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PRE AND POST GLOBAL FINANCIAL CRISIS 2008: AN INVESTIGATION INTO INDIAN FINANCIAL MARKETS

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Abstract
To examine the impact of Global Financial Crisis of 2008, the study investigated the key role of macroeconomic variables which are fundamental in nature and their relationship with benchmark stock index of Indian financial markets, the study used monthly Dec 1995 to July 2019. The empirical analysis started with testing of stationarity by using ADF unit root tests. After testing for stationarity, the test for selection of optimal lag-length for econometric analysis done through Akaike information criteria, Bayesian/Schwarz information criteria. The ARDL bound test for pre and post-crisis-2008 revealed that long-run relationship remained intact between NIFTY 50 and macroeconomic variables, but the significance of macroeconomic variables changed pre and post-crisis such as lending interest rates are significant pre-crisis but post-crisis, they become insignificant, but variables such as foreign institutional investors, foreign exchange remained significant pre and post-crisis.
Keyword: ARDL**,** Global Financial Crisis, Indian Financial Markets, Macroeconomics

INTRODUCTION

The issue of subprime loans in the U.S. economy expanded around the world in the year 2008, triggering a global financial crisis. The financial crisis, which originated in the U.S. and shook the world, had little impact on the Indian stock market, mainly because of strong economic fundamentals in India and lower Indian stock exposure to international equity markets. After the Great Depression of the 1930s, the 2007–2009 global financial crisis is the second-largest economic downturn in history. Major financial institutions such as Fannie Mae, Freddie Mac, Bear Stearns, Lehman Brothers, Merrill Lynch, Citigroup, and the American International Group (AIG) came close to bankruptcy. The wealth of American families decreased by $11 trillion in 2008, which was equivalent to the combined output of Germany, Japan, and the United Kingdom at that time.

On the one hand, neither bankers nor economists in finance anticipated the coming of the financial crisis. Fahlenbrach & Stulz (2009) showed that CEOs in the banking industry have refused to cut their shareholdings, suggesting that these key Wall Street stakeholders did not expect a financial crisis. Colander et al., (2009) debated that analysts and economists were not able to anticipate the crisis. Neither the Federal Reserve System (FED) nor the Treasury noticed the financial bubble; after retiring from the position of Chairman of the FED, Alan Greenspan acknowledged that he had failed to predict the speculative mortgage-lending bubble in the credit markets.

Adebambo, Brockman, & Yan (2015) , on the other hand, found that individual market players may have been aware of the uncertainty that is yet to come. Hanley & Hoberg (2019) examined risk factors in bank 10-Ks and considered that these variables predicted financial uncertainty in 2008. The data is also ambiguous on whether the financial market community was aware of the impending financial crisis or how it would alter the dynamic relationship between the macro-economic variables and financial markets. Considered the most devastating financial occurrence since the Great Depression, a series of coordinated monetary and fiscal measures were deployed by the Group of Twenty (G20) central banks and governments to counter the macroeconomic impact of this crisis. Even though GFC has buffeted economies worldwide, it has more seriously impacted developed economies than developing and emerging economies with developed economies, consequently enduring slow economic growth, historically low-interest rates, sluggish private spending, lower employment, decreased working hours, poor wage growth and high budget deficit.

Taking into account, the relationship between financial sector variables and production difference, Felipe & Estrada (2020) analysed the potential growth of 52 economies in 2000-2018 and observed that potential growth in the world decreased from an average of 3.0 percent in 2000-2007 to 2.6 percent in 2010-2018. The global financial crisis-2008 is well suited to understanding the complex relationship between the stock market index and macroeconomic variables because the magnitude of the crisis makes it an apt breakpoint to test macroeconomic variables' predictive powers. Through their research, Prasad & Reddy (2009) found out that the influence of the 2008 global financial crisis on India was difficult to quantify, but specific sectors of the economy impacted by the spill over effects of the financial crisis and stock markets were one of the sectors.

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Their findings show that during the financial crisis, international institutional investors took nearly $ 11 billion out of India, and, as a result, equity prices dropped 60 percent. In their research paper for the World Bank, Didier et al., (2010) studied the factors responsible for the co-movement between U.S. returns and stock returns in 83 countries prior to and after the fall of Lehman Brothers and found that the financial channel was the primary source of transmission.

In India, with the liberalization measures, the stock market has undergone significant transformations. India's National Stock Exchange (NSE) has evolved as one of the world's biggest stock exchanges in terms of total turnover, containing many large, medium-sized, and small enterprises. Global capital inflows have made a critical contribution to stock-market production. India has become a significant destination for the emerging market economies (EMEs) community, contributing to a fourth of overall equity capital inflows. India has also partnered with many countries and international bodies across Asia, Europe, and the Western Hemisphere in numerous bilateral trade and economic partnership agreements. Our stock exchange in the global world economy has been rising day by day. Therefore, a study has been carried out to examine the impact of the global financial crisis on the dynamic relationship between key macro-economic variables and Indian stock markets by considering the global financial crisis of 2008 as a breakpoint.

