mishra, 2010; Kumar and Pandey, 2011 among others). A critical issue in resource allotment and hazard administration is whether money related markets turn out to be more reliant amid monetary emergencies. This issue has obtained awesome significance among scholastics and professionals, particularly since the presence of a few developing business sector emergencies of the 1990s (Kenourgios and Padhi, 2012). Until then, monetary emergencies models were created as to emergencies as occasions happening in individual nations. Nonetheless, those emergencies scenes centered the experimental research around the examination of virus impacts and the between provincial or intercontinental nature of the stuns.

Causality in change tests that are presented by Cheung and Hong (2001), Ng (1996), and Hafner and Herwartz (2006) are utilized every now and again with a specific end goal to decide the heading of instability overflows. Alaganar and Bahr (2003), Neaime (2006) and Köseoğlu and Çevik (2013) utilized Cheung and Ng and Hong causality in change tests to examine unpredictability overflows between various money related markets. Be that as it may, there are restricted reviews that examine instability overflows with Hafner-Herwartz causality in difference test. Some of them are made by Görmüş (2012), Nazlıoğlu et al. (2013) and Nazlıoğlu et al. (2015).

There are litrature that examine the unpredictability overflows between Turkish stock. Korkmaz and Çevik, (2009), Taşdemir and Aslan, (2009), Adıgüzel et al. and Okur and Çevik, (2013) utilized causality in fluctuation tests in their reviews. In the light of studies in the writing, it is felt that it

will be helpful for speculators to investigate changing instability overflows between Turkish securities exchange segment lists inside the setting of budgetary emergencies.

According to Kumar and Pundey (2011) that instability overflow between the US and other developing markets and decided a unidirectional transmission of unpredictability from the US to alternate nations. This finding shows up very natural and backings our theory. Al-Zeaud and Alshbiel (2012) expressed that scientists have analyzed unpredictability overflows amongst develop and developing markets and established that develop markets do in fact impact the restrictive differences and returns of other territorial markets. Chittedi (2007) utilized a Granger Causality test and reasoned that the created markets of the US, Japan and France have an impact on the creating business sector of India. However there was no proof that the created markets affected the other BRIC countries.

Kenourgious (2007) inspected the connections between the created markets of the US and UK with the developing BRIC markets and found an expansion in the relationships and volatilities amid emergency periods instead of stable circumstances. Bhar and Nikolova (2009) dissected the cooperation of the BRIC countries with whatever remains of the world. Their examination reasons that India shows the most elevated territorial and worldwide relationship, trailed by Brazil, Russia and ultimately China. As far as anyone is concerned there are no different investigates that widely concentrate on overflow virus from the created to the developing markets of the BRIC countries.

The Johansen trial of co integration has been connected in a few empirical studies, including Richards (1995), Niarchos et al (1999), Johansson and Ljungwall, (2008), and Badhani (2009). Richards (1995) utilizing the Johansen trial of co-integration to examine whether there exist long - run connections among the Japanese, the US, and a few European securities exchanges. The reason for the review was to exactly test the productive market hypothesis, which recommends that co-integration is probably not going to be watched. Richards (1995) found no confirmation of cointegration and contended that every list arrangement incorporates nation particular segments which make them carry on diversely after some time. Niarchos et al (1999), Johansson and Ljungwall, (2008), and Badhani (2009) utilized the Johansen trial of combination to look at the

long-run relationship between the Greek and the U.S securities exchange, the securities exchanges in Greater China, and the Indian and the U.S stock exchange, individually. None of these reviews discovered supporting proof of co joining.

Engle (1982) studied that there is significant impact of spillover between France and Germany, France and UK, and volatility spillover effects from U.K to Germany by using ARCH technique. Bollerslev (1986) also used this methodology to investigate the links between UK, Franc, US and Japan and find out that there is strong relationship between USA and other countries.

Engle (2002) studied that the developing business sector returns are higher, and more unsurprising, with higher instability that created markets and connections with created markets were low, in this manner speaking to appealing supporting open doors for speculators in created markets.

A study by Billio et al (2010) experimentally explored the interconnectedness among stock establishments utilizing monthly data. They discover insurance agencies, intermediaries, banks, and multifaceted investments have turned out to be very interrelated over the previous decade. Commercial banks and back up plans are assessed to have a more noteworthy effect on flexible investments and venture banks than the other way around. Their systemic hazard measures contain prescient energy to recognize money related emergency periods. Conversely, we propose a systemic hazard measure that depends on various center factors (esteem at-hazard measures rather than returns), and uses distinctive methodological ideas. Our review is the principal that gives exact evaluations of the span of intra-month overflow impacts from multifaceted investments to other budgetary foundations.

Boyson, Stahel, and Stulz (2010) used Quantile regression (QR) approach to investigate in order to analyze conditional variables. In the same way, Chan et al. (2006) and Billio et al. (2009) sagest an administration changing structure to assess the probabilities of changing to a "systemic risk administration". The joint circulation of hedge stock investments returns is examined by Brown and Spitzer (2006) who measure the reliance structure between multifaceted investments procedures utilizing copulae. While the initial two reviews appraise the impacts on state probabilities as

opposed to the extent of the overflow impacts, the last review gives assesses on the tail-reliance structure without exhibiting experimental appraisals of the size of potential hazard overflows.

A few researches also give proof of risk in the insurance sector. Allen and Gale (2005) said that the significant development in the exchange of credit hazard crosswise over segments of the financial framework has prompt to a move in hazard from the managing an account division to the protection area. Fenn and Cole (1994) explore the disease impacts among life coverage organizations when real insurance agencies report noteworthy composes downs of their portfolios. Negative riches impacts on shareholders of other insurance agencies are appeared to be especially solid if the compose downs allude to garbage bonds or business contracts.

In a strong leveraged partnership investment, have gain considerable attention of contagion, risk transmission process between different institutions and possible change of systematic risk in stock (Bernanke, 2006).

