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Sectoral Returns, Volatility and Global Financial Crisis: Evidence from Indian Market

Abstract

The present paper attempts to assess the impact of recent global financial crisis on different economic sectors. The daily closing indices of 19 sectors listed at BSE have been taken over a period of 2006-19 as a proxy to Indian economic sectors. The study found that every sector has shown a drop during crisis period. Realty sector followed by utility, energy and telecom registered the acute drop during the study period. Information criterion values recommended the use of EGARCH model for all sectors. The results indicated that the volatility of automobile sector followed by Oil & Gas, Information Technology, Energy and Realty sectors was affected most. Banking sector followed by Fast Moving Consumer Goods, Health Care and Finance and capital goods detected to be least affected sectors.

Keywords: Asymmetric Effect, Global Financial Crisis, Heteroscedastic, Returns, Sectoral Indices and Volatility.

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Introduction

The crisis pronounced in the United States compelledmany business tycoons to windup their businesses. Globalisation of different economies and inter-linkages of markets were two prominent factors that smoothens the spread of contagious impact of financial crisis on almost every economy across the globe. The recent financial crisis was a massive economic downturn devastating international financial markets. Decline in gross domestic product, unrest in economy and collapse of financial markets were the most ominous consequence of this crisis. The impact of crisis was so powerful that almost every stock market experienced catastrophic financial loss. Many researchers (e.g. Bhanumurthy 2010, Chong 2011, Schwert 2011, Sed 2012 and Neaime 2012) have analysed the impact of financial crisis on different economies but there are limited studies that have interrogated the impact of crisis over any specific economic sectors. Further out of the studies targeting at sectoral indices, predominantly the impact of crisis over banking sector has been assessed and rest of the sectors have remained unexplored. The growth rate of different sectors differs with each other and that cannot be treated to get affected by the crisis at the same pace. The comprehensive analysis that could unveil the effect of recent financial crisis over different sectors is in dearth. In this context, the present paper makes an attempt to highlight the impact of recent global financial crisis over different sectors of the Indian economy. The uniqueness of each sector influences its vulnerability during crisis period and the same has motivated the researchers to conduct this study. We made an attempt to analyse the impact of global financial crisis over sectoral indices of S&P BSE. Almost every sector has shown a dip during the crisis period. Banking sector followed by automobile, consumer durables, health care and capital goods have reported great fluctuation during the study period. To assess whether this downfall has been caused by crisis or some other shock, we introduced dummy variable as a proxy o crisis period. The work done in this context by the earlier researchers have been summarised in the following section.

Review of Literature

The impact of financial crisis has been analysed by researchers in different contexts likeManda (2010) assessed the impact of the global financial crisis on the volatility of US stock market. The study reported that market was relatively calm during pre-crisis period i.e. from 2004 to 2007. However,during the global financial crisis the market volatility significantly increased. The effect of sub-prime lending crisis on volatility of US stock

returns was analysed by Chong (2011)also. The results of GARCH model highlighted volatility clustering of the market. The results indicated that sub-prime lending crisis increased the volatility.The impact of recent financial crisis on Indian stock market was studied by Sharma and Seth (2011). The data of Bombay Stock Exchange and National Stock Exchange over a period of 10 was analysed before and during financial crisis period. Saha and Chakrabarti (2011) examined global financial crisis and the contagion effect of volatility among the financial markets through GARCH model. The study covering a period January 2006 to December 2010 indicated presence of volatility spill over between stock to exchange rates and vice-versa during the three sub-periods i.e. pre-crisis, during crisis period and post-crisis period.

