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Integration of Markets during Pre and Post Subprime Crisis: Evidence from India

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Abstract

With financial markets becoming far more volatile after liberalization and globalization, it becomes crucial for investors and policymakers to be considerate about dependencies among the two financial markets (stock market and foreign exchange market) and commodity market. The study tries to analyze the response of integration among the markets through the recent period of global financial crisis by making use of daily closing prices of CNX NIFTY, Indian rupees per US Dollar and COMDEX as representative for stock price index, exchange rate and commodity price index respectively. The period is from 21st Oct, 2005 to 31st Aug, 2015, which has been further divided into pre-crisis period (21st Oct, 2005 – 31st Aug, 2008) and post-crisis period (1st Sept, 2008 – 31st Aug, 2015). To investigate the long-run relationship among the markets, Johansen's co-integration technique was applied followed by VECM and Granger Causality test. Results indicate that there exists co-integration between the markets both during pre and post-crisis period. It is also found that during the pre-crisis period, causality only existed from stock market to foreign exchange market. In the post-crisis period however, significant causal relationship wasfound running from stock market to commodity market and exchange rate.

Keywords: Subprime Crisis, Johansen co-integration, Granger Causality, Forex

JEL Classification: E44, F31

Paper Classification: Research Paper

Introduction

Opening of economies and increasing volatility among the financial markets in the post liberalization period has induced an increasing interest in the analysis of integrated market relationships (Mensi et al., 2013). Investors and policy makers need to be careful about dependencies among the two financial markets (stock market and foreign exchange market) and commodity market, as, analyzing these transmission channels will not only enhance the dexterity of policy makers in framing policies but also help in foreseeing the impact of their decisions.

In the past, the focal point of researchers and investors in their decision making process was limited to stock, forex and money markets largely. However, in recent years, the commodity market has also gained tremendous importance as an investment avenue rather than just being a risk hedging instrument. This has led to a significant increase in the liquidity of commodity market (Vivian and Wohar, 2012). In this regard, Driesprong et al. (2008) have discovered that prices of major commodities like oil to be the determinant as well as predictor of stock prices. Further, Bacer and McDermott (2010) have argued that gold can be considered as an asset holding its value even in unpleasant market conditions.

Besides these, the current account balance of the country also has an impact on the relationship among forex, stock and commodity markets. Most of the previous studies have followed three approaches while examining integrated market relationships. The first one is by examining long run causal relationship among stock markets across various countries using techniques such as GARCH models, causality test[1] and co-integration test[2]. Second one is that of understanding the dynamics of relationship among various financial markets in a single country, utilizing techniques such as GARCH and co-integration test. Finally panel analysis is used in investigating the linkage dynamics among various financial markets across various countries[3]. Expanding these studies further, the linkage dynamics are studied by including a factor of uncertainty.

The Subprime Crisis of 2008, triggered by the collapse of Lehman Brothers-USA, not only affected US alone, rather the ripples of this crisis spread throughout the globe. India too could not insulate itself completely from the adverse effects of this crisis. Economic growth of the country decelerated from 8.8% on an average during the previous five years to 6.7 per cent in 2008-09 (Bajpai 2011). Moreover, during times of turmoil, links between the asset classes severely alter and give less scope for diversification of portfolios. The empirical evidence of this study hinges on the phenomenon termed as "Paradox of Diversification"[4].

An attempt is made to analyze the integration among the said markets during the times of financial crunch. Nath and Samantha (2003), examined the integrated markets condition where the shocks in one market gets reflected immediately in other markets. The transmission mechanism of monetary policy in such cases becomes smooth and speedy, thus making policy interventions more effective in bringing results in the desired direction within specified time horizons. The development of highly integrated financial markets has always been the focus of modern policy makers.

