INTERRELATIONSHIP AND CAUSALITY BETWEEN SOME FINANCIAL VARIABLES AND GDP: AN EMPIRICAL STUDY OF POST-REFORM INDIA

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[Corporate leaders as well as economists having faith on the neo-liberal ideas often accuse government of not taking enough steps for next generation reform or more doses of liberalization. Opposition parties or coalition partners sometimes receive their wrath too. The next generation reform generally means reform in the service sector, particularly in the financial sector. On the other hand, turmoil that played havoc in the financial markets of many countries, particularly in last few decades, generate just the opposite view. This debate invariably brings into the limelight, the relation between real variables and financial variables. It further paves the way for debating on the issue of degree of reaction against variations in certain financial indicators, especially stock prices. Here, an effort has been made to find out the relationship between Gross Domestic Product (GDP) and stock price indices in the post reform India. Two types of indices are considered here, one is BSE SENSEX and other one is BSE 100. Time series analysis registers presence of interrelationship between the GDP and stock indices but no causal relationship.

Key words: *Financial variables, Macroeconomic variables, Time series analysis.]*

JEL Code: E44; C22; C32

Introduction

With the advent of liberalization that started during 1990-91, financial sector, particularly stock market,has become an important matter of public debate. India so far has experienced both the ugly and good face of it. We have noticed different scams through which huge sums have been wiped out. On the other hand, the technological developments in such markets as well as regulatory mechanism adopted are really some noticeable achievements.At the time of crashes in such market, debates generally take the conspicuous trajectory. These debates heavily veer around the discussion on the relation between stock market indices and macro variables of real sector. Experts with different orientations react differently during a massive 'reds' and in massive 'greens'. Some are highly sensitive to such development, some are highly indifferent to it and some others prefer to choose middle path. These reactions often bring as a by-product some important terms in public domain such as 'policy paralyses, 'next generation reform', 'over-financialization' etc. Thus such discussions inevitably bring in the hot spot the issue of interrelation between financial variable and real variable.

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In this paper an attempt has been made to enquire whether one of the most important macroeconomic variables, GDP is interrelated with the mostfascinated indices, BSE SENSEX and BSE 100. Causality has also been tested in this paper.

Literature Review

The relationship of financial market variables like stock market prices with macroeconomic variables are investigated by many researchers using different econometric instruments. Revolutions in the time series analyses further facilitate such types of investigations. Impulse response function applied by Sims(1980), Vector error correction model by Engle, Granger(1987), Error variance decomposition analyses by Lastrapes, Koray(1990), Granger causality test used by many like Lee(1992) etc. could be considered as important milestones in this direction. Miller, Modigliani(1961), Fama(1981) also investigated relation between real and financial variable. Atmadja(2005) considered short term interest rates as macroeconomic variable. Both types of interest rates have also been used by many also like Mukherjee, Naka(1995). Chaudhuri, Smiles(2004) considered money supply as an important variable. Some researchers also prefer index of industrial production as an important real variable (Agrawalla, Tuteja, 2007), (Padhan, 2007). Ahmed(2008), Ibrahim(2003) tried to find out relationship between stock prices and exchange rate fluctuations. Modis(2007) found correlation between US GDP and the number of sunspots as well as between the Dow Jones Industrial Averages (DJIA) and observed that correlation between stock market growth and GDP growth does not need scientific support because they both reflect fundamental aspects of the same economy. Nath andSamanta(2000) examined the nature and degree of relationship between foreign exchange and stock market in India during the liberalisation era.

Data Baseand Methodlogy

Data used for this study is secondary in nature and source of it is RBI database. Time series analysis has been done on this data to achieve the targeted objective. Data of market value of GDP at constant (2004-05) price for the period 1990-91 to 2012-13 is used. Annual averages of share price indices, BSE SENSEX(1978-79=100) and BSE 100 (1983-84=100), for the same period have been used.

For conductingunit root test the study at the beginning started with the Augmented Dicky Fuller model of the following type:

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \sum_{i=1}^{m} y_i \Delta Y_{t-i} = u_t$$

where**Y**is log transformed value of GDP(lgdpcp) or BSE SENSEX(lsensex) or BSE 100(lbse100) ; **t** is time and **i**is lag.$\mathbf{u}_t$ is disturbance term with white noise property.Δ represents first difference.

Thus study at the beginning considers the presence of both trend and intercept term. However, if this is found not-suitable then Random Walk with drift model is to be considered. Failure of this will lead to testing through Random walk without drift model. Co-integration is to be checked first by considering the order of integration of the variables, lgdpcp, lsensex and then lbse100. Then the order of integration of theestimated residuals, obtained through OLS, of the linear relation between lsensex (lbse100) andlgdpcp is to be derived. Since co-integration relation does not show how short term forces are correcting error to keep long run relation intact, the Error Correction Model(ECM) of the following type is used to get some light on it.

$$\Delta Y_t = \xi + \eta \Delta X_t + \hat{e}_{t-1} + w_t$$

where $\hat{e}_{t-1}$ is the one period lagged estimated residual to be obtained from the linear regression $Y_t = a + bX_t + e_t$, whereY_t represents lsensex or lbse100 andX_t represents lgdpcp.

Vecor Auto Regression (VAR) model is then fitted to check the direction of causality, if any. The model is of the following type

$$Y_t = \theta_1 + \sum_