Sed (2012) examined the impact of the global financial crisis on volatility of Czech and Polish stock markets. The study classified the entire study period into three sub-period viz., before, during and after the crisis. The study observed ARCH effect and discerned that stock market volatility increased during global financial crisis. The empirical study of Indian and Pakistan stock market by Ali and Afzal (2012)revealed that global financial crisis adversely affected stock returns and increased the volatility. The daily closing price of KSE-100 and BSE-100 indices covering a period from January 2003-August 2010 were analysed through EGARCH model. The impact of crisis over sectoral index has been assessed by Al-Rjoub and Azzam (2012). The study reported that the crisis had adversely affected stock returns of all sectors and the banking sector crisis in the emerging markets were the most affected by US Sub-prime lending.

The analysis of daily closing price of stock prices from 1992 to 2009 deduced drastic fall in stock prices. Joshi (2012) examined the impact of Global Financial Crisis on seven Asian stock markets viz., India, China, Hong Kong, Malaysia, Japan, Indonesia and Korea. The daily closing indices have been analysed through GARCH and TARCH models. The results revealed that the crisis has increased volatility and leverage effect in all markets except Korea. The Korean market appeared to be insulated from the crisis.

Neaime (2012) explored the transmission of the global financial crisis on the MENA region coveringseven major stock market indices of Egypt (EGX 30), Jordan (Amman Stock Exchange), Morocco (MADEX), Tunisia (Tunindex), Kuwait (Kuwait Stock Market Index),Saudi Arabia (Tadawul all Stock Index) and the UAE's Dubai Financial Market General Index (DFMGI: IND) over a span of2007-2010. The empirical results from GARCH, TARCH and ARCH-M models exhibited that most countries in the region are correlated with the developed countries. The regional financial integration of markets with developed markets exposed these markets to international crisis. However, appropriate foreign exchange reserves safeguarded Tunisia and Saudi Arabia to some extent.

The impact of global financial crisis on the volatility of Indian stock market has been investigated bySakthivel et., al. (2014)through GJR GARCH model. The results deduced the adverse impact of crisis on mean returns and volatility of stock market. Kulshreshtha and Mittal (2015) also noted the similar findings for BSE Sensex, BSE 100, BSE 200, BSE 500, CNX NIFTY, CNX 100, CNX 200 and CNX 500. The study covering a span from 2000 to 2014 observed the significant impact of crisis on the Indian stock market. Danielsson (2018) analysed the effects of stock market volatility on risk-taking and financial crises across different countries. The findings suggest that volatility itself does not predict crises but prolonged periods of low volatility can be used as a reliable crisis indicator. Chaudhary, Hussain and Shaheen (2018) also reported that external shocks considerably effect the functioning of stock markets. The volatility pattern of stock markets across different countriesrevealed that innovations shook the confidence of investors and enhanced volatility of stock markets.

The above summary highlights that the performance of market during external shocks has been investigated earlier also but unfortunately study analysing the impact of different sectors of the same economy hasn't been much explored. In this context, the present paper makes an attempt to analyse the impactof recent global financial crisis over Indian sectoral indices.

Research Methodology

The present study aims at assessing the impact of global financial crisis on different sectors of Indian economy. Daily closing indices of 19 sectors viz., Auto, Bankex, Basic Materials, Capital Goods, Consumer Discretionary, Consumer Durables, Energy, Finance, FMCG, Healthcare, Industrials, Information Technology, Metal, Oil Gas, Power, Realty, Teck, Telecom and Utilities have been taken on daily interval for a span of around 14 years from 2006 to 2019. At the outset logarithmic returns have been computed for each index and the same has been tested through Jarque Berra test to study the distribution pattern.

The presence of unit root has also been tested to check the stationarity of the data through Augmented Dickey Fuller Unit Root test. Since the results indicated the absence of unit root in all series, data has been analysed further without any transformation. Usually the financial time series suffer with the heteroscedasticity, therefore ARCH (autoregressive conditional heteroskedasticity) test has been applied to check whether the data is homoscedastic or heteroscedastic. The results evidenced the heteroscedasticity of all series and that's why following ARCH based models have been applied to understand the volatility of the different indices.

