CHAPTER 1: INTRODUCTION

1.1 GENESIS OF THE STUDY

“If any country in the world sneezes, Latin America catches pneumonia” (Forbes and Rigobon, 2001). Over the last 5 decades, it has been observed that the world has gone through lot of turmoil. The number of crisis over this period has increased, thus, spreading to other parts of the world. The spark might start in one country, but the burns are felt in other countries as well irrespective of whether these countries share any common fundamentals or not. The word ‘contagion’ seems to take the blame of all the transmission of crisis from one financial market to the other. The meaning of ‘contagion’ has still not arrived at professional consensus by the researchers. There is a need to understand ‘contagion’ to be able to assess the dimensions of the impact of contagion on other financial markets and to design policy measures to insulate for the impact of contagion (Moser, 2003).

Crisis in one country impacts the equilibrium in other countries. Changes in the equilibrium further bring about changes in the macro-economic variables and the financial markets. The financial variables respond to the change in equilibrium further speeding up the process of adjustment to the new equilibrium. This change in financial markets thus, causes the crisis in other countries. The process of transmission of shocks and the possible impact thereof motivates us to study the impact of such crisis on Indian stock market. The study would help the policy makers in framing policies that would insulate the financial markets from getting affected due to shocks in other parts of the world (Kenourgios et al., 2011, Syriopoulos, 2006, 2007, 2011, 2013; Syriopoulos et al., 2015).

The implications of contagion on any country might be very little, i.e. not much impact on the financial markets of the country. On the other hand, it can prove to be fatal for any country. If the impact on the financial markets is deep, then International Monetary Fund (IMF) would have to come out with bailout procedures; thus, impacting the Balance of Payments of those countries which have not been impacted due to contagion effect of crisis in some other country. Further, in order to assess the change in portfolio risk and return, international investors need to evaluate the
correlation between various classes of assets in different countries to reduce risk and maximize returns.

1.2 MOTIVATION BEHIND THE STUDY

With increased globalization, the last two decades have witnessed an enormous flow of external capital in the form of both direct and portfolio investments. The increase in international capital mobility is due to increase in the interaction between world economies, both developing and developed (Chen et al., 2005). Due to liberalization of capital markets and the development of new varieties of financial instruments, the level of international diversification of portfolios has increased. Since the work of Grubel (1968) on the benefits of international diversification of portfolio, the relationship among the various stock markets has been studied extensively. Such linkages may be due to common macroeconomic policies or may be without any common link among the stock markets of the countries under the study. However they do have implications on portfolio diversification and macroeconomic policy formulation of a country (Srivastava, 2007).

The reasons for understanding contagion can be stated as under:

a) Generally, a country’s stock markets should reflect fundamentals of its own country rather than that of other countries (Raj and Dhal, 2008). In other words, stock market of a country is often considered the barometer of the development and fundamental of its economy rather than the fundamentals of other economies. Therefore, if contagion exists, then it is important to know its extent and measure the same.

b) If the markets are relatively highly correlated, then a shock in one market would affect the other markets too. This would rather increase the risk of an investor indulging in international portfolio diversification. If the stock markets in different countries display relatively low correlations, then international diversification would substantially reduce portfolio risk and increase expected returns. If contagion occurs after a negative shock, then market correlations would increase in bad states, which would defeat the basic idea of international portfolio diversification (Forbes and Rigobon, 1999).
c) If the markets are highly correlated, then a negative shock to one market will lead to a ripple effect in other markets too. Thus, a negative shock in one market will lead to bad states in the other. Investors can predict the market conditions and thus earn abnormal profits. This is against the basic concept of Efficient Market Hypothesis (EMH theory) (Raj and Dhal, 2008).

d) Many models of investor behavior are based on the assumption that investors react differently in case of large negative shocks. Understanding how investors react to positive and negative shocks would help us in understanding how shocks are transmitted across markets (Forbes and Rigobon, 1999). According to Calvo (1999), the uninformed investors try to extract information from the informed investors’ trades. This opens up possibility that if informed investors are forced to sell emerging market securities to meet margin calls, for example, this action may be misread by the uninformed investors as signaling low returns in the emerging markets.

e) Many international institutions and policy makers worry that a negative shock in one country will have a negative impact on the financial markets of the market of other economy, even if the fundamentals of the second country are strong and there is very little connection between the two countries. This will put a negative impact on the financial flows towards the second economy. Even if this is a temporary effect, it could lead to financial crisis in the second country—a situation that is not supported by the fundamentals of the country. If this sort of contagion occurs in an economy, the role of international financial institutions increases as they need to intervene and invest huge amounts of money to bring stabilization to the situation (Forbes and Rigobon, 2000).