REVIEW OF LITERATURE

Chakraborty (2008) investigated the relationship between real GDP growth and financial development using the Engle and Granger Cointegration Test and the causality of Granger to check the direction of causality through quarterly observations from Q3-1996 to Q1-2005. The analysis verified the nature of the long-term relationship between stock market capitalization, bank credit production, and real GDP growth rate. Causality ran from the actual GDP growth rate to financial market capitalization. The volatility in exhibited stock prices was found to be cointegrated with the rate of GDP production, the output from the industrial sector. Research by Garg & Kalra (2018) published conflicting findings from the analysis mentioned above. By using the data over a period from 1991 to 2017, they studied the impact of macroeconomic factors on the Indian stock market. They found that macroeconomic variables such as exchange rate, gold rates, foreign exchange rate, GDP, and Sensex have a favourable relationship, i.e., the BSE benchmark index except for inflation and unemployment.

Gopinathan & Durai (2019) expanded the research to study the systemic effect of macroeconomic factors on stock market returns by using the monthly findings for the period from 1994 to 2018. The conventional statistical tests such as Engle & Granger and Philipps and Ouilaris showed that there was no association between the SENSEX benchmark index and IIP, WPI, Exchange Rate, Money supply, and BSE; however, the Johansen Cointegration test showed that there is a long-term relationship between the Industrial Production Index (IIP), Wholesale Price Index (WPI), Broad Money Supply (M3), Exchange Rate . They used the ACE algorithm for the conversion of original variables to analyse further the non-linear interaction between the variables involved and Sensex and concluded that both the Johansen Cointegration test and the Engle-Granger cointegration test showed the non-existence of long-run correlation between macroeconomic variables and Sensex on transformed variables.

Gurloveleen et al., (2016) analysed the effect of ten macroeconomic factors on Indian capital market functioning. Their study utilized monthly Broad Money, Call Money Rate, Crude Oil Price, Exchange Rate, Foreign Exchange Reserve, Foreign Institutional Investors, Gross Fiscal Deficit, Industrial Production Index, Inflation Rate, Trade Balance, and BSE 500. Their analytical results indicated that of the ten macroeconomic variables listed, International institutional investors and exchange rates have a significant effect on BSE 500. The critical finding of their study was that the Indian equity markets were a weak form of Efficient Market Hypothesis (EMH); therefore, by analysing the information through historical data, investors would not be able to achieve abnormal profits.

Keswani & Wadhwa (2019) examined the causal relationship between macroeconomic factors and Sensex and the National Stock Exchange (NSE). Five macroeconomic variables were selected, namely, disposable income, exchange rate, inflation rate, interest rate. Their research showed that government policy, exchange rates, inflation levels, and interest rates affected stock indices market shifts. Nathani et al., (2015) sought to analyse the variables impacting National Stock Market Exchange stock prices by taking into account the quarterly data series of exchange rates, gross domestic product, money supply, price-earnings ratio, dividend yield ratio, and market book value. Their observational findings found that there is a strong and important association between price-earnings ratio, price-book ratio, and exchange rate, and stock prices. The causal link between macroeconomic factors and stock market indexes was investigated by Sahu & Dhiman (2011), using correlation tests and Granger Causality tests using annual data from 1981 to 2006. Their empirical outputs showed that there is no causal association between Sensex and actual Gross Domestic Product, although both variables, i.e., Sensex and Real Gross Domestic Product, move in the same direction but do not cause each other fundamentally. Paramati & Gupta (2011) examined whether stock market success results in economic growth or the contrary. They also used the monthly data for the Industrial Production Index (IIP) and the quarterly Gross Domestic Product (GDP) for the period 1996 to 2009 to examine the short and long-run relations. When comparing monthly and quarterly, their findings were very different. Monthly findings indicated a bidirectional correlation between Industrial Production Index and BSE as well as the NSE and quarterly results showed that causality ranged from GDP to NSE in the case of NSE and GDP. Even so, there was no connection in the case of BSE and GDP. Naka et al., (1998) used VECM to examine the relationship between selected macroeconomic variables and the Indian stock market on IIP, CPI, M1, and the price of a financial commodity generating the money market index and Sensex, using quarterly observations from Q1 1960 to Q4 1995. Results showed that domestic inflation was a constraining variable in the domestic equity market performance context.

Makan et al., (2012) studied the effect of macroeconomic variables on Indian stock markets by using the monthly data from April 2005 to March 2012 to consider Industrial Production Index Call Money Rate, Dollar Price, Consumer Price Index, Foreign Institutional Investment, Crude Oil Prices, Gold Price and Sensex. Also, they found a sectoral study of five industries (auto, capital goods, FMCG, product, durables for consumers). They concluded in their study that the exchange rate, call rate, and FII are more significant and have an influence on the Indian stock market. Sensex had a positive relationship with FII and call rates, while a negative relationship had been found between the exchange rate and Sensex. Gaur & Dash (2015) examined and influenced Sensex and Nifty through independent macroeconomic variables such as net FIIs, inflation rate, IIP, Exchange rate, and Mumbai Interbank Offer Rate (MIBOR). It concluded that the FIIs movement was a significant determinant of markets indirectly affected by the economy's performance and key variables such as GDP growth rate, inflation rate, interest rate, etc. Alam (2017) exploited monthly observations of inflation, Industrial Production Index, short & long-term interest rates, inflation, exchange rate, money supply, CNX Nifty and BSE Sensex for the period from March 2005 to April 2013 and found that a long-term heteroscedastic relationship existed between macroeconomic variables and stock prices using the Johansen cointegration test.