Generalized Autoregressive Conditional Heteroskedasticity (GARCH)

It was developed in 1982 by Robert F. Engle to overcome the problem of violating the principle of parsimony. GARCH model is a generalised version of ARCH model that contains fewer parameters.

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \epsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2$$

Where;σ_t^2 is the conditional variance, ϵ_{t-i}^2 is the previous day's squared error and σ_{t-j}^2 is the previous time period volatility. The stability condition of GARCH model suggests that $\omega > 0$, $\alpha > 0$, $\beta > 0$. The stationarity condition of the model asserts that finite unconditional variance as a result the sum of two coefficients can never be more than one i.e. $\alpha + \beta < 1$.

Threshold ARCH (TARCH) Model

GARCH model was not truly competent to assess the impact of asymmetric news and therefore Glosten, Jaganathan, and Runkle (1993) and Zakoian (1994) have proposed the Threshold ARCH Model. The model segregates the innovations (shocks) into two disjoint intervals i.e. positive and negative.

$$\sigma_t^2 = \omega + \alpha_1 \epsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \gamma \epsilon_{t-1}^2 d_{t-1}$$

Where; σ_t^2 is the conditional variance, ϵ_{t-i}^2 is the previous day's squared error and σ_{t-j}^2 is the previous time period volatility, $d_{t-1} = \begin{cases} 1, & \text{if } \epsilon_t < 0 \\ 0, & \text{otherwise} \end{cases}$ Positive innovations represent the good news for the economy whereas negative depicts the bad news. The impact of good news is ∞ and the bad news has an impact of ∞ + γ. If γ = 0, the volatility is believed to be symmetric, and if it is not zero the impact is assumed to be asymmetric.

Exponential GARCH (E-GARCH) Model

The exponential GARCH (EGARCH) model has been proposed by Nelson (1991) to capture the leverage effect. The model allows the leverage effect to be exponential rather than quadratic. The term leverage effect denotes the greater impact of negative news as compared to the positive news. The same has been captured through the value of γ. If γ = 0, the impact is assumed to be symmetric. However, if γ < 0, the impact is considered to be asymmetric.

$$\ln \sigma_t^2 = \omega + \beta \ln(\sigma_{t-1}^2) + \gamma \frac{\epsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha \left(\left| \frac{\epsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} \right| - \sqrt{\frac{2}{\pi}} \right)$$

Where; σ_t^2 is the conditional variance, ϵ_{t-i}^2 is the previous day's squared error and σ_{t-j}^2 is the previous time period volatility.The logarithmic specification, the model guarantees the positivity for the conditional variance.

Asymmetric Power ARCH (APARCH) Model

The APARCH model has been given by Ding, Engle and Granger (1993) to exhibit the stylized properties of financial time series.The specification of variance equation of APARCH (p,q) is as follows:$\sigma_t^\delta = \omega + \sum_{i=1}^{p} (\alpha_i |\epsilon_{t-i}| - \gamma_i \epsilon_{t-i})^\delta + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^\delta$

Where, σ_t^2 is the conditional variance, ϵ_{t-i}^2 is the previous day's squared error and σ_{t-j}^2 is the previous time period volatility. The model assumes:

$$\omega > 0, \delta > 0, \alpha_i \geq 0, -1 < \gamma_i < 1, i = 1, \ldots, p, \beta_j \geq 0, \quad j = 1, \ldots, q$$

The model considers the clustering effect of volatility. The model captures asymmetric effect also.

All the models have been compared on the basis of information criterions and the best model has been selected on the basis of least values of Akaike information criterion and Schwartz information criterion. To assess the impact of global financial crisis over the sectoral volatility, the crisis period has been taken as a dummy variable.

Finding and Analysis

Table 1 depicts the descriptive statistics of different sectoral indices. During the study period realty sector registered the highest return followed by Consumer goods and banking sector. The sector (realty sector) observed to be most volatile market for the investors. During recession period, it reported least return followed by utility and Oil & Gas sectors. The returns of almost every sector found to have high kurtosis with negative skewness (except Banking, Consumer goods and financial sector). The Jarque-Bera test statistics reveals that none of the return series follows normal distribution.