For all the above reasons, it is important to study the concept of contagion and evaluate under what circumstances contagion occurs.

1.3 OBJECTIVE OF THE STUDY

The world economy has often witnessed situations when the assets lose a part of their value. Economic crisis has been felt in different parts of the world at various points of time. Crisis originates in one country but its tremors are felt in various countries. Following the collapse of the Thai baht’s peg on July 2, 1997, the financial markets of
East and South East Asia—in particular, Thailand, Malaysia, Indonesia, the Philippines, and the Korea—headed in a similar, downward direction during late 1997 and early 1998 (Baig and Goldfajn, 1999; Yang and Lim, 2004). As the regional markets face intense pressure of the devaluation of the baht, the pressure was also reflected in the managed currencies in Malaysia and Indonesia. As the situation became more pressurizing, intense foreign exchange and stock market turmoil spread in the entire region leading to a collapse of the Korean won. The bad news of the distress, particularly, bank and corporate fragility; became commonplace in the affected countries. The situation appeared as if anything negative in one market would have an impact on the other markets as well, both economically and politically (Baig and Goldfajn, 1999). In October 1997, the Hong Kong market fell and then partially rebounded. North America, South America, Europe and the rest of the Asia showed similar movements (Forbes and Rigobon, 2002). In December 1994, the Mexican markets fell and the Latin American markets followed suit (Forbes and Rigobon, 1999). In September 2001, the terrorist attack in USA deeply affected the US stock markets and the ripple effect was felt on Portuguese, Japanese, German, and the English economies (Leitao and Oliveira, 2005). According to Mittal and Bishnoi (2003), the terrorist attack on USA in September 2001 also affected the Indian stock markets (measured through Nifty and Sensex).

However, the research focus on stock market integration shifted again to non-Asian developed countries, post September 11, 2001 terror attack in USA (Mittal and Bishnoi, 2003) and the sub-prime crisis in 2008 that developed into the largest financial shock impacting institutions, markets and the very core of financial system of various economies (IMF 2008; Majid and Kassim, 2009). The impact of such shocks that originated in USA was felt across in many countries. More recently, the studies have focused on the implications of European debt crisis and its spillover effects on other developed and emerging stock markets (Darvas, Ferry and Sapir, 2011).

The above cases show that the dramatic movement in one stock market can have a powerful impact on markets of different sizes and structures throughout the world. Does this high rate of stock market co-movement during states of market turmoil
constitute contagion? Or the global markets are so interdependent on each other that they have similar rates of co-movements?

Table 1.1 clearly brings out single day percent change in various Asian markets and the US stock market when a crisis occurred in some part of the world. The table shows that six countries showed including India showed a downfall reaction towards the October 1987 crisis whereas stock markets of two countries, Indonesia and South Korea showed no change towards the October 1987 shock. For the Southeast Asian crisis India, China and Hong Kong stock markets showed a single day downward movement; whereas no change was experienced by four stock markets under study, i.e. US, Japan, Malaysia and South Korea. On the other hand, two countries namely, Indonesia and Taiwan showed an upward movement in the stock market, post the Asian crisis of 1997. However, the stock markets of Malaysia initially showed no change but they reacted to the crisis little late, i.e. in August 1997 and the stock markets could regain the same levels after two and a half years, i.e. in February 2000. For the US crisis of 2001 or popularly known as 9/11 shock, all the stock markets except Chinese stock markets showed a single day fall. For the US Sub-prime crisis, six markets including Hong Kong, Indonesia, US, Taiwan, Japan and South Korea showed a single day fall whereas Indian stock market did not react to the crisis initially. Similarly, China and Malaysia stock markets did not show any change like India. Indian stock market reacted to the crisis in October 2008 and took about eight months to recover.