Lin et al. (1994) argued that instability and returns of two value markets might be connected because of close exchange and venture interface, developing money related market combination, universal resource estimating models, and market infection. Volatility spillover in glabol financial stocks have been recorded a “Meter Ahowr” Engle et al. (1990) and Ito (1992). Roll (1989) and Hamao (1991) stated that the relationship between financial markets have been increased after the financial crises 1987. As indicated by Hamao et al. (1991), in number relationship among financial stocks could generally change speculator discernments concerning the significance of remote monetary news, thereby for all time expanding the connection in stock returns and unpredictability crosswise over business sectors.

Data transmission between business sectors can be measured through mean returns and unpredictability. Past research, for example, King and Wadhwani (1991), Cheung and Ng (1992), Theodossiou and Lee (1993) and Susmel and Engle (1994), focus on volatility and mean overflow impacts. They have found that positively overflow impacts radiate from the US market to other

national securities exchanges and those structures of data transmission have changed since the October 1987 financial crash.

Bekaert and Harvey (2002) studied the impact of integration to bring down expected returns, because of increeases in value costs as outside financial specialists put resources into developing business sector resources with potential expanded benefits. De Jong and De Roon (2005) considered these ideas by allowing for time variety in betas in their investigation of time differing market coordination and expected returns of 30 developing markets crosswise over Latin America, Asia, the Far East, Europe, the Mid-east and Africa.

According to Engle (1982) much attention on the modeling volatility in financial time series and introduce ARCH (autoregressive conditional heteroskedasticity) model for this volatility. The large number of researcher depends on the univariate model for this literature (Bollerslev et al. 1992; & Engle, 2001). The economic integration play important role in the international financial market. Many articales on the volatilities and co volatilities difference in the financial markets. But some researchers inspect the independent stock markets through multivariate model (GARCH) in the different countries such as U.S, Canada, Germany, Japan and U.K, (Odossion & Lee, 1993). And check the statistical mean is significant spillovers exist in the U.S and other financial markets. According to Karolyi (1995) check the volatility different markets such as U.S and Canada in short run dynamic return for both countries. His only check the weekly returns and volatility in both countries such as U.S and Canada financial market. Bae and Karolyi (1994) reported that the joint dynamic model for the U.S and Japan countries and check the daytime and nighttime volatility of returns in their countries from 1988 to 1992. They extend and conclude the GARCH model used for the asymmetric effect “bad new” from the foreign market stock. And they provide the evidence and explained if asymmetric effect we ignore then the efficient relation of stock market become between the U.S and Japan.

Therefore, the role of emerging markets is currently more important. Recently, research depends on the developed and emerging markets. Goetzmann et al. (2005) reported that the financial analysts and the economists focus on the diversification of the investment and the emerging markets are

increasingly. In Asia developed markets and emerging markets returns and volatilities check during the 1988 to 2000, (Worthington & Higgs, 2004). They identify the multivariate and check out the statistical mean developed markets and the emerging the markets them explains the effect on the spillover volatility of the stock market through GARCH models. Different countries used the multivariate model (GARCH) for the emerging markets and the developed markets statistically mean are existing. Lee (2007) studied that the two china countries stock exchange the used the multivariate model (GARCH) for the Hong Kong and U.S market stock return, but no direct financial relationship between both countries and not suitable for the both multivariate models. After Lee (2012) reported that they check again the different countries ralationship such as U.S, Japan and Korea, but the china stock exchange has direct connection to these stock markets. Different researchers studied the china stock exchange effect on other countries stock such as Wang et al. 2004; Wang et al. 2005; Lin and Wu, 2006. According to Ng (2000) he reported that we check the volatility of spillover between the U.S and Japan markets. The results suggest that due to global factors, there is a significant relationship from regional to Pacific countries.

Arouri H edi (2011) studied the transmission of volatility between stock return and oli prices and found the volatility and return. Furthermore Valadkhani et al. (2013) analyzed the progression of cross-country GDP unpredictability transmission, and they discover the stun impacts are chiefly applied by the bigger economies onto the littler economies.

The investigation of the financial market mix, the degree to which a specific development in one market influences resulting developments in different markets, is critical to financial specialists and has coordinate ramifications in the portfolio hypothesis. In spite of the earlier Markowitz (1952) and Grubel (1968), both contending that global enhancement enhances effectiveness, there is confirmation of a home inclination astound that portfolios are observed to be commanded by interests in one's nearness, and markets that are geologically and financialy close tend to impact each other (Janakiramanan and Lamba, 1998). Johansson and Ljungwall (2008) contend that such diversification, or co movement, is an aftereffect of nearer political and financial collaboration among nations. They discovered critical spillover impacts among the financial markets of mainland

China, Hong Kong, and Taiwan, taking after their developing financial ties over the previous decades.

Many studies conducted on the spillover impacts in world stock markets. Liu and Pan (1997) concentrated the volatility and return from USA and Japan financial markets to 4 Asian stocks, and found that USA stocks mush persuasive at transmitting data. In the EU, there has been expanded stock diversification among EU co untries taking after the presentation of Euro, with proof of solid spillover impacts (Melle, 2003; Savva et al, 2004).

It is demonstrated with many researches that volatility spillover effected by financial crises. Literature also provides the studies about the impact of economic shocks on vitality among different stocks. Chan-Lau and lvaschenko, (2002), Nikkinen et al. (2013), Ranjeeni, (2014) and Syriopoulos et al. (2015) broke down the changing volatility spillover between stocks because of the diverse sorts of emergencies.

Financial and economic literature discussed the financial market integration. The information easily transferred from one market to another due to financial integration. Susmel and Engle (1994), Theodossiou and Lee (1993), Cheung and Ng (1992) and King and Wadhwani (1991) studied this behavior and their results differ from country to country. Financial information is the source which creates volatility spillover between financial markets. But according to Khalil (2014) it's not essential that the geographical boundaries and monetary relationship between the stocks is the cause of volatility effect. Recent studies have used Quantile regression to investigated relationship among financial markets. This technique is recommended by Baur (2013) analyze the interdependence between conditional and dependence variable. This method analyze country to country quintiles which are vary and calculate there relationship by multivariate asymmetry. On the other hand liner regression method is used to calculate the average impact. According to Koenker (2005) Quantile regression method is flexible and gives knowledge to investigate specific issues.