Table1: Descriptive Statistics

Sectors	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
Automobiles	0.106	-0.110	0.015	-0.301	7.478	2751.01
Banking	0.176	-0.135	0.019	0.103	9.009	4870.80
Basic Materials	0.126	-0.126	0.017	-0.381	8.312	3880.89
Consumer Discretionary Goods & Services (CDGS)	0.114	-0.124	0.014	-0.658	10.524	7861.07
Capital Goods (CG)	0.198	-0.097	0.018	0.302	10.125	6890.61
Consumer Durables (CD)	0.125	-0.117	0.017	-0.355	8.857	4691.14
Energy	0.175	-0.162	0.017	-0.312	12.849	13123.94
Finance	0.174	-0.125	0.018	0.025	9.876	6372.00
Fast Moving Consumer Goods (FMCG)	0.070	-0.083	0.013	-0.229	6.511	1689.41
Health Care	0.078	-0.086	0.012	-0.576	7.894	3406.41
Industrials	0.170	-0.098	0.017	-0.074	9.477	5656.32
Information Technology (IT)	0.108	-0.118	0.016	-0.110	8.217	3673.39
Metal	0.149	-0.143	0.022	-0.220	7.613	2893.85
Oil & Gas	0.175	-0.162	0.017	-0.431	13.794	15799.09
Power	0.168	-0.121	0.017	-0.078	11.359	9417.73

Realty	0.211	-0.280	0.027	-0.467	10.436	7568.13
Teck	0.131	-0.093	0.015	-0.081	8.793	4526.13
Telecom	0.162	-0.143	0.019	-0.030	7.317	2511.95
Utility	0.154	-0.169	0.017	-0.433	14.558	18101.72

Source: Author's calculation

To rule out the possibilityof unit root, Augmented Dickey Fuller Unit root test has been administered. The test verifies (or rejects) the null hypothesis of absence of unit root in the data. Table 2 depicts the results of unit root test. The probability of test statistics suggests that we cannot accept the null hypothesis. Therefore, it can be concluded that none of the series has unit root i.e. all series are stationary. The test was conducted not only for the whole period but also for the sub-periods like pre-crisis period, crisis period and post-crisis period. The results of sub-period alsoproposedsimilar conclusion.

The heteroscedasticity of the data has been examined through Autoregressive Conditional Heteroscedastic (ARCH) test. The results reported in table 2 reveals that we cannot accept the null hypothesis and thus may conclude that all series are heteroscedastic and must be analysed further with help of Autoregressive Conditional Heteroscedastic (ARCH) models.

Table2: Results of Unit Root and ARCH tests

Sectors	Unit Root Test				ARCH Test			
	Total Period	Pre Crisis	Crisis	Post Crisis	Total Period	Pre Crisis	Crisis	Post Crisis
Automobiles	-49.86	-16.06	-18.11	-44.33	324.74	17.55	107.28	47.33
Banking	-50.20	-14.89	-19.41	-44.27	118.38	9.54	5.57	61.31
Basic Materials	-50.72	-16.65	-18.61	-45.02	298.21	29.44	54.76	26.15
CDGS	-47.69	-14.60	-18.28	-30.58	390.09	97.77	54.27	87.19
CG	-49.70	-12.94	-19.29	-43.44	120.60	29.74	25.85	36.77
CD	-52.59	-16.28	-20.38	-45.91	185.85	24.43	38.39	23.68
Energy	-52.90	-17.05	-19.48	-47.75	186.26	78.94	34.04	17.04
Finance	-49.74	-14.89	-19.11	-44.10	135.56	23.15	11.66	43.41
FMCG	-54.52	-16.49	-20.44	-48.39	361.89	74.06	64.08	37.80
Health Care	-51.26	-15.11	-19.80	-44.95	340.47	64.62	82.51	37.32
Industrials	-48.46	-14.74	-18.45	-42.79	168.32	54.83	30.87	40.20
IT	-42.73	-17.69	-21.73	-47.54	207.29	47.06	16.64	97.50
Metal	-51.78	-16.51	-18.62	-46.97	282.13	23.29	56.98	14.72
Oil & Gas	-53.36	-17.14	-19.75	-47.99	173.39	72.52	31.96	25.60
Power	-51.24	-15.37	-19.76	-45.06	118.65	46.85	20.06	6.03
Realty	-49.57	-7.92	-20.08	-44.62	99.84	23.78	3.97	144.67
Teck	-42.25	-17.00	-21.76	-47.69	183.44	45.39	23.78	47.01
Telecom	-55.38	-16.50	-21.62	-48.34	111.23	22.06	24.08	21.52
Utility	-51.58	-15.46	-19.47	-46.47	260.50	43.47	46.70	1.08