The relationship between conditional macroeconomic variables volatility and conditional stock market volatility investigated by Kumari & Mahakud (2015) using Univariate non-linear conditional heteroskedastic models, Bollerslev's generalized conditional heteroskedastic models (GARCH), Nelson's exponential GARCH and GARCH threshold models of Zakoian and Glosten et al.,. They selected both SENSEX and NIFTY as the dependent variable for their study, and an independent variable Short term (91) & Long-term interest rates (10 years), Exchange rate, FIIs, IIP, M3, WPI. Multivariate VAR results revealed a significant relationship between price stock market volatility and fluctuation of macroeconomic variables specifically yielded on long-term bonds, M3, and WPI. The existence of causality between stock market volatility and wholesale price inflation index was bidirectional, and uni-directional causality was observed in the case of FIIs and M3 between Sensex & yield on long-term debt.

METHODOLOGY AND DATASET

To examine the impact of the global financial crisis of 2008 on the relationship between stock market benchmark index and key macroeconomic variables, we divided our study period into two groups: pre-2008 and post-2008. The cut off the month is September 2008, because, from September 2008 onwards, economies around the world started to feel the impact of the crisis, Marimuthu (2012). The NIFTY 50, key index of the National Stock Exchange, is considered as a benchmark for Indian financial markets. Following the Arbitrage Pricing Theory (APT), a pre- stipulated multi-factor model has been established for the study, and the broad model takes the subsequent structure as given below:

$$NIFTY_t = \alpha + \beta_1 CPI_t + \beta_2 FX_t + \beta_3 FII_t + \beta_4 GP_t + \beta_5 M3_t + \beta_6 OP_t + \beta_7 GFD_t + \beta_8 LR_t + \beta_9 IX_t + \beta_{10} EX_t + \beta_{11} GSEC_t + \beta_{12} EIPI_t + \varepsilon_t$$

where NIFTY 50$_t$=closing prices of month t; CPI$_t$=consumer price inflation index for month t; FX$_t$=USD/INR exchange rate for the month t; FII$_t$= Net investments by FIIs in the Indian capital market for the month t; GP$_t$= Average price of Gold in Mumbai for the month t; M3$_t$= Broad money supply for the month t; OP$_t$= Brent Spot Price FOB for the month t; GFD$_t$ = Gross fiscal deficit for the month t; LR$_t$= Lending interest rates for the month t; IX$_t$= Value of imports for the month t; EX$_t$=Value of exports for the month t; GSEC$_t$= Yield on 10-year gov.t bond for the month t; EIPI$_t$= Economic Activity, Production Index for the month t

Before applying this model to the datasets, the transformation of raw data for the NIFTY 50 and other macroeconomic variables have been done to make highly skewed data into less skewed and can be essential for formulating pattern in the data more interpretable. Several variables are used in econometric studies in a logarithmic form; the log transformation could be used from the standpoint of univariate time series modelling.

Test of stationarity

We need to test whether a time series is stationary or not, which can be verified by the unit root test of stationarity. For this purpose, two such test– i.e., the Augmented Dickey-Fuller (ADF) test **(**Dickey and Fuller, 1979) is used to infer the stationarity of the series.

Autoregressive Distributed Lag Model (ARDL) approach to cointegration testing or bound cointegration testing approach

When two-time series variables X and Y do not autonomously swing around a constant value, but their arrangement (could be linear) is called Cointegration. From time to time, the said variables are a long-term

association. Yule (1926) discussed the notion that a time series-based regression model, which is trending, may be spurious. Granger and Newbold (1974) also took on this topic of false regression, which contributed to the introduction of the principle of Cointegration. When it is possible to transform the non-stationary series into the stationary series by differentiating once, the series is said to be integrated of order one and is characterized by I(1). If the series needs to be stationary with variance k cycles, otherwise the series is assumed to be I(k).
Johansen and Juselius (1990) when there are one cointegrating vector, we cannot apply the method of Cointegration. Therefore, it is essential to investigate the Autoregressive Distributed Lag (ARDL) method suggested by Pesaran and Shin (1995) and Pesaran et al. (1996b) to cointegrate or associate a long-term relationship, regardless of whether the underlying variables are I(0), I(1) or a combination of both. The implementation of the ARDL method to Cointegration in such a situation should provide practical and useful estimates. In comparison to the cointegration method Johansen and Juselius (1990), the Autoregressive Distributed Lag (ARDL) approach to Cointegration allows us to define the cointegrating vector(s). That is, every one of the underlying variables serves as an equation of a single long-term relationship. Once defining one cointegrating vector (i.e., the underlying equation), the cointegrating vector's ARDL model is re-parameterized into ECM. The re-parameterized result gives the variables of a single model short-run dynamics (i.e., conventional ARDL) and long-run relation. Re-parameterisation is feasible since with the ECM; the ARDL is a complex single model equation and of the same form. The distributed lag Model clearly implies the use of unregulated regressor lag in a regression function. Certain benefits that the ARDL has over other estimation techniques include: it requires the variables to have different optimum lags, which is nearly impossible for other traditional cointegration techniques; it is more suitable when dealing with limited sample size, unlike other estimation techniques that require comprehensive data collection for validation.
The ARDL *($p,q_1,q_2\dots q_k$)* model is given as below:

$$\phi(L,p)y_t = \sum_{i=1}^{k} \beta_i(L,q_i)x_{i,t} + \delta w_t + \mu_t$$

where

$$\phi(L,p) = 1 - \phi_1 L - \phi_2 L^2 - \cdots . -\phi_p L^p$$

$$\beta(L,p) = 1 - \beta_1 L - \beta_2 L^2 - \cdots .. -\beta_q L^q, fori = 1,2,3 \dots . k, \mu_t \sim iid(0;\delta^2)$$