H1: The financial interdependence exists among South Asian (Pakistan, India and Sri Lanka) and East Asian (China and Japan) stock markets.

Chapter 03

Methodology and Data

3.1 Data

This study use volatility series to investigate the interdependence between stocks of three South Asian countries (Pakistan, Sri Lanka and India) and two East Asian countries (China and Japan) by standard GARCG model. This study use daily data which is available from Jan. 01, 2000 to June 30, 2016. And these countries are selected because their economy is growing rapidly during last decades.

Following are the stock indices are used:

Country	Index
Pakistan	KSE
India	BSE
Sri Lana	CSE
China	SZSE
Japan	NIKKEI

3.2 Methodology

To investigate the interdependence between stocks, many researches use to calculate it by Correlation coefficient method. This method address only symmetric liner relationship among variables and it can't differentiate the movement of stock prices. Therefore, strong and appropriate technique is necessary to calculate the multifaceted reliance between stocks.

The extension of least square method is Quantile regression which is used by Koenker and Bassett (1978) to calculate different conditional mean of different models for different quantiles. The Quantile regression approach is better than traditional regression method, this technique offers most exact results of the impact of conditional on the exogenous variables. It is consider to be a most appropriate technique to investigate interdependence between variables. In past Quantile regression method is widely used in many areas.

Following equation is used for quantile regression:

$$Qy(T|x) = info\{b|Fy(b|x) \geq T\} = \sum k\omega k(T)xk = x\omega(T)$$

where y is a dependent variable that is assumed to be linearly dependent on x and Fy(b/x) is the conditional distribution function of y given x. β(τ), τ ∈ [0, 1] represent the QR coefficient, that can determines the dependence relationship between vector x and the τth conditional quantile of y. Dependence is unconditional if no exogenous variables are included in x. The values of β (τ) determine the complete dependence structure of y. The dependence of y based on a specific explanatory variable in vector x could be: (a) constant where the values β (τ) do not change for different values of τ; (b) monotonically increasing (decreasing) where β(τ) increases (decreases) with the value of τ; and (c) symmetric (asymmetric) where the value of τ is similar (dissimilar) for lower and upper quantiles.

a) Correlation Matrix
b) Unit Root Test
c) GRACH volatility spillover
d) Quantile regression approach

3.2.1 Descriptive statistic

Descriptive statistic provide a summary of all variables according to the following measures mean, median, mode, kurtoses, minimum, maximum, skewness, variencess and Jarque bera. Mean shows central tendency of the data. Positive and negative values are checked by Skewnes. Std. deviation is use to check the descriptive values, high volatility shows high descriptive values. Kourtoses check peekness and flatness of the data and normality is checked by jorque bera.

3.2.2 Correlation Matrix

This test is used to check the relationship between given variables. The range of correlation is -1 to +1.

3.2.3 Unit root test

Unit root test is used to check the stationary of the data. It must be necessary that the data should be stationery. Augmented Dickey fuller (ADF) is used to check the stationary of data. This test formed by Dickey and fuller (1979).

3.2.4 GARCH (1,1) Model

GARCH (1,1) model is used to check the volatility spillover between financial stock markets. There are a number of test contain in ARCH family. It is used on that data which face heteroscedasticity and autocorrelation problems. ARCH (1) model is used to detect heteroscedasticity and autocorrelation problems. In this study GARCH 1,1 model is used to developed volatility series of the South and East Asian stock markets.

3.2.5 Qualtile Regression Approach

Koenker and Bassett (1978) developed Quantile regression approach. Quantile regression is the extension of linear regression analyses. The Quantile regression approaches presents most perfect results of the given variables. According to theory there are seven quantiles 0.05 to 095 in quantile regression approach. In this study only three quantiles are used 0.05(lover quantile), 0.5(middle quantile) and 0.95(upper quantile).

Chapter 04

Results & Discussion

Table 4.1 Descriptive Statistic

	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
RBSE	0.027	0.013024	-0.42706	14.15075	31381.81
RCSE	0.0398	0.009509	0.347516	52.11001	605280.3
RKSE	0.0541	0.011269	-0.25702	9.618648	11058.08
RNIKI	0.0289	0.012772	-0.44715	13.25561	26591.49
RSZSE	0.0254	0.051966	-0.06055	1274.087	4.05E+08

This table presents the descriptive statistic of monthly returns. It shows in column one to five the mean, the std. dev., the Skewness, the Kurtosis, the Jarque-beta. The average monthly return of India, Sri Lanka, Pakistan, China and Japan is 0.027, 0.039, 0.054, 0.028 and 0.054 respectively. Std. deviation of India, Sri Lanka, Pakistan, China and Japan is 0.013, 0.095, 0.011, 0.012 and 0.51 respectively. Moreover the returns found negatively skewed in India, Pakistan, China and Japan (-0.42,-0.34,-0.44,-0.06) and positively skewed in Sri Lanka (0.34). the value of Kurtosis is higher than 3 whish shows that the data is leptokurtic. The Jarque-Berra test rejects the null hypothesis of normality.