Source: Author's calculation

The ARCH models are able to capture the time-varying volatility and clustering effect of financial time series. The present paper applied four prominently used ARCH based models viz., GARCH, TARCH, EGARCH and APARCH models. Along-with different other parameters, the models estimate the values of Akaike and Schwarz information criterions. These values have been used to compare the suitability of different models. The results have been reported in table 3.

Table 3: Values of Information Criterions

Sectors	AIC				SIC			
	GARCH	EGARCH	APARCH	TARCH	GARCH	EGARCH	APARCH	TARCH
Automobiles	-5.245	-5.823	-5.245	-5.236	-5.236	-5.812	-5.232	-5.225
Banking	-4.761	-5.476	-4.761	-4.753	-4.752	-5.464	-4.747	-4.741
Basic Materials	-4.921	-5.577	-4.920	-4.912	-4.911	-5.566	-4.907	-4.901
CDGS	-5.381	-6.083	-5.381	-5.374	-5.372	-6.072	-5.368	-5.362
CG	-4.915	-5.519	-4.914	-4.906	-4.905	-5.507	-4.901	-4.895
CD	-4.953	-5.633	-4.952	-4.945	-4.943	-5.622	-4.939	-4.934
Energy	-5.534	-6.096	-5.533	-5.524	-5.524	-6.085	-5.520	-5.513
Finance	-4.896	-5.637	-4.895	-4.887	-4.886	-5.626	-4.882	-4.876
FMCG	-5.670	-6.194	-5.669	-5.660	-5.660	-6.183	-5.656	-5.648
Health Care	-4.993	-5.659	-4.992	-4.984	-4.984	-5.648	-4.979	-4.973
Industrials	-5.038	-5.638	-5.037	-5.028	-5.028	-5.627	-5.023	-5.017
IT	-4.486	-5.125	-4.485	-4.477	-4.476	-5.114	-4.472	-4.466
Metal	-4.942	-5.626	-4.941	-4.934	-4.932	-5.615	-4.928	-4.923
Oil & Gas	-4.990	-5.696	-4.989	-4.982	-4.980	-5.685	-4.976	-4.970
Power	-4.040	-4.664	-4.039	-4.031	-4.031	-4.652	-4.026	-4.019

Realty	-5.251	-5.893	-5.250	-5.242	-5.242	-5.882	-5.237	-5.231
Teck	-4.700	-5.228	-4.699	-4.690	-4.690	-5.217	-4.686	-4.679
Telecom	-5.035	-5.793	-5.035	-5.028	-5.026	-5.782	-5.022	-5.017
Utility	-4.820	-5.478	-4.819	-4.811	-4.810	-5.467	-4.806	-4.800