Thus, the table gives us mixed results on the impact of crisis on other countries; and so does the literature on contagion of stock markets. The table shows that the stock markets react differently to crisis originating in different countries. The mixed results motivate us to study and examine the level of integration between markets and then further test for contagion if interdependence among markets are validated. More specifically, the objectives of the present study are two-fold:

a) To examine the co-integration between Indian stock market and other Asian stock markets:

   i. A significant aspect with regard to the methodology applied to test for possible co-integration is to incorporate the possibility of existence of
structural breaks in the individual stock price series as well as the relationship.

ii. Determining the accurate sequence of such break dates is a major task for researchers analyzing time-series data on stock market integration.

b) To test for contagion effect of US Sub-prime crisis on Indian stock market and other Asian stock markets applying two recent econometric methods:

i. DCC-GARCH model based on time-varying correlation technique in order to capture the dynamic nature of the stock markets.

ii. Copula model which examines contagion from crisis originating country to other countries when the series is possibly non-linear in nature.
Table 1.1: Single Day Percent Change In Various Stock Markets

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Crisis</th>
<th>Date</th>
<th>US</th>
<th>India</th>
<th>China</th>
<th>Hong Kong</th>
<th>Indonesia</th>
<th>Taiwan</th>
<th>Japan</th>
<th>Malaysia</th>
<th>South Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Black Monday</td>
<td>19th Oct 1987</td>
<td>21% fall</td>
<td>2% fall</td>
<td>Data unavailable</td>
<td>33.3% fall</td>
<td>No change</td>
<td>4.7% fall</td>
<td>15% fall</td>
<td>15.9% fall</td>
<td>No change</td>
</tr>
<tr>
<td>2</td>
<td>Asian crisis</td>
<td>2nd July 1997</td>
<td>No change</td>
<td>1.3% fall</td>
<td>5.3% fall</td>
<td>1.5% fall</td>
<td>7.3% rise</td>
<td>3.4% rise</td>
<td>No change</td>
<td>No change</td>
<td>No change</td>
</tr>
<tr>
<td>3</td>
<td>US Crisis 2001</td>
<td>11th Sept 2001</td>
<td>5% fall</td>
<td>4% fall</td>
<td>No change</td>
<td>8.8% fall</td>
<td>3.5% fall</td>
<td>5.4% fall</td>
<td>6.6% fall</td>
<td>3.7% fall</td>
<td>12% fall</td>
</tr>
<tr>
<td>4</td>
<td>Sub-prime crisis</td>
<td>15th Sept 2008</td>
<td>5% fall</td>
<td>No change</td>
<td>No change</td>
<td>3.6% fall</td>
<td>9.5% rise</td>
<td>4.9% fall</td>
<td>5% fall</td>
<td>No change</td>
<td>6.1% fall</td>
</tr>
</tbody>
</table>

Source: Author’s calculation based on data collected from Bloomberg

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2 Market started falling on 16th October till 19th October 1987
3 Upward movement in the market started, market reached the same level back on 15th September 1997
4 Market started falling in August 1997 and reached back the same level on February 2000
5 Market recovered by 1 December 2010
6 Initially no change in Indian stock markets, started falling in October 2008, recovered in 8 months
7 Market started falling drastically from 29th September 2008 and reached back the same level on 8th May 2009.
8 Market recovered in 3 days
International stock market linkages have been extensively investigated. Research has traditionally focused on major developed markets (see Eun and Shim, 1989; Koch and Koch, 1991; Kasa, 1992; Masih and Masih, 1997; Longin and Solnik, 2001; Bessler and Yang, 2003). Recent works have extended this line of research to the linkages between emerging stock markets and the developed stock markets (e.g., Arshanapalli et al., 1995; Choudhry, 1997; Tuluca and Zwick, 2001; Manning, 2002; Chen et al., 2002; Lin, 2008; Dedola and Lombardo, 2012). The extent and the nature of international stock market linkages considered in the literature cover both long-run relationships and short-run dynamic linkages. The former is most relevant to gauging the long-run gains from international diversification, while the latter sheds light on the propagation mechanism of international stock market fluctuations.