Table 4.2 Estimation of GARCH (1, 1)

	India	Sri Lanka	Pakistan	Japan	China

Ω	1.80E-06	1.53E-06	3.10E-06	2.08E-06	-5.21E-07
	0	0	0	0	0
G	0.067813	0.172005	0.088073	0.059946	4.701265
	0	0	0	0	0
Λ	0.922219	0.841841	0.887402	0.927962	0.431144
	0	0	0	0	0
(g + λ)	0.990032	1.013846	0.975475	0.987908	5.132409

This table presents variance equation of GARCH model: $h_{t= \omega+ \delta\varepsilon^2{}_{t-1} + \lambda h_{t-1}}$. The ARCH and GARCH coefficients (0.067, 0.922) are statistically significant for India and the sum of ARCH and GARCH is 0.99 which indicates that the volatility exist in Indian market. The ARCH and GARCH coefficients (0.172, 0.841) are statistically significant for Sri Lanka and the sum of ARCH and GARCH is 1.013 which indicates that the volatility exist in Sri Lanka market. The ARCH and GARCH coefficients (0.088, 0.887) are statistically significant for Pakistan and the sum of ARCH and GARCH is 0.975 which indicates that the volatility exist in Pakistan market. The ARCH and GARCH coefficients (0.059, 0.92) are statistically significant for Japan and the sum of ARCH and GARCH is 0.98 which indicates that the volatility exist in Japan market. The ARCH and GARCH coefficients (4.701, 0.431) are statistically significant for China and the sum of ARCH and GARCH is 5.132 which indicates that the volatility exist in China market.

Table 4.3 Diagnostic test for conditional volatility series

	India	Sri Lanka	Pakistan	Japan	China
Mean %	0.0172	0.0108	0.0127	0.0165	2.2491

Std. Dev.%	0.0198	0.0273	0.0127	0.0199	51.0922
Median	9.98E-05	4.48E-05	8.04E-05	0.000123	0.000864
Maximum	0.001987	0.00584	0.001244	0.002887	18.62897
Minimum	3.61E-05	1.12E-05	2.81E-05	0.00004	2.57E-05
Skewness	3.553002	9.846572	2.931365	7.718097	31.09339
Kurtosis	19.96206	134.7541	14.14249	79.8793	1042.981
Jarque-Bera	84861.68	4453009	39777	1542812	2.72E+08
ADF Statistic	-0.021453	-0.084705	-0.031983	-1.032742	-2.06E+00

This table presents the descriptive statistic of monthly returns. It shows in column one to five the mean %, the std. dev. %, the Skewness, the Kurtosis, the Jarque-beta and ADF Statistic for Unit root test. The RBSE average monthly return is 0.0172% with 0.0198% standard deviation. The RCSE average monthly return is 0.0108% with 0.0273% standard deviation. The RKSE average monthly return is 0.0127% with 0.0127% standard deviation. The RNIKI average monthly return is 0.0165% with 0.0199% standard deviation. The RSZSE average monthly return is 2.2491% with 51.0922% standard deviation. The ADF statistics rejected the null hypothesis at 10%,5% and 1% levels.

Table 4.4 Quantile Regression Analyses

	DV: India					
IV	0.05		0.5		0.95	
Sri Lanka	0.011***	0.009	0.001	0.2617	0.261***	0.011
Pakistan	0.051***	0.000	0.256	0.000	1.057***	0.000
Japan	0.079***	0.000	0.510	0.000	1.762***	0.000
China	7.005***	0.001	-0.00437	0.2095	-0.005***	0.0004
R-sq	0.0453		0.1715		0.3225	

Following table 4.4 presents the Quantile regression analyses of South and East Asian countries stock markets. It reports the estimation results of the quantile regression model, we can deduce that the model is able to describe and assess in an appropriate manner, the interdependence of volatility series. Indeed, the explanatory power of the exogenous variables associated with each quantile (0.05, 0.5 and 0.95) is generally high. Where India is considered dependent and Sri Lanka, Pakistan, Japan and China are considered independent stock markets. Coefficient shows that there is empirically significant impact on Indian market by Sri Lanka, Pakistan, Japan and China at lower level and upper level. The value of coefficients at lower level is 0.011, 0.051, 0.079 and 7.005 respectively. And the coefficients values at upper level at 0.261, 1.057, 1.762 and -0.005.

Table 4.5 Quantile Regression Analyses

	DV: Sri Lanka					
IV	0.05		0.5		0.95	
Pakistan	0.010***	0.000	0.019**	0.0253	-0.079	0.3537
Japan	0.009**	0.061	0.119***	0.000	0.108	0.3973
China	-0.00134	0.9446	-0.0011**	0.0213	-0.0013***	0.000
Sri Lanka	0.002	0.1733	0.020**	0.0109	0.179	0.3301
R-sq	0.00541		0.0222		0.0486	

Following table 4.5 presents the Quantile regression analyses of South and East Asian countries stock markets. It reports the estimation results of the quantile regression model, we can deduce that the model is able to describe and assess in an appropriate manner, the interdependence of volatility series. Indeed, the explanatory power of the exogenous variables associated with each quantile (0.05, 0.5 and 0.95) is generally high. Where Sri Lanka is considered dependent and India, Pakistan, Japan and China are considered independent stock markets. Coefficient shows that there is empirically significant impact on Sri Lanka market by India, Pakistan, Japan and China at lower level, middle level and upper level. The value of coefficients at lower level is 0.010, 0.009 and 0.079. And coefficient values at middle level are 0.19, 0.119, -0.001 and 0.020 respectively. And the coefficients values at upper level are -0.0013.

Table 4.6 Quantile Regression Analyses

DV: Pakistan						
IV	0.05		0.5		0.95	
Japan	-0.029***	0.000	-0.053*	0.0413	-0.230***	0.000
China	-2.867	0.3008	-1.996***	0.001	-1.205***	0.000
India	0.026***	0.000	0.117***	0.000	0.856***	0.000
Sri Lanka	3.103** *	0.000	-5.883***	0.0008	-3. 02***	0.000
R-sq	0.0317		0.0236		0.1340	

Following table 4.6 presents the Quantile regression analyses of South and East Asian countries stock markets. It reports the estimation results of the quantile regression model, we can deduce that the model is able to describe and assess in an appropriate manner, the interdependence of volatility series. Indeed, the explanatory power of the exogenous variables associated with each quantile (0.05, 0.5 and 0.95) is generally high. Where Pakistan is considered dependent and India, Sri Lanka, Japan and China are considered independent stock markets. Coefficient shows that there is empirically significant impact on Pakistan market by India, Sri Lanka, Japan and China at lower level, middle level and upper level. The value of coefficients at lower level is -0.029, 0.026 and 3.103. And coefficient values at middle level are -0.053, -1.996, 0.117 and -5.88 respectively. And the coefficients values at upper level are -0.230, -1.205, 0.856 and -3.02 respectively.