L is a lag operator such that $L^0 y_t = X_t, L^1 y_t = y_{t-1}, and$ w_t is a s x1 vector of deterministic variables like time trends, or exogenous variable with a fixed lags, *P=0,1,2,…m, q=0,1,2…m, i=1,2,….k:* in total of $(m+1)^{k+1}$ several ARDL model specifications. The maximum lag order, m, will be chosen by lag criteria through Vector Auto Regression (VAR).
The ARDL model for our study is as follows:

$$\begin{aligned}\Delta LNIFTY_t = \gamma_0 &+ \sum_{i=1}^{n} \gamma_{1i}\Delta LNIFTY_{t-i} \\ &+ \sum_{i=0}^{n} \gamma_{2i}\Delta LCPI_{t-i} \\ &+ \sum_{i=0}^{n} \gamma_{3i}\Delta LFX_{t-i} \\ &+ \sum_{i=0}^{n} \gamma_{4i}\Delta LFII_{t-i} \\ &+ \sum_{i=0}^{n} \gamma_{5i}\Delta LGP_{t-i} \\ &+ \sum_{i=0}^{n} \gamma_{6i}\Delta LM3_{t-i} + \sum_{i=0}^{n} \gamma_{7i}\Delta LOP_{t-i} + \sum_{i=0}^{n} \gamma_{8i}\Delta LGFD_{t-i} + \sum_{i=0}^{n} \gamma_{9i}\Delta LLR_{t-i} + \sum_{i=0}^{n} \gamma_{10i}\Delta LIX_{t-i} \\ &+ \sum_{i=0}^{n} \gamma_{11i}\Delta LEX_{t-i} + \sum_{i=0}^{n} \gamma_{12i}\Delta LGSEC_{t-i} + \sum_{i=0}^{n} \gamma_{13i}\Delta LEIPI_{t-i} + \delta_1 LNIFTY_{t-1} + \delta_2 LCPI_{t-1} \\ &+ \delta_3 FX_{t-1} + \delta_4 LFII_{t-1} + \delta_5 LGP_{t-1} + \delta_6 LM3_{t-1} + \delta_7 LOP_{t-1} + \delta_8 GFD_{t-1} + \delta_9 LLR_{t-1} \\ &+ \delta_{10} LIX_{t-1} + \delta_{11} LEX_{t-1} + \delta_{12} LGSEC_{t-1} + \delta_{13} LEIPI_{t-1}\end{aligned}$$

Where $\varepsilon, \gamma, and\ \delta$the white-noise error are term, the short-run coefficients, and the long-run coefficients of the model, and Δ is the first difference operator. In addition, *t* signifies time, and *n* is the maximum number of lags in the model. The study variables, LNIFTY 50, LCPI, LFX, LFII, LGP, LM3, LOP, LGFD, LLR, LIX, LEX, LGSEC, LEIPI, are the log of NIFTY 50, CPI, F.X., FII, G.P., M3, O.P., GFD, L.R., IX, EX, GSEC, and EIPI respectively.

Table 1: Groups 1 and 2 are divided from Dec 1995 to July 2019, considering the September 2009 as a break point. Group 1 consists of 154 months and group 2 consists of 130 months

Sample	Sample Period	Total Months
Sample 1	Dec 1995-Sept 2008	154
Sample 2	Oct 2008-July 2019	130

Source: Author's calculation

Empirical Results and Discussion

Lag Length Selection through VAR

To select the lag length, we will choose the same criteria as we did for the cointegration test in our previous results.

Table 2: Lag length output selection through Vector Auto Regression. The initial lag of 12 was selected as the time series consists of monthly observations

Lag	LogL	LR	FPE	AIC	SC	HQ
0	684.83	NA	1.08E-20	-9.078	-8.815	-8.971
1	2623.06	3509.75	4.52E-31	-32.987	-29.301*	-31.489*
2	2798.41	286.71	4.34E-31*	-33.073	-25.96	-30.185
3	2937.65	203.21	7.36E-31	-32.67	-22.14	-28.392
4	3124.85	240.32*	7.46E-31	-32.916	-18.963	-27.247
5	3297.05	190.87	1.11E-30	-32.96	-15.584	-25.9
6	3475.5	166.39	2.01E-30	-33.087*	-12.28	-24.637

** indicates lag order selected by criterion; LR- Sequential modified LR test statistic(each test at 5% level); FPE- Final Prediction error; AIC-Akaike information criterion; SC- Schwarz Information Criterion, HQ-Hannan-Quinn Information Criterion*

ARDL Short-Run Model: Group 1 (Dec 1995-Sept 2008)

Table 3: Autoregressive Distributed Lag (ARDL) short run results for Group 1: Dec 1995-Sept 2008

ARDL Short Run Model-Group 1				
Variable	Coefficient	Std. Error	t-Statistics	*p-value*
LNIFTY(-1)*	0.874	0.039	22.091	0.000
LCPI	-0.263	0.312	-0.843	0.400
LEIPI	0.043	0.135	0.318	0.750
LEX*	-0.172	0.069	-2.496	0.013
LFII*	0.005	0.000	5.407	0.000
LFX*	-1.148	0.349	-3.288	0.000
LFX(-1)	0.807	0.362	2.229	0.027
LGFD*	-0.003	0.000	-3.263	0.001
LGP	0.033	0.064	0.527	0.598
LGSEC	-0.266	0.159	-1.674	0.096
LGSEC(-1)*	0.385	0.154	2.490	0.014
LIX	0.146	0.056	2.577	0.011
LLR	0.396	0.244	1.617	0.108
LLR(-1)*	-0.681	0.246	-2.762	0.006
LM3	0.240	0.150	1.591	0.113
LOP	-0.034	0.031	-1.088	0.278
C	0.210	0.805	0.261	0.794
R-Sqaured	0.990			
Adjusted R-Squared	0.989			
Durbin-Watson stat	1.905			