This study tries to contribute to the prevailing works by using composite price index of stock and commodity market in analyzing co-integration relationship among stock market, commodity

[1]Huanga (2000), Azman (2010) Sensoy (2014), were among the few who used the approach in their study.
[2]Badrinath (2005), Morales (2009), Kasman (2011), Wang (2013) and Turhan (2014) followed a different approach in understanding the relationship between the markets.
[3]Yau (2006) and Zhu (2014) have followed a combination of the two approaches.
[4](Authers, 2010): Where the investors buy on the assumption that the markets are not correlated, but ultimately leading to more correlation.

market and exchange rate at the time of crisis in India. Barely studies have been done in understanding linkage dynamics among the said markets in India or internationally.

The second section of the paper presents a summary of the relevant empirical literature, section three introduces the data used in the study, whereas, section four describes methodologies and presents empirical results and section five provides the conclusion and discussion.

Literature Review

The dynamic nexus among forex, stock and commodity markets has been well studied in the literature, including the change in their linkages during the times of turmoil. The fact that turmoil of different origins has varied impact on the relationship among markets, it has attracted the interest of academicians and policy makers to probe into its detailed dynamics. In this regard, the literature talks about the European crisis (1992), the Asian Financial crisis (1997), the Subprime crisis (2008) and the European crisis (2010).

Aroskara et al. (2004) argued that European crisis of 1992 created instability in the prevailing relationships among European currencies. They have divided the study period into pre-crisis, crisis and post-crisis period. In the case of Asian crisis of 1997, Yang et al.(2003) studied the existence of relationships among the USA, Japan and ten Asian emerging stock markets and concluded that the markets strengthened during the crisis, and these markets have generally become more integrated in the aftermath of crisis than before the crisis period. Further, Khalid and Kawai (2003) identified the channels through which the Asian crisis spread among neighboring countries. For this, a data of financial market indicators i.e. foreign exchange rates, stock market prices and interest rates from East Asian countries were collected. A VAR model was constructed and Granger Causality test was applied to investigate linkages amongst various markets of different Asian countries. The results however suggested that the contagion in the financial market was not the key source for the financial crunch in the Asian region; rather there were other factors responsible for the spread of economic crisis. Click and Plummer(2005) tried to understand the integration among the stock markets in ASEAN countries after the Asian Crisis using co-integration test to investigate long-run relations. The concluding results suggested that, as markets are not fully co-integrated; the benefits of portfolio diversification across the international markets are not eliminated but reduced. Choudhry and Peng (2007) empirically investigated the long-run association among the stock markets of the Far East countries around the Asian crisis, 1997 and also found that USA and Japan had a significant influence on this relationship. Also there are studies that have empirically analyzed integration among interest rates (Juan Fernandez de Guevara 2007) and stock markets (Ian Babetskii 2007) among the European countries. Researchers have also investigated existence of relationship between a country's trade concentration and level of its financial integration using GARCH-M model (Gibson 2008). Wang (2010) and Zhu et al.(2014) studied the co-movement among the stock markets of Asia by applying Johansen co-integration test in pre and post crises period. Investigators concluded that no (limited) co-movements existed in the pre-crises period but the linkage amongst them grew stronger since the crisis struck Asia in 1997 and in some cases, it even grew stronger after the crises.

Kassim (2009) using VAR methodology and William Cheung (2010) using VAR model, Granger Causality test and Cointegration VECM analyzed the linkage dynamics among the stock markets through the global crisis period of 2007-08, concluded that the connections among the markets developed stronger relations during the crisis and in the aftermath of crisis as well. Therefore resulting in lesser benefit arising from diversification of portfolio. Dufrénot et al.(2011) conducted their study to explore whether the volatility changes in stock markets of Latin American countries

(LACs) in the aftermath of 2007-08 crisis could be attributed to the worsening environment of US financial markets. The study utilizes Markov-switching model for a period covering January 2004 to April 2009 and concluded that the financial stress from USA markets has spread to the LACs stock markets creating volatility, particularly in Mexico. On the contrary, Xu and Hamori(2012) in their study on the impact of global financial crisis 2008 on linkage dynamics of the BRICS countries in the mean and variance of stock prices revealed that the transmission effects from US market to BRIC markets weakened both in the mean and the variance after the 2008-09 crisis. Similarly, Guidi(2012) analyzed linkage dynamics among Indian stock market and developed markets of Asia (Hong Kong, Japan and Singapore), by means of co-integration methodology, where results indicated absence of strong linkages among the markets, providing potential benefits to the investors through portfolio diversification.