Source: Author's calculation

The AIC and SIC are used to identify the risk of over-fitting (also under-fitting). The values of these criterions reveal the amount of information that may be lost while applying the specific model. The model with least possible criterion value is appreciated. As indicated by table 3, both of the criterions recommend the application of EGARCH model to capture the impact of crisis on the volatility of different sectors. Therefore the present paper shares the results of only EGARCH model. The model assists to capture the asymmetric behaviour and the existence of leverage effect through gamma (ϒ). If the value of gamma is less than zero (i.e. negative) and significant, the impact of shock (innovation) is assumed to have asymmetric effect. The results of EGARCH model are as follows:

Table 4: Results of EGARCH Model

Sectors	ω	α	ϒ	β	Dummy
Automobiles	-0.439	0.183	-0.071	0.966	0.016
Banking	-0.207	0.121	-0.047	0.986	0.015
Basic Materials	-0.439	0.189	-0.063	0.966	0.035
CDGS	-0.521	0.220	-0.078	0.961	0.034
CG	-0.407	0.199	-0.045	0.970	0.024
CD	-0.560	0.213	-0.035	0.953	0.032
Energy	-0.460	0.184	-0.046	0.963	0.050
Finance	-0.252	0.134	-0.053	0.983	0.024
FMCG	-0.516	0.178	-0.042	0.958	0.023
Health Care	-0.507	0.168	-0.031	0.958	0.024
Industrials	-0.449	0.208	-0.055	0.967	0.031
IT	-0.653	0.199	-0.036	0.941	0.052
Metal	-0.360	0.165	-0.040	0.971	0.033
Oil & Gas	-0.602	0.220	-0.068	0.950	0.068
Power	-0.404	0.200	-0.043	0.971	0.035
Realty	-0.457	0.182	-0.030	0.958	0.047
Teck	-0.503	0.181	-0.049	0.959	0.036
Telecom	-0.434	0.139	-0.033	0.960	0.027
Utility	-0.375	0.178	-0.040	0.973	0.040

Source: Author's calculation

Table 4 summarises the parameters of EGARCH model. At 5% level of significance, all coefficients found to be significant. However, at 1% level of significance, the impact of crisis over automobile sector turned to be insignificant. The negative value of gamma confirms the leverage effect on all sectors. It shows that impact of shocks is asymmetric in nature for Indian stock market. The market experiences greater impact of negative news as compared to the positive news. The banking sector experienced least impact of shocks from global financial crisis followed by automobile, fast moving consumer goods, finance, health care, capital goods, telecom, industrials, consumer durables, metals, consumer discretionary goods, basic materials, power & teck. The maximum affected sector noted to be oil & gas. The sector has 6.8% influence of oscillations followed by information technology (5.2%), energy (4.9%), realty (4.7%) and utility.

Conclusion

The heat of turmoil caused due to the recent financial crisis was felt in the entire world economy. The IMF's forecast for the global economy depicts the severity and of the crisis. All countries and all sectors faced the recessionary pressure though of varying dimension. Many researchers have made an attempt to identify the possible impact of crisis over their respective economies. However, the specific sectors haven't been much explored. In this context, the present paper analysed the impact of global financial crisis over the return and volatility of 19 Indian sectoral indices.

The results deduced from daily observation from 2006 to 2019 revealed that all sectors experienced downfall during the crisis period. Realty sector observed to be most volatile market. It reported least return during recession period, followed by utility and Oil & Gas sectors. The returns found to be stationary and heteroscedastic. AIC and SIC recommended the use of EGARCH model to capture the volatility of different sectors. All sectors observed to have significant influence of crisis over volatility of index. Oil & Gas sector followed by information technology energy, realty and utility reported to be the sectors worst affected from the global meltdown. The Indian banking sector followed by automobile, fast moving consumer goods, finance, health care experienced least impact of shocks. The results suggest that during global turmoil an investor can safeguard his interest through directing the investment in these sectors. The results are expected to be fruitful while designing international portfolios. The results of this study are limited to Indian stock market. A further comprehensive study can be done to compare the return and volatility reaction of different economies.

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