The Asian countries included in the study are India, China, Japan, Hong Kong, Taiwan, South Korea, Malaysia and Indonesia. The eight Asian countries have been selected for the study since they attract the maximum Foreign Direct Investment (FDI) from global markets; which is approximately 83 percent of the total FDI inflow to all Asian countries. Further the market capitalization in US dollar terms was the highest for these eight Asian countries for the year 2011; roughly around 87 percent of the total market capitalization of all Asian countries. The period of study is from the year 1991 to 2011 as the year 1991 was a turning point for the Indian financial system, which witnessed lot of reforms (For details, please refer to Chapter 2). Thus a need was felt to test for co-integration and interdependence between financial markets so that the international portfolio managers could design and diversify their portfolios accordingly.

1.4 SCHEME OF THE STUDY

The study is divided into seven chapters. Following this introductory chapter, Chapter 2 of the study examines the growth of Indian stock market very closely. The chapter tries to understand the behavior of Indian stock market before and after 1991

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9 Author’s calculations based on data extracted from World Bank website/ report last accessed on 23rd August. http://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD

10 Author’s calculations based on data extracted from World Bank website/ report last accessed on 23rd August 2015. http://data.worldbank.org/indicator/CM.MKT.LCAP.CD
as from this year onwards, India saw many reforms in the macro-economic scenario and the financial markets also witnessed drastic changes; which contributed to the changing dynamics of financial market in India. The financial markets saw an increase in the trading volumes, risk containment measures, growing investor base, inflow of capital through Foreign Institutional Investors, opening of more avenues of trading etc. The policy changes that were programmed in the Indian financial markets led to an increase in the interest of domestic and international investors.

**Chapter 3** of the study is a brief survey on the existing relevant literature. The survey examines the various definitions that researchers have come out with in the past few years though no professional consensus has been achieved on the definition of contagion. This chapter makes a modest attempt to reconcile all the different viewpoints of the researchers in the area. Further, causes of contagion and their impact on macro-economic fundamentals, investor behavior and financial markets were studied. Various models that have been used to examine contagion have been discussed in the literature drawing out the limitations of each methodology. Through this survey, the lacunae in the existing literature are found out which stand as the justification of the present study.

**Chapter 4** of the study works around the idea of co-integration between Indian stock market and selected Asian markets have been studied to examine the level of co-integration between markets. If the markets are co-integrated, then the next level of study would be to examine level of contagion. The study has applied recent time-series econometric methods like unit root test in the presence of endogenous structural breaks (Lee and Strazicich, 2003; 2004) that uses Lagrange Multiplier (LM) test statistic and allows for at most two breaks both under the null and the alternative hypothesis. Once the stationarity of each stock index has been tested, the study applies the Gregory and Hansen (1996) co-integration technique that allows for one endogenously determined structural break in the co-integrating relationship. The results obtained in this chapter suggests that majority of the Asian markets are co-integrated with Indian stock market.

The objective of **Chapter 5** is to examine contagion between US stock market with eight Asian markets in the light of US Sub-prime crisis of 2007-08 using Dynamic Conditional Correlation Generalized Autoregressive Conditional Heteroskedasticity
(DCC-GARCH) model and Asymmetric Dynamic Conditional Correlation GARCH (ADCC-GARCH) models were applied in chapter 5 to test for contagion during the US Sub-prime crisis of 2007-08. This chapter divides the period of study into three eras: pre-crisis period, during crisis period and post crisis period. The change in correlation is studied over periods for the pairs of countries. All the Asian markets have been paired with the US stock market to understand the ripple effect of the 2007-08 crises. However, both DCC GARCH and ADCC GARCH model might not give correct results in case the series is non-linear in nature. Thus, it would be better to test for contagion using Copula model which is appropriate model to test in case the series is non-linear in nature. To address this limitation, the focus of Chapter 6 of the thesis is to examine contagion effect between the US stock market and the eight Asian stock markets during the Sub-prime crisis period by applying copula model which takes into consideration the non-linearity aspect. This model was suggested by Sklar (1959) and has subsequently been used to evaluate models of time-varying multivariate conditional densities. Copulas allow us to decompose the multivariate distribution and to model the marginal behavior of a series. Thus, multivariate distributions are decomposed into marginal distributions and a copula which explains the relationship between all the marginal distributions. It is best to use copula model when the series is possibly non-linear. The findings of the study indicate that the most of the Asian stock markets have got impacted due to the US Sub-prime crisis of 2007-08.

Finally, Chapter 7 summarizes the major results derived in the study, with special focus on policy prescriptions and suggests further scope of study with regard to stock market integration and contagion.