On the contrary, Sensoy and Sobaci (2014) investigated the relationship dynamics between major European countries and Turkey during the global financial crisis (Subprime crisis and Euro zone crisis) for the period from September 2004 to April 2013. The results proved the existence of integration between Turkey and major European economies in terms of risk perception, thereby restricting the diversification benefits for global investors.

Past studies empirically investigated linkage dynamics of stock markets, foreign exchange markets or interest rates or a combination of them regionally/ globally, with various techniques to analyze the existence/ absence of relationship among them. Barely studies are conducted in India, during Global Financial Crisis 2008 to analyze the relationship among price indices of stock, commodity and foreign exchange market. Therefore, this study aims at contributing to the existing literature by analyzing the long-run and short-run relationship among the price index of stock markets, commodity market and foreign exchange market and a causal relationship among them, such that the results of the study could be beneficial to the investors/ portfolio managers in diversifying their portfolios.

Methodology

To analyze the dynamic inter-linkages between stock, commodity and the foreign exchange markets, the study makes use of daily closing prices of CNX NIFTY (stock price index), COMDEX (commodity price index) and nominal exchange rate of India rupee v/s the US dollar. The period of study expands from 21 October, 2005 to 31 August, 2015. The sample has been further sub-divided into pre-crisis period and post-crisis period, i.e. from 21 October, 2005 to 31 Aug, 2008 and from 1st September, 2008 to 31st August, 2015 respectively.

The literature review provides evidence for the presence of some long-run relationship amongst non-stationary variables which require systematic treatment, and the same has been attempted here. The methodology carried out in the paper concerns three parts: Co-integration analysis, Vector Error Correction Mechanism and Granger Causality using VECM.

The first step entails the use of Augmented Dickey-Fuller test to check for stationarity and to detect the presence of unit roots in time series. This is in tune with the Johansen co-integration test, which demands that the series should be integrated of the same order.

Subsequently, Johansen co-integration (the λ_{trace} and λ_{max} statistic test) is applied to examine if any long-run equilibrium linkage exists amidst the non-stationary variables. Any equilibrium relationship among non-stationary variables implies that, the variables must be linked and the

linkage necessitates the variables to be co-integrated. The variable denoted are as follows: 'p_t' is the commodity price index, 'e_t' is the exchange rate and 'n_t' is the stock price index. Johansen and Juselius (1990) give the following general model:

$$x_t| = \pi_1 x_{t-1} + \cdots + \pi_k x_{t-k} + \mu + e_t \qquad for\ t = 1, \ldots, T,$$

Here, vector $x_t = (p_t, e_t, n_t, e_t)$ are independent normal errors with mean zero and covariance matrix Λ, μ is an intercept vector. The co-integrating equation (1, 1, -1), is a linear combination of $e_t+n_t-p_t$ such that it is stationary. When the confirmation for co-integration could be established, rest of the work concerns estimating the error correction model. The disequilibrium in the long run relationship is examined using speed of adjustment parameter applying Vector Error Correction Mechanism (VECM). Subsequently, based on the above general methodology, we estimate the following models in our study:

$$\Delta p_t = c_1 + \lambda_p(p_t - \beta_0 - \beta_1 e_t - \beta_2 n_t) + \sum a_{11}\,\Delta p_{t-i} + \sum a_{12}\,\Delta e_{t-i} + \sum a_{13}\,\Delta n_{t-i} + e_{1t}$$

$$\Delta e_t = c_2 + \lambda_e(p_t - \beta_0 - \beta_1 e_t - \beta_2 n_t) + \sum a_{21}\,\Delta p_{t-i} + \sum a_{22}\,\Delta e_{t-i} + \sum a_{23}\,\Delta n_{t-i} + e_{2t}$$

$$\Delta n_t = c_3 + \lambda_n(p_t - \beta_0 - \beta_1 e_t - \beta_2 n_t) + \sum a_{31}\,\Delta p_{t-i} + \sum a_{32}\,\Delta e_{t-i} + \sum a_{33}\,\Delta n_{t-i} + e_{3t}$$

Where β_s are the long-run equilibrium relationship coefficients, λ_s are the measures of short run responsiveness to the deviations from the above equilibrium long-run relationships i.e. the average speed of adjustment coefficients of p_t,e_t and n_t to their deviations from the above long-run equilibrium relationship, a_s are the VAR response coefficients and e_s are the Gaussian errors.