Table 4.7 Quantile Regression Analyses

	DV:Japan					
IV	0.05		0.5		0.95	
China	7.337	0.0997	-1.70E-06	0.0025	-8.06***	0.000
India	8.802***	0.000	0.254	0.000	1.483***	0.000
Sri Lanka	1.883	0.9483	0.025***	0.000	-0.007	0.3894
Pakistan	-1.22**	0.0053	-1.052	0.3546	-0.033***	0.000
R-sq	0.046369		0.099735		0.452322	

Following table 4.6 presents the Quantile regression analyses of South and East Asian countries stock markets. It reports the estimation results of the quantile regression model, we can deduce that the model is able to describe and assess in an appropriate manner, the interdependence of volatility series. Indeed, the explanatory power of the exogenous variables associated with each quantile (0.05, 0.5 and 0.95) is generally high. Where Japan is considered dependent and India, Sri Lanka, Pakistan and China are considered independent stock markets. Coefficient shows that there is empirically significant impact on Japan market by India, Sri Lanka, Pakistan and China at lower level, middle level and upper level. The value of coefficients at lower level is 8.802 and 1.22. And coefficient values at middle level is 0.025. And the coefficients values at upper level are -8.06, -1.483 and -0.033 respectively.

Table 4.8 Quantile Regression Analyses

	DV:China					
IV	0.05		0.5		0.95	
India	0.009	0.7735	0.349**	0.013	5.598	0.3839
Sri Lanka	-0.0003	0.9762	-0.177***	0.000	-1.612***	0.000
Pakistan	0.0082	0.8545	0.279***	0.000	-1.294	0.6378
Japan	1.142	0.8876	0.866***	0.000	4.154	0.2424
R-sq	0.0145		0.0730		0.0795	

Following table 4.8 presents the Quantile regression analyses of South and East Asian countries stock markets. It reports the estimation results of the quantile regression model, we can deduce that the model is able to describe and assess in an appropriate manner, the interdependence of volatility series. Indeed, the explanatory power of the exogenous variables associated with each quantile (0.05, 0.5 and 0.95) is generally high. Where China is considered dependent and India, Sri Lanka, Pakistan and Japan are considered independent stock markets. Coefficient shows that there is empirically significant impact on China market by India, Sri Lanka, Pakistan and Japan at lower level, middle level and upper level. The values of coefficient at middle level are 0.349, --0.177, 0.279 and 0.866 respectively. And the coefficients values at upper level is -1.612.

4.2 Discussion

In this study GARCH (1, 1) model ($h_{t=\omega+\delta\varepsilon^2_{t-1}+\lambda h_{t-1}}$) is used to estimate the conditional volatility series of each stock market. According to many researchers GARCH model is better to estimate the volatility spillover among stock markets with the existence of ARCH effect (Bollerslev et al., 1994, Nikkinen et al., 2008, Ramlall, 2010). The choice of the GARCH model is made

after a comparison with a non-linear EGARCH specification. The criteria used to determine the performance include the information criteria of Akaike and Schwarz and the log-likelihood value comparison. Result show a strong relevance of the standard GARCH compared to the EGARCH.

It is important to mention that by reference to the financial literature related to application of the quantile regression technique, we proceeded by calculate seven quantile, from the lower (0.05) to the higher one (0.95). However, we just reported in Tables 3 and 4 the results of three major quantiles (0.05, 0.5 and 0.95) which relate, most frequently, the maximum of information. Indeed, these three quantiles allows us considering extreme situations inherent to financial markets, respectively bearish movements, mean movements and bullish movements. We report further the standard errors which are obtained using the pairs bootstrapping procedure (Buchinsky, 1995). This allows us to judge the nature of co-movement (symmetric or asymmetric).

This study confirm the previous findings that there is financial interdependence between regional markets. According to Bhar & Nikolova (2007) the Asia pacific markets and European market have strong interdependence and Brazil have also great regional impact regarding volatility spillover. The same results have been observed for the Asian region in so far as the positive and significant dependence with other stock markets is evident for every part of quantiles and the dependence increases in past decades.

This approach used for the first time to study financial markets interdependencies in terms of volatility, it confirm the results of previous studies which used different methodologies in order to judge the existence of unidirectional and sometimes bidirectional volatility spillovers between financial markets (Gilenko and Fedorova, 2014; Bekiros, 2014; Li, 2007; Darrat and Kasch-Haroutounian et Price, 2001; Forbes and Rigobon, 2001, 2002; etc…). Our findings support the robustness of this methodology to detect interdependencies between volatility series which represent a non-linear history over time.

Chapter 04

Conclusion

The study aims to explore the relationship of financial market interdependence by using quantile regression approach. The QR approach is considered satisfactory to show the financial market interdependence in different circumstances. Three emerging South Asian countries (Pakistan, Sri Lanka and India) and two developed East Asian Countries (China and Japan) are included in this study.

Throughout this study, we were able to verify the existence of volatility transmission between emerging markets as well as between emerging and developed markets. This evidence can be explained by the reinforcement of financial integration level which strengthens the degree of dependence between emerging and developed markets. We note that several studies examined the interdependence in emerging economies and confirmed that they are stronger after financial integration (Bensafta et Samedo, 2011; Phylaktis and Ravazzolo, 2002; Carrieri et al., 2007; Calvo et Reinhart, 1996). One of the important results of this study is that the geographical proximity involves a great increase of transmission. The results shows that there is volatility transmission between all markets of South and east Asian countries but there is strong volatility transmission between Pakistan and Japan, Pakistan and India and Pakistan and Sri Lanka stock markets at an absolute level (all three quantiles are significance). The results show that there is significance impact of Pakistan, Sri Lanka, China and Japan on Indian stock market. Their coefficients are significant at Bearish and Bullish movement. Pakistan and Japan have significance impact on Sri Lanka stock exchange at Bearish and mean movement. China has significance impact on Sri Lanka at mean level. The Indian stock market has significance impact on Sri Lanka at mean and bullish movement. The Japan, India and Sri Lanka have absolute significance impact on Pakistan stock exchange and China has significance impact on Pakistan stock exchange at mean and bullish movement.