*significant at a 5% level: Source: Author's calculation

Residual Diagnostics & Stability Diagnostics: Group 1 (Dec 1995-Sept 2008)

Table 4: Group 1 (Dec 1995-Sept 2008) Residual & Stability Diagnostics

Group 1	
Residual Diagnostics	*p-value*
Serial Correlation L.M. Test	0.483
Heteroskedasticity Test	0.778
Jarque Berra Test	0.620

Stability Diagnostic Test	
Ramsey Reset Test	0.579

ARDL Long Run Form and Bounds Test: Group 1 (Dec 1995-Sept 2008)

Table 5: Autoregressive Distributed Lag (ARDL) bound test results for Group 1 (Dec 1995-Sept 2008)

F-Bounds Test				
Test Statistics	Value	Significance Level	I(0)	I(1)
F-Statistics	5.348	10%	1.76	2.77
k	12	5%	1.98	3.04
		2.50%	2.18	3.28
		1%	2.41	3.61

Table 6: Autoregressive Distributed Lag (ARDL) Long Run output of Group 1(Dec 1995-Sept 2008)

Variable	Coefficient	Std. Error	t-statistics	*p-value*
C	0.210	0.805	0.261	0.794
LNIFTY(-1)*	-0.125	0.039	-3.161	0.001
LCPI	-0.263	0.312	-0.843	0.400
LEIPI	0.043	0.135	0.318	0.750
LEX*	-0.172	0.069	-2.496	0.014
LFII*	0.005	0.000	5.407	0.000
LFX(-1)*	-0.341	0.144	-2.366	0.019
LGFD*	-0.003	0.000	-3.263	0.001
LGP	0.033	0.064	0.527	0.598
LGSEC(-1)*	0.118	0.048	2.477	0.014
LIX	0.146	0.056	2.577	0.110
LLR(-1)*	-0.285	0.113	-2.523	0.012
LM3	0.240	0.150	1.591	0.113
LOP	-0.034	0.031	-1.088	0.278
D(LFX)*	-1.148	0.349	-3.288	0.001
D(LGSEC)	-0.266	0.159	-1.674	0.096
D(LLR)	0.396	0.244	1.617	0.108

*significant at a 5% level

Table 7: Autoregressive Distributed Lag (ARDL) level equation output for Group 1(Dec 1995-Sept **2008)**

Variable	Coefficient	Std. Error	t-statistics	*p-value*
LCPI	-2.106	2.618	-0.804	0.422
LEIPI	0.344	1.045	0.329	0.742
LEX*	-1.381	0.665	-2.076	0.039
LFII*	0.040	0.015	2.624	0.009
LFX*	-2.728	0.977	-2.791	0.006
LGFD*	-0.024	0.010	-2.324	0.021
LGP	0.270	0.515	0.525	0.600
LGSEC*	0.950	0.359	2.641	0.009
LIX	1.168	0.600	1.945	0.053
LLR*	-2.280	1.003	-2.272	0.024
LM3	1.919	1.266	1.515	0.131
LOP	-0.274	0.282	-0.972	0.332
C	1.679	6.400	0.262	0.792

*significant at a 5% level:

The cointegration equation coefficient is -0.125198, which is significant at a 5% level.
EC=LNIFTY-(-2.106*LCPI+0.344-LEIPI-1.381-LEX+0.040*LFII-2.728*LFX-0.024*LGFD+0.270*LGP+0.950*LGSEC+1.168*LIX-2.280*LLR+1.919*LM3-0.274*LOP+1.679

ARDL Short-Run Model: Group 2 (Oct 2008-July 2019)

Table 8: Autoregressive Distributed Lag (ARDL) short run output Group 2 (Oct 2008-July 2019)

Variable	Coefficient	Std. Error	t-Statistics	*p-value*	Variable	Coefficient	Std. Error	t-Statistics	*p-value*
LNIFTY(-1)*	0.750	0.063	11.907	0.000	LGFD(-2)	0.000	0.001	1.857	0.066
LCPI	0.510	0.446	1.142	0.256	LGP	-0.105	0.125	-0.844	0.400
LCPI(-1)	-0.678	0.442	-1.532	0.128	LGP(-1)	-0.305	0.178	-1.718	0.088
LEIPI	0.068	0.103	0.663	0.508	LGP(-2)*	0.563	0.169	3.333	0.001
LEIPI(-1)*	-0.204	0.101	-2.006	0.047	LGP(-3)*	-0.292	0.117	-2.501	0.014
LEIPI(-2)	0.199	0.102	1.945	0.054	LGSEC	0.135	0.096	1.394	0.166
LEX	0.229	0.061	0.371	0.711	LGSEC(-1)	-0.104	0.107	-0.980	0.329
LFII*	0.001	0.000	3.316	0.001	LGSEC(-2)	0.118	0.106	1.112	0.269
LFII(-1)	0.000	0.000	0.567	0.572	LGSEC(-3)*	-0.187	0.081	-2.289	0.024
LFII(-2)	0.000	0.000	1.137	0.258	LIX	-0.127	0.063	-2.020	0.046
LFII(-3)*	0.000	0.000	2.357	0.020	LIX(-1)	0.068	0.054	1.265	0.209
LFX*	-1.209	0.179	-6.754	0.000	LLR	-0.065	0.056	-1.172	0.244
LFX(-1)*	1.129	0.176	6.383	0.000	LM3*	-0.552	0.406	-1.361	0.177
LGFD	0.000	0.001	0.414	0.679	LM3(-1)*	1.002	0.398	2.518	0.013
LGFD(-1)	0.001	0.000	1.207	0.230	LOP	0.039	0.028	1.370	0.174
					C	-2.238	1.189	-1.882	0.063
R-squared	0.992								
Adjusted R-squared	0.989								
Durbin-Watson stat	1.760								