Finally, causality tests on error correction model could help identify a structural model and determine whether the estimated model appears to be reasonable. To test for causality in a co-integrated environment, we cannot use standard F-test, as Granger Causality involves only stationary variables and co-integration is viewed as an indirect test of long run causality (Enders, 2010). In multivariate environments, testing for long run causality between two variables becomes problematic as it is impossible to tell which explanatory variable is causing the dependent variable through Error Correction term; hence study uses Granger Causality test under VECM environment which includes differenced variables and not actual variables at level that are non-stationary.

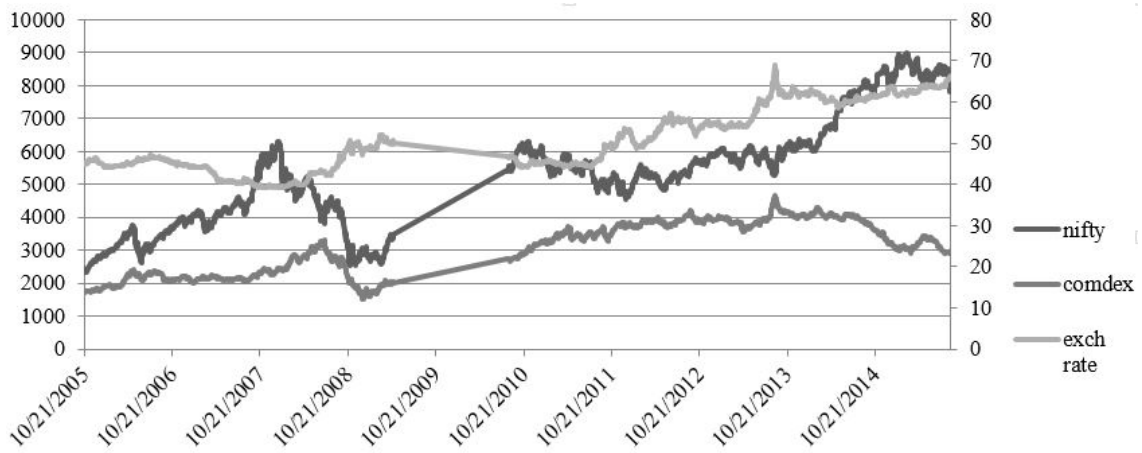
Furthermore, it should be noted that under VECM framework the speed of adjustment parameters also signify the temporal or long run causality among the variables and the short-run causality in this case can be understood by running block exogenity tests on the lagged endogenous variables employing standard F-test or χ^2-test[5].

Empirical Results

Figure 1 explains the period in which there was drastic fall in the price index of stock market, commodity market and exchange rate, telling the date before which will be considered as pre-crisis and after as the post crisis period.

[5]It is very necessary that the exogenity tests are conducted in the VECM specification which contains variables in first difference as the test statistic obtained from running similar tests on a non-stationary variables do not follow the conventional F and χ^2 distribution (Toda and Yamamoto,1995)

Figure 1: Showing price index movements of Commodity market, Forex market and Stock market in India



Source: Bloomberg

In the year 2008, stock market, the forex market and commodity market witnessed a drastic change in the price trend as revealed. The effect of this crisis was positive at the start, as it brought more inflow of FIIs into the country, which made the people feel that emerging economies are insulated from crisis and would act as an alternative engine of growth to the world economy. But the effect soon turned negative as the crisis spread to emerging economies. Subprime crisis affected India by affecting its Current account and Capital account. Its current account deficit increased from 1.5percent of GDP in 2007-08 to 2.6percent of GDP in 2008-09. The capital account surplus dropped from a record high of 9.3percent of GDP in 2007-08 to 0.9percent of GDP in 2008-09 due to withdrawal of capital by FIIs from Indian Financial Markets. The impact of this crisis was felt in terms of reduction in exports, decline of industrial growth and employment, depreciation of rupee, downturn in stock returns and many other indicators.