According to results India and Pakistan stock exchange has significance impact on Japan stock exchange at bearish and bullish movement. China and Sri Lanka have significance impact on Japan stock exchange at mean and bullish movement respectively. Pakistan, India and Japan have significance impact on China stock exchange at mean. And the Sri Lanka stock exchange has significance impact on Pakistan stock exchange at mean and bullish movement.

So far, the most frequently useful question for governmental policy makers in emerging economies is: How to avoid volatility transmission and the risk of contagion? In fact, many studies tried to answer this question such as Masson (1999) and Forbes and Rigobon (2001). Given the high fragility of the emerging financial systems, it is necessary to rationalize their economic and financial openness in order to reduce the occurrence of financial risk and consequently the risk of contagion. More precisely, they must undertake some reforms related to exchange rate regimes and interest rates policy, in order to avoid the high devaluation of the national currency which generally results in financial crises (Nguyen, 2005). We note also that international cooperation is generally considered as alternative way to predict and avoid the risk of crises and contagion resulting from international fluctuations. This suggests that emerging countries have to take part in regional and international blocks (World Bank and FMI), which aims at making coordination between them and establishing common prudential rules.

5.1.1 Recommendations of study

The results shows that the transmission of volatility spillover has significance impact on South and East Asian countries, which is helpful for the investors who intend to invest in these countries. According to this study the interdependence between Pakistan and Japan, Pakistan and India and Pakistan and Sri Lanka stock markets has on absolute level which is very attract full for domestic and international investors.

For managerial implication, it is necessary for the emerging (South Asian) stock markets to rationalize their financial and economic system to avoid the financial risk. These counties should be coordinated with in world financial institutions like World Bank and IMF to make reforms according to the changes in world economy.

This study is helpful for the investors of South and East Asian countries to check the stock market stability for making investment decision. It is more helpful for emerging countries (south Asian countries) investors to invest in the develop countries (East Asian countries).

5.1.2 Limitation of study

This study limited on three emerging South Asian countries Pakistan, Sri Lanka, India and two developed East Asian countries China and Japan and the time period from 2000 to 2016 (only 16 years) due to shortage of time. The different financial crises periods are ignored. In future large number of countries from South and East Asian region may include and also check the crises be heavier.

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Appendix

Descriptive statistic

	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	ADF Statistic
RBSE	0.027	0.013024	-0.42706	14.15075	31381.81	-0.97609***
RCSE	0.0398	0.009509	0.347516	52.11001	605280.3	-0.91126***
RKSE	0.0541	0.011269	-0.25702	9.618648	11058.08	-0.85753***
RNIKI	0.00289	0.012772	-0.44715	13.25561	26591.49	-1.03274***
RSZSE	0.0254	0.051966	-0.06055	1274.087	4.05E+08	-2.05912***

Correlation Matrix

	VCSE	RKSE	RCSE	RNIKI	RSZSE
VCSE	1				
RKSE	0.020994	1			
RCSE	0.010364	0.02654	1		
RNIKI	-0.00831	0.021435	0.035237	1	
RSZSE	-0.000761	0.0087157	0.0051762	0.0515339	1.00E+00

GARCH (1,1)

	India	Sri Lanka	Pakistan	Japan	China
Ω	1.80E-06	1.53E-06	3.10E-06	2.08E-06	-5.21E-07
	0	0	0	0	0
G	0.067813	0.172005	0.088073	0.059946	4.701265
	0	0	0	0	0
Λ	0.922219	0.841841	0.887402	0.927962	0.431144
	0	0	0	0	0
(g + λ)	0.990032	1.013846	0.975475	0.987908	5.132409
Log- likelihood	18616.14	21059.48	19366.6	18393.39	1.24E+04

Descriptive statistic

	diagnostic test for conditional volatility				
Mean %	0.0172	0.0108	0.0127	0.0165	2.2491
Std. Dev.%	0.0198	0.0273	0.0127	0.0199	51.0922
Median	9.98E-05	4.48E-05	8.04E-05	0.000123	0.000864
Maximum	0.001987	0.00584	0.001244	0.002887	18.62897
Minimum	3.61E-05	1.12E-05	2.81E-05	0.00004	2.57E-05
Skewness	3.553002	9.846572	2.931365	7.718097	31.09339
Kurtosis	19.96206	134.7541	14.14249	79.8793	1042.981
Jarque-Bera	84861.68	4453009	39777	1542812	2.72E+08
ADF Statistic	-0.021453	-0.084705	-0.031983	-1.032742	-2.06E+00

Quantile Regression Approch

Dependent Variable: VBSE 0.05
Method: ML - ARCH (Marquardt) -
Date: 02/25/17 Time: 23:45
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.011666
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.28E-05	1.25E-06	26.28298	0
VCSE	0.011141	0.004261	2.614647	0.009
VKSE	0.05185	0.004858	10.67325	0
VNIKI	0.079964	0.006839	11.69164	0
VSZSE	7.05E-07	2.20E-07	3.200592	0.0014

Pseudo R-squared	0.037619	Mean dependent var	0.000172
Adjusted R-squared	0.036979	S.D. dependent var	0.000198
S.E. of regression	0.000222	Objective	0.037107
Quantile dependent var	4.80E-05	Restr. objective	0.038557
Sparsity	0.000153	Quasi-LR statistic	398.5979
Prob(Quasi-LR stat)	0		