*significant at a 5% level

Residual Diagnostics & Stability Diagnostics: Group 2 (Oct 2008-July 2019)

Table 9: Group 2: Oct 2008-July 2019 Residual & Stability Diagnostics

Residual Diagnostics	*p-value*
Serial Correlation L.M. Test	0.485
Heteroskedasticity Test	0.286
Jarque Berra Test	0.908
Stability Diagnostic Test	
Ramsey Reset Test	0.138

ARDL Long Run Form and Bounds Test: Group 2 (Oct 2008-July 2019)

Table 10: Autoregressive Distributed Lag (ARDL) bound test results for Group 2 (Oct 2008-July 2019)

F-Bounds Test				
Test Statistics	Value	Significance Level	I(0)	I(1)
F-Statistics	4.1974	10%	1.76	2.77
k	12	5%	1.98	3.04
		2.50%	2.18	3.28
		1%	2.41	3.61

Table 11: Autoregressive Distributed Lag (ARDL) long run output of Group 2: Oct 2008-July 2019

Variable	Coefficient	Std. Error	t-Statistics	*p-value*
C	-2.238	1.189	-1.882	0.063
LNIFTY(-1)*	-0.249	0.063	-3.959	0.001
LCPI(-1)	-0.168	0.243	-0.693	0.490
LEIPI(-1)	0.006	0.185	0.427	0.671
LEX	0.023	0.062	0.371	0.711
LFII(-1)*	0.004	0.001	3.931	0.000
LFX(-1)	-0.082	0.134	-0.610	0.543
LGFD(-1)	0.002	0.001	1.790	0.076
LGP(-1)*	-0.139	0.067	-2.064	0.042
LGSEC(-1)	-0.039	0.072	-0.545	0.587
LIX(-1)	-0.059	0.059	-1.011	0.315
LLR	-0.066	0.056	-1.173	0.244

LM3(-1)*	4.500	0.173	2.603	0.011
LOP	0.039	0.029	1.371	0.174
D(LCPI)	0.506	0.446	1.142	0.256
D(LEIPI)	0.068	0.103	0.664	0.508
D(LEIPI(-1))	-0.200	0.103	-1.946	0.055
D(LFII)*	0.002	0.005	3.317	0.001
D(LFII(-1))*	-0.002	0.006	-2.586	0.011
D(LFII(-2))*	-0.001	0.005	-2.358	0.020
D(LFX)*	-1.210	0.179	-6.755	0.000
D(LGFD)	0.000	0.001	0.415	0.679
D(LGFD(-1))	-0.001	0.001	-1.857	0.066
D(LGP)	-0.105	0.125	-0.845	0.400
D(LGP(-1))*	-0.272	0.122	-2.232	0.028
D(LGP(-2))*	0.292	0.117	2.501	0.014
D(LGSEC)	0.135	0.097	1.394	0.166
D(LGSEC(-1))	0.069	0.087	0.787	0.433
D(LGSEC(-2))*	0.187	0.081	2.289	0.024
D(LIX)	-0.128	0.063	-2.020	0.046
D(LM3)	-0.553	0.406	-1.361	0.177

*significant at a 5% level

Table 12: Autoregressive Distributed Lag (ARDL) level equation output for Group 2: Oct 2008-July 2019

Variable	Coefficient	Std. Error	t-Statistics	*p-value*
LCPI	-0.6739	1.06154	-0.6349	0.527
LEIPI	0.2565	0.5975	0.4292	0.6687
LEX	0.092	0.25742	0.3577	0.7213
LFII*	0.014	0.00422	3.488	0.0007
LFX	-0.3284	0.5051	-0.65	0.517
LGFD	0.0076	0.0047	1.6182	0.1088
LGP*	-0.557	0.196	-2.837	0.0055
LGSEC	-0.156	0.297	-0.5251	0.6007
LIX	-0.2373	0.2529	-0.9385	0.3503
LLR	-0.2634	0.2263	-1.164	0.2472
LM3*	1.80307	0.713	2.527	0.0131
LOP	0.15829	0.1126	1.40462	0.1633
C	-8.9703	5.239	-1.7122	0.09

*significant at a 5% level

EC=LNIFTY-(-0.6740*LCPI+0.2565*LEIPI+0.092*LEX+0.0147*LFII-0.3285*LFX+0.0077*GFD-0.5578*LGP-0.1561*LGSEC-0.2374*LIX-0.2634*LLR+1.8037*LM3+0.1583-LOP-8.9704

Cointegrating Equation (-1) =-0.249519

The global financial crisis-2008 is well befitting to comprehend the dynamic relationship between the stock market index and macro-economic variables because the sizeable magnitude of the crisis makes it an apt breakpoint to test the predictive powers of macroeconomic variables.