Table 1: The Chow test

Break Point date	F-statistic
1st September, 2008	243.535 (0.00)
Value in parenthesis indicates p-values	

The graph (Fig: 1) and Chow test (Table: 1) confirmed that 1st September 2008 can be taken as breaking point in apportioning the data sample into pre and post crisis period. Taking the above results into consideration, we move towards formal testing of time series. To test the stationarity of time series variables, Augmented Dickey-Fuller Test has been applied. The pre requisite before applying co-integration test is that, variables should be Integrated of order one I (1), which requires the variables to be non-stationary at levels, but stationary at first difference.

Table 2: Unit Root Test for price index of Commodity market, Forex market and Stock market

ADF test				
Variable	**Pre – Crisis Period**		**Post – Crisis Period**	
	Levels	**First Difference**	**Levels**	**First Difference**
e_t	-0.978 (0.76)	-25.974 (0.00)	-2.750 (0.07)	-19.641 (0.00)
p_t	-1.344 (0.61)	-25.229 (0.00)	-1.315 (0.62)	-39883 (0.00)
n_t	-2.109 (0.24)	-25.416 (0.00)	-1.221 (0.67)	-37.425 (0.00)

During both pre and post crisis period, evidences from unit root tests suggest that, variables get stationary at their first difference and at levels they are non-stationary as can be inferred from the Table 2, this means that variables follow an I (1) process. As all variables are stationary at first difference, it is appropriate to test whether variables are co-integrated or not. A stochastic trend among any set of non-stationary variables strongly suggests the existence of an equilibrium relationship among them, since an equilibrium relationship implies that the variables cannot independently move. This movement denotes the existence of co-integration.

Table 3: Estimation results from Johansen co-integration test

Pre – Crisis			
Null hypothesis	**Alternative hypothesis**	**Trace Statistic**	**5% Critical value**
r = 0	r > 0	26.333**	24.276
r 1	r > 1	05.542	12.321
r 2 r > 2	01.855	04.130	
Max Eigen Value			
r = 0	r = 1	20.791**	17.797
r = 1	r = 2	03.687	11.225
r = 2	r = 3	01.855	04.130
Post – Crisis			
Null hypothesis	**Alternative hypothesis**	**Trace Statistic**	**5% Critical value**
r = 0	r > 0	33.090**	29.797
r 1	r > 1	03.218	15.494
r 2	r > 2	00.576	03.841
Max Eigen value			
r = 0	r = 1	29.872**	21.132
r = 1	r = 2	02.642	14.265
r = 2	r = 3	00.576	03.841

***denotes rejection of hypothesis at 5% level of significance.*

Results indicated in Table 3 demonstrate, the existence of only one co-integrating relationship between the variables during both pre-crisis period and post-crisis period. The lag length for the same is 30 days based on usual lag length selection criteria.

Typically, one of the variables is used to normalize the co-integrating vector by fixing its coefficient at unity. Study uses commodity price index as the normalizing (dependent) variable and other variables (stock price index and exchange rate) as independent variables. Results of the same in pre-crisis and post-crisis scenario can be depicted as follows:

Pre-crisis

$p^t=0.891\ e^t+0.533n^t+\varepsilon^t$

[6.024] [7.958]

Post-crisis

$p^t=-6.99e^t+2.835n^t+\varepsilon^t$

[5.551] [-4.364]

The above equations state that during pre-crisis period, there exists a positive relationship between foreign exchange rate and commodity price index and between stock index and commodity price index. During the post crisis period, stock price index had a positive impact on commodity price index, whereas, there existed a negative relationship between foreign exchange rate and commodity price index. In the aftermath of crisis, not only the nature of relationship changed but also the magnitude of change was high. A unit change in the exchange rate causes 0.891 unit change in commodity price index in pre-crisis period and 6.995 units change in post-crisis period, indicating strong co-integration between the two markets. Also during this period, there existed a negative relationship between the two markets compared to a positive relationship between the markets in the pre-crisis period. Whereas, in case of stock price index, a unit change causes 0.533 unit change in commodity price index in the pre-crisis period compared to 2.835 units change in the post crisis period, signifying tough co-integration after the crisis period.