Quantile Regression Approch

Dependent Variable: VBSE 0.5

Method: ML - ARCH (Marquardt) -
Date: 02/25/17 Time: 23:47
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.053402
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.59E-05	1.70E-06	9.356583	0
VCSE	0.001919	0.00171	1.122421	0.2617
VKSE	0.256853	0.017555	14.63131	0
VNIKI	0.510409	0.017701	28.83548	0
VSZSE	-4.37E-07	3.48E-07	-1.25506	0.2095

Pseudo R-squared	0.164633	Mean dependent var	0.000172
Adjusted R-squared	0.164077	S.D. dependent var	0.000198
S.E. of regression	0.000161	Objective	0.259633
Quantile dependent var	9.98E-05	Restr. objective	0.310801
Sparsity	0.000147	Quasi-LR statistic	2784.784
Prob(Quasi-LR stat)	0		

Dependent Variable: VBSE 0.95
Method: ML - ARCH (Marquardt) -
Date: 02/25/17 Time: 23:48
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.011666
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.96E-06	3.81E-05	-0.23503	0.8142
VCSE	0.261216	0.102825	2.540406	0.0111
VKSE	1.057384	0.098231	10.76426	0
VNIKI	1.762629	0.256818	6.863349	0
VSZSE	-5.51E-06	1.57E-06	-3.51356	0.0004

Pseudo R-squared	0.316918	Mean dependent var	0.000172
Adjusted R-squared	0.316463	S.D. dependent var	0.000198
S.E. of regression	0.000413	Objective	0.139036
Quantile dependent var	0.000557	Restr. objective	0.203542
Sparsity	0.00271	Quasi-LR statistic	1002.307
Prob(Quasi-LR stat)	0		

Dependent Variable: VCSE
Method: ML - ARCH (Marquardt) -
Date: 02/25/17 Time: 23:50
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.011666
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.33E-05	7.01E-07	18.97679	0
VKSE	0.010222	0.001424	7.179968	0
VNIKI	0.009235	0.004929	1.873587	0.061
VSZSE	-1.34E-08	1.94E-07	-0.06943	0.9446
VBSE	0.00257	0.001887	1.361895	0.1733

Pseudo R-squared	0.005402	Mean dependent var	0.000108
Adjusted R-squared	0.004741	S.D. dependent var	0.000273
S.E. of regression	0.000288	Objective	0.028037
Quantile dependent var	1.60E-05	Restr. objective	0.028189
Sparsity	7.10E-05	Quasi-LR statistic	90.32445
Prob(Quasi-LR stat)	0		

Dependent Variable: VCSE
Method: ML - ARCH (Marquardt) -
Date: 02/25/17 Time: 23:50
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.053402
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.43E-05	1.61E-06	15.11685	0
VKSE	0.019529	0.008729	2.237221	0.0253
VNIKI	0.119899	0.012565	9.542403	0
VSZSE	-1.16E-06	5.02E-07	-2.30302	0.0213
VBSE	0.020921	0.00822	2.545324	0.0109

Pseudo R-squared	0.019113	Mean dependent var	0.000108
Adjusted R-squared	0.018461	S.D. dependent var	0.000273
S.E. of regression	0.000277	Objective	0.240153
Quantile dependent var	4.47E-05	Restr. objective	0.244832
Sparsity	0.000108	Quasi-LR statistic	345.8887
Prob(Quasi-LR stat)	0		

Dependent Variable: VCSE
Method: ML - ARCH (Marquardt) -
Date: 02/25/17 Time: 23:51
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.011666
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000288	3.32E-05	8.658995	0
VKSE	-0.07967	0.085884	-0.9276	0.3537
VNIKI	0.108047	0.12764	0.846494	0.3973
VSZSE	-1.34E-05	1.50E-06	-8.96912	0
VBSE	0.179623	0.184417	0.974007	0.3301

Pseudo R-squared	0.022312	Mean dependent var	0.000108
Adjusted R-squared	0.021662	S.D. dependent var	0.000273
S.E. of regression	0.000349	Objective	0.23963
Quantile dependent var	0.000354	Restr. objective	0.245098
Sparsity	0.005844	Quasi-LR statistic	39.40248
Prob(Quasi-LR stat)	0		

Quantile Regression Approch

Dependent Variable: VKSE
Method: ML - ARCH (Marquardt) -
Date: 02/25/17 Time: 23:53
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.011666
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.07E-05	3.44E-07	118.3252	0
VNIKI	-0.02921	0.002013	-14.508	0
VSZSE	-2.86E-07	2.76E-07	-1.03482	0.3008
VBSE	0.026742	0.002134	12.53209	0
VCSE	0.003102	0.000483	6.417158	0

Pseudo R-squared	0.031779	Mean dependent var	0.000127
Adjusted R-squared	0.031135	S.D. dependent var	0.000127
S.E. of regression	0.000153	Objective	0.026928
Quantile dependent var	3.94E-05	Restr. objective	0.027812
Sparsity	0.000107	Quasi-LR statistic	348.7879
Prob(Quasi-LR stat)	0		

Quantile Regression Approch

Dependent Variable: VKSE
Method: ML - ARCH (Marquardt) -
Date: 02/25/17 Time: 23:52
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.053402
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.32E-05	4.38E-06	16.68699	0
VNIKI	-0.05377	0.026344	-2.04101	0.0413
VSZSE	-1.99E-06	6.05E-07	-3.29833	0.001
VBSE	0.117724	0.014246	8.263555	0
VCSE	-0.00588	0.001744	-3.37154	0.0008

Pseudo R-squared	0.022303	Mean dependent var	0.000127
Adjusted R-squared	0.021653	S.D. dependent var	0.000127
S.E. of regression	0.000131	Objective	0.209199
Quantile dependent var	8.04E-05	Restr. objective	0.213972
Sparsity	0.000126	Quasi-LR statistic	304.1114
Prob(Quasi-LR stat)	0		