ARDL Bound Test

F-statistics for group 1 (Dec 1995-Sept 2008) and group 2 (Oct 2008-July 2019) are presented in table 5 and table 10, respectively. F-statistics for group 1 is greater than lower bound, and upper bound at a 5% significance level, which implies a long-run cointegration exists between NIFTY 50 and macro-economic variables of the study. F-statistics for group 2 is greater than lower bound, and upper bound at a 5% significance level, which implies a long-run cointegration exists between NIFTY 50 and macro-economic variables of the study.

Group 1 Cointegration equation coefficient (-0.125198) is significant at 5% level which infers the short-run adjustment corrected in the long run by 12 percent whereas, for group 2, Cointegration equation coefficient(-0.2495) is significant at 5% level which suggests short-run adjustments corrected by 24 percent in the long run.

The difference in the speed of adjustments pre and post-crisis of 2008 can be attributed to the fact that post-crisis 2008, Globalization took a hit, and economies all around the world started to strengthen and isolate their financial systems with enhanced scrutiny in terms of risk and capital management. Rather than International factors, domestic factors became significant in affecting the stock markets. Classesens & Van Horen (2015) discussed in their research paper that global banking was going through structural changes and with an increased number of players and a more focussed approach on the regional level.

From the period Dec 1995 to September 2008, short-run results are presented in the table 3 and for the period from October 2008 to July 2019 are presented in table 8. We can observe that coefficients of LEX, LFII, LFX, LFX_{t-1}, LGFD, $LGSEC_{t-1}$, LIX, LLR_{t-1} are significant at 5% level, whereas from Oct 2008 to July 2019, $LEIPI_{t-1}$, LFII, $LFII_{t-3}$, LFX, LFX_{t-1}, LGP_{t-2}, LGP_{t-3}, $LGSEC_{t-3}$, LIX, $LM3_{t-1}$ are significant at 5% level.

First, let us focus our discussion on those variables which remain significant in both the samples, i.e., pre- and post-crisis of 2008. Foreign institutional investors' inflows remained significant in pre- and post-crisis of 2008, but the magnitude decreased after 2008. In pre-crisis, a one percent increase in LFII led to a 0.005% increase in stock market index whereas post-crisis, the change dropped to 0.0017%, which means that one percent increase in FIIs led to an increase of 0.0017%. This explained the reason behind a net inflow of USD 20.3 billion in 2007-08, and after 2008-09, FIIs money saw an exodus of the magnitude of USD 15 billion as foreign money used by their parent companies to strengthen their balance sheets.

The variable LFX_{t-1} remained significant in both the samples at a 5% level, but the coefficient magnitude increased post-crisis. In pre-crisis, a one percent increase in USD/INR led to a 0.80723% increase in the stock market index, post-crisis this increase raised to 1.1279%. This can be attributed to the fact that to handle the crisis of 2008, RBI and the government released a financial package and a huge amount of liquidity in the markets to prevent the rupee crossing the 50 mark. The sharp drop in the foreign exchange rate made the exports more competitive. Pre crisis-2008, there was an increased investment from FPI in Indian capital market because of which there was an increased involvement in Indian forex markets by them, Indian forex markets witnessed a huge surge in capital inflows, which resulted in a sharp appreciation of the exchange rate with rupee touched a high of 39.20/USD in Nov 2007. Forex reserves maintained by RBI swelled to USD 309.7 in the month end of March 2008.

Post-crisis, because of global risk aversion, the daily volatility in the rupee on an annualized basis increased to 16 percent, and rupee depreciated to Rs 50/USD. RBI intervened in the forex markets by selling nearly 18.7 billion USD in the spot market during October 2008 (RBI, 2009).

The coefficient of LIX (Value of imports) is significant at a 5% level in the pre- and post-crisis periods. Although, the sign of the coefficient for LIX changed from positive to negative with reduced magnitude. In the pre-crisis period, a one percent increase in imports led to a 0.1462 increase in the stock market index, whereas post-crisis, a one percent increase in LIX, led to a 0.1279% decrease in the stock market index. The Value of imports in India in US$ terms was on an increasing spree, and they were at a level of USD 33523 million just before one month of crisis, i.e., August 2008. The period between Sep-2008 to Sep-2009 saw negative growth in imports because of the global financial crisis. They dropped to a level of USD 15062 million in February 2009. This can be attributed to the appreciation of the USD/INR rate, which made imports costlier after the 2008 crisis. During the main period of the crisis, on an average, imports and exports contracted by almost 20 percent in the first phase from Oct-2008 to Sept-2009 and then approximately 28 percent during the second phase of Dec-2008 to Sept-2009.

Bown & Crowley (2012) empirical results revealed a 4 percent appreciation results in 60 to 90 percent more products being added to the import protection list and indirectly affecting the current account deficit. Imports went down even in total terms all over the world, as pointed by Levchenko et al. (2010), where they mentioned that after the downturn of 2008, there was a 40% shortfall in imports in the U.S.

We performed residual diagnostics and stability diagnostic results for the ARDL short-run model for Group 1 and Group 2 to check for normality, serial correlation, and heteroskedasticity. The results for group 1 and group 2 are presented in table 4 and table 9, respectively.