Considering the time paths of co-integrated variables, where the trends of co-integrated variables are associated, the dynamic paths of such variables require them to bear some relation to the current deviation from equilibrium relationship. The linkage between the change in a variable and the deviation from the equilibrium is examined using VECM. This is because, if the system needs to return to its long-run equilibrium, the movements of at least few of the variables need to respond to the magnitude of the disequilibrium.

Table 4: Results from VECM indicating the speed of adjustment parameters

Pre – Crisis		
λp	**λ e**	**λ n**
-0.016905**	0.002839**	-0.008762
[-3.53981]	[1.98045]	[-1.13576]
Post – Crisis		
λp	**λe**	**λn**
-0.000173	-0.017364**	0.001436***
[-0.42056]	[-4.48766]	[2.58675]

***rejection of hypothesis at 5% level of significance and *** rejection of hypothesis at 1% level of significance. Indicating in the parenthesis are the t-values*

Table 4 articulates that during pre-crisis period, any disequilibrium in the commodity price index is corrected with speed of convergence of 1.69 per cent by commodity market and 0.28 per cent by exchange rate, as the t-statistic is significant for commodity market and foreign exchange market. In the post-crisis period, disequilibrium in commodity market is corrected with the speed of convergence of 1.73 per cent by exchange rate, 0.14 per cent by stock market. Conclusively, any

disequilibrium in the stock market takes about 50 days to come back to equilibrium in the pre-crisis period and about 95 days in the post-crisis period.

As discussed in Section 3, the speed of adjustment parameters also describes the long run causality among the variable. In our present study, we observe that λ_p and λ_e are significant during the pre-crisis period and λ_e and λ_{nare} significant in post-crisis period, hence indicating that, long-run causality runs from commodity price index to its own future values and to the exchange rate for pre-crisis period and from commodity price index to the exchange rate and to the stock market in the post-crisis period[6]. Further, in order to check for short run causality, we restrict the lagged endogenous variables and check if these restrictions are sufficiently binding by means of a χ^2 test. The results of the test presented in Table 5 show that in the pre-crisis period only the changes in stock market index cause changes in foreign exchange rate; however, during post-crisis period it is the stock market that cause changes in exchange rate and commodity market. In other words, in the short-run there is a unidirectional causality running from stock market price index to exchange rate both during the pre-crisis and post-crisis period, however, causality is also found running from stock market to commodity market in the post-crisis period.

Table 5: Results of Granger Causality Test

Pre – Crisis		
Dependent Variable – Δp		
Excluded	Chi – Sq	Inference
Δe	34.868 (0.250)	Δe ↛ Δp
Δn	34.633 (0.260)	Δn ↛ Δp
Dependent Variable – Δe		
Δp	26.406 (0.654)	Δp ↛ Δe
Δn	50.371 (0.011)	Δn → Δe
Dependent Variable – Δn		
Δp	31.278 (0.401)	Δp ↛ Δn
Δe	20.338 (0.907)	Δe ↛ Δn
POST – CRISIS		
Dependent Variable – Δp		
Δe	2.195 (0.970)	Δe ↛ Δp
Δn	36.890 (0.000)	Δn → Δp
Dependent Variable – Δe		
Δp	8.6642 (0.370)	Δp ↛ Δe
Δn	16.005 (0.042)	Δn → Δe
Dependent Variable – Δn		
Δp	7.249 (0.510)	Δp ↛ Δn
Δe	11.181 (0.192)	Δe ↛ Δn

The Granger Causality test under VECM, during pre-crisis period concluded, there was no causality among either of the markets except one causal relationship was found running from stock market to Forex market. Reason being, the positive effect of subprime crisis initially saw added inflows of FIIs into the economy, raising the market sentiments as investors felt emerging