Dependent Variable: VKSE
Method: ML - ARCH (Marquardt) -
Date: 02/25/17 Time: 23:52
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.011666
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000251	2.02E-05	12.41587	0
VNIKI	-0.23066	0.019438	-11.8666	0
VSZSE	-1.27E-05	8.34E-07	-15.2064	0
VBSE	0.856864	0.084386	10.15414	0
VCSE	-0.03364	0.004058	-8.29128	0

Pseudo R-squared	0.117124	Mean dependent var	0.000127
Adjusted R-squared	0.116537	S.D. dependent var	0.000127
S.E. of regression	0.000286	Objective	0.113706
Quantile dependent var	0.000405	Restr. objective	0.12879
Sparsity	0.002185	Quasi-LR statistic	290.6311
Prob(Quasi-LR stat)	0		

Quantile Regression Approch

Dependent Variable: VNIKI
Method: ML - ARCH (Marquardt) -
Date: 02/26/17 Time: 00:32
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.011666
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.86E-05	1.06E-06	45.88253	0
VSZSE	7.33E-07	4.45E-07	1.65E+00	0.0997
VBSE	8.87E-02	7.70E-03	11.52191	0
VCSE	1.88E-04	2.89E-03	0.064883	0.9483
VKSE	-1.20E-02	4.29E-03	-2.79003	0.0053

Pseudo R-squared	0.045443	Mean dependent var	0.000165
Adjusted R-squared	0.044808	S.D. dependent var	0.000199
S.E. of regression	0.000215	Objective	0.033095
Quantile dependent var	5.68E-05	Restr. objective	3.47E-02
Sparsity	2.08E-04	Quasi-LR statistic	319.3513
Prob(Quasi-LR stat)	0.00E+00		

Quantile Regression Approch

Dependent Variable: VNIKI
Method: ML - ARCH (Marquardt) -
Date: 02/26/17 Time: 00:32
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.053402
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.42E-05	2.16E-06	38.97711	0
VSZSE	-1.70E-06	5.61E-07	-3.02479	0.0025
VBSE	0.254887	0.022458	11.34956	0
VCSE	0.025719	0.002389	10.76394	0
VKSE	-0.0105	0.011344	-0.92575	0.3546

Pseudo R-squared	0.089588	Mean dependent var	0.000165
Adjusted R-squared	0.088983	S.D. dependent var	0.000199
S.E. of regression	0.000177	Objective	0.216894
Quantile dependent var	0.000123	Restr. objective	0.238237
Sparsity	0.000136	Quasi-LR statistic	1254.02
Prob(Quasi-LR stat)	0		

Quantile Regression Approch

Dependent Variable: VNIKI
Method: ML - ARCH (Marquardt) -
Date: 02/26/17 Time: 00:33
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.011666
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000158	4.09E-06	38.52478	0
VSZSE	-8.07E-06	3.42E-07	-23.6216	0
VBSE	1.48328	0.014901	99.5416	0
VCSE	-0.00772	0.008969	-0.86084	0.3894
VKSE	-0.30334	0.011383	-26.6488	0

Pseudo R-squared	0.444034	Mean dependent var	0.000165
Adjusted R-squared	0.443664	S.D. dependent var	0.000199
S.E. of regression	0.000312	Objective	0.098458
Quantile dependent var	0.000371	Restr. objective	0.177093
Sparsity	0.001001	Quasi-LR statistic	3308.598
Prob(Quasi-LR stat)	0		

Quantile Regression Approch

Dependent Variable: VSZSE
Method: ML - ARCH (Marquardt) -
Date: 02/26/17 Time: 00:34
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.011666
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000154	1.25E-05	12.32604	0
VBSE	0.009985	0.034693	0.28782	0.7735
VCSE	-0.00031	0.010436	-0.02978	0.9762
VKSE	0.008224	0.044852	0.183364	0.8545
VNIKI	0.011367	0.080447	0.141294	0.8876

Pseudo R-squared	0.000011	Mean dependent var	0.022491
Adjusted R-squared	-0.00065	S.D. dependent var	0.510922
S.E. of regression	0.51158	Objective	6.733976
Quantile dependent var	0.000158	Restr. objective	6.734047
Sparsity	0.00166	Quasi-LR statistic	1.7956
Prob(Quasi-LR stat)	0.773287		

Quantile Regression Approch

Dependent Variable: VSZSE
Method: ML - ARCH (Marquardt) -
Date: 02/26/17 Time: 00:35
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.053402
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000665	3.56E-05	18.65718	0
VBSE	0.349902	0.141377	2.474967	0.0134
VCSE	-0.17702	0.030186	-5.86449	0
VKSE	0.279571	0.181358	1.54154	0.1232
VNIKI	0.866943	0.188214	4.606154	0

Pseudo R-squared	0.000464	Mean dependent var	0.022491
Adjusted R-squared	-0.0002	S.D. dependent var	0.510922
S.E. of regression	0.511553	Objective	66.49107
Quantile dependent var	0.000864	Restr. objective	66.52191
Sparsity	0.002763	Quasi-LR statistic	89.28012
Prob(Quasi-LR stat)	0		

Quantile Regression Approch

Dependent Variable: VSZSE
Method: ML - ARCH (Marquardt) -
Date: 02/26/17 Time: 00:35
Sample: 1 6022
Included observations: 6022
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.011666
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.00659	0.000456	14.45209	0
VBSE	5.598938	6.42993	0.870762	0.3839
VCSE	-1.61221	0.103835	-15.5266	0
VKSE	-1.2949	2.750746	-0.47074	0.6378
VNIKI	4.154607	3.553848	1.169044	0.2424

Pseudo R-squared	0.000818	Mean dependent var	0.022491
Adjusted R-squared	0.000154	S.D. dependent var	0.510922
S.E. of regression	0.511331	Objective	120.5333
Quantile dependent var	0.008079	Restr. objective	120.632
Sparsity	0.087843	Quasi-LR statistic	47.32505
Prob(Quasi-LR stat)	0		