Jarque-Bera normality test significance value is greater than 5%, suggesting a normal distribution. Serial correlation L.M. test suggesting no serial correlation, and results of heteroskedasticity test showed no presence of heteroskedasticity in the data. Ramsey RESET test statistics value for both the sample period suggesting the estimated model is free from specification errors as the *p*-value is greater than 5% significance level. The CUSUM stability test results for group 1 and group 2 showed in figure 1 and 2 respectively are suggesting that estimated model parameters are stable, as the blue line for both the samples, lie between the lower bound and upper bound.

Figure 1. CUSUM stability test for Group 1

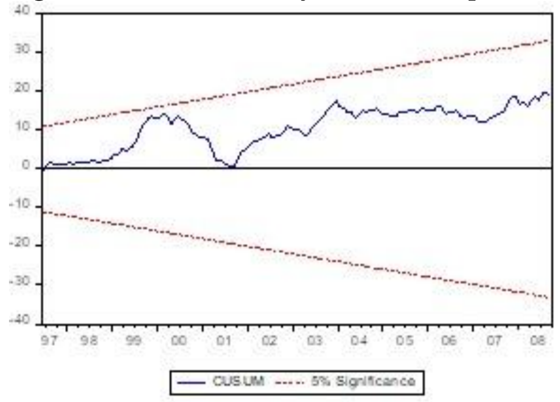

Figure 1. CUSUM stability test for Group 2

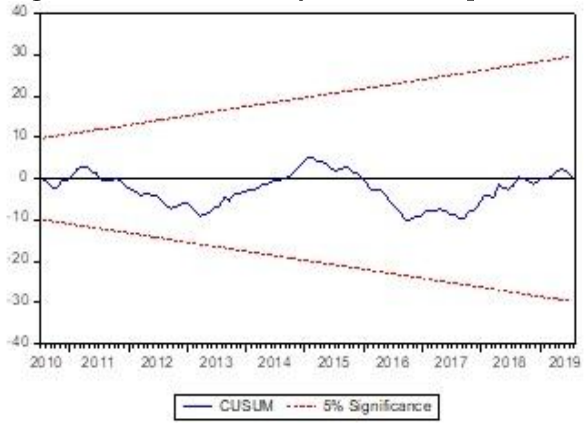

Figure 1. CUSUM stability test

CONCLUSION

The 19th century and the initial years of 20th-century witness dramatic shifts in the world economy because of various economic and financial crisis such as Great depression of 1929, The OPEC oil prices shocks of 1973, The Asian financial crisis of 1997, Dot com bubble of 2001, and the latest being the Global Financial Crisis of 2008. All these crises changed the financial system structurally with enhanced regulation and risk management. The Indian financial markets were also affected by these International crises, as well as domestic crisis such as Harshad Mehta Scam, which gave birth to the Securities Exchange Board of India. The ARDL bound test pre and post-crisis-2008 revealed that long-run relationship remained intact between NIFTY 50 and macroeconomic variables, but the significance of macroeconomic variables changed pre and post-crisis such as lending interest rates are significant pre-crisis but post-crisis, they become insignificant, but variables such as foreign institutional investors, foreign exchange remained significant pre and post-crisis. The coefficient of cointegration equation pre and post-crisis suggested that post-crisis, the speed of adjustment slowed down. That explains the emergence of domestic gold prices, broad money supply significance post-crisis in the long run.

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Appendix

Appendix IA

Augmented Dickey-Fuller unit root test results

				Level					First Difference	
Variable No.	**Variable Code**	**Intercept**		**Trend & Intercept**			**Intercept**		**Trend & Intercept**	
		t-Statistic	Prob.*	t-Statistic	Prob.*		t-Statistic	Prob.*	t-Statistic	Prob.*
1	**LCPI**	0.1713	0.9704	-1.8206	0.6922		-6.8804	0.0000	-6.8712	0.0000
2	**LEIPI**	-1.0396	0.7395	-1.6938	0.7516		-4.0294	0.0015	-4.1423	0.0062
3	**LEX**	-1.3306	0.6158	-0.6689	0.9736		-5.3733	0.0000	-5.5014	0.0000
4	**LFII**	-12.7069	0.0000	-12.7663	0.0000		-10.3141	0.0000	-10.2952	0.0000
5	**LFX**	-0.8510	0.8025	-1.7995	0.7027		-15.3149	0.0000	-15.2889	0.0000
6	**LGFD**	-3.7689	0.0037	-3.7604	0.0201		-13.5925	0.0000	-13.5636	0.0000
7	**LGP**	0.2832	0.9771	-2.0391	0.5769		-15.3299	0.0000	-15.3581	0.0000
8	**LGSEC**	-2.3982	0.1432	-2.4071	0.3750		-7.0942	0.0000	-7.1162	0.0000
9	**LIX**	-0.9473	0.7721	-1.5772	0.7997		-27.9549	0.0000	-27.9317	0.0000
10	**LLR**	-2.4673	0.1246	-3.3483	0.0607		-16.8631	0.0000	-16.8587	0.0000
11	**LM3**	-2.1365	0.2306	-0.2324	0.9921		-2.0835	0.2516	-2.9534	0.1476
12	**LOP**	-1.7625	0.3987	-2.0087	0.5936		-13.5632	0.0000	-13.5608	0.0000
13	**LNIFTY**	-0.6143	0.8639	-2.5265	0.3151		-16.5635	0.0000	-16.5327	0.0000
	Test critical values @ 5%	-2.87185		-3.42649			-2.871845		-3.426251	