[6]The long run co-integrating equation contains p^t as the dependant variable, lagged errors of which represent the error correction term in the VECM framework.

economies were insulated from crisis and would act as an alternative engine for growth of the world economy. Later, crisis did hit the emerging economies and the impact was felt in terms of reduction in exports, decline of industrial growth and employment, depreciation of rupee, down turn in stock returns and many other indicators. Hence in the aftermath of the crisis, causal link was found running from stock market to commodity market and exchange rate, signifying, stock market as the major source of changes in the prices of foreign exchange market and commodity market.

Conclusion

The instability in the price movements of the three markets viz. Commodity market, Forex market and Stock market has always created an interest towards the understanding of the dynamic relationship among these markets. Especially during the times of turmoil, the relationship among the markets is different in the future from that of the past. This dynamic linkage among the markets was studied applying Johansen Co-Integration Technique, Vector Error Correction Mechanism and Granger Causality under VECM.

Where, Johansen Co-integration test concluded the existence of a long-run relationship amongst the markets in the pre-crisis and post-crisis period of 2008. Since there existed only one co-integrating equation among the markets, they are not fully co-integrated and therefore the benefits from diversification of portfolio across the markets are reduced (Click and Plummer 2005)

As per the co-integrating equation in the pre-crisis period, stock and forex markets had positive relationship with commodity market. Whereas in the post crisis period, the nature of association between exchange rate and commodity market changed from positive to negative, and the magnitude changed: forex market and commodity market get highly integrated after the crisis, compared to the extent of integration between stock and commodity market after the crisis period.

The time path of co-integrated variables, influenced by the amount of deviation from long-run equilibrium was analyzed using VECM. The speed of adjustment parameters describes the long run causality among the variables. The long run causality runs from commodity price index to its own future values and to exchange rate in the pre-crisis period and from commodity price index to exchange rate and stock market in the post-crisis period. Granger Causality test was applied to document the causal linkages among the financial markets in the short run. In the pre-crisis period, we could find evidence of stock market caused exchange rate. Nonetheless, in the post crisis period the dynamics of linkages changed and the causal linkage among the markets was found running from stock market to commodity market and exchange rate.

Hence concluding that, in the aftermath of the crisis, markets have become more interlinked to one another, both in the long-run and short-run. Diversifying investments in commodity market would be advantageous, as the linkage of exchange rate and stock market to commodity market is weak. As evident, crisis first affected stock market, as a result of which there were price changes in commodity market and exchange rate. Investors need to be cautious before investing into stock market especially in the immediate aftershock of crisis.

To conclude, investors can take advantage of this situation by diversifying their portfolio investments to a certain extent in the long run, but at the same time they have to be cautious about the short run causal linkages among markets which might have an impact on their real investment returns.

Discussion

The study is in line with the general view of most of the previous studies such as (Wang 2010) and (Zhu et al. 2014) where Asian Crisis 1997 and (Kassim 2009) and (William Cheung 2010) during Global Financial Crisis 2008 came up with the results saying the financial markets globally/ regionally have strong relationship among them through the crisis period and in few cases it even strengthened further in the aftermath of crisis period. On the contrary (Guidi 2012) analyzed the link between Indian and developed Asian stock markets (Japan, Hong Kong and Singapore), indicating absence of strong linkage among these markets. As discussed earlier, barely studies in Indian markets have considered empirically investigating linkage dynamics among the price index of stock market, commodity market and foreign exchange market, they are unlike any of the studies cited under literature review section, even then they follow broad conclusion of the studies, of strong linkages among the markets during the crisis period and gets even stronger in the after crisis period, except, a weak linkage was found of foreign exchange market and stock market to commodity market.

Limitations and Future Scope

The study was unable to capture volatility transmission, as it concentrated only on analyzing the long-run and short-run linkage dynamics among the markets, during the Global Financial Crisis 2008. Therefore, study can be further extended by empirically analyzing volatility spillovers among these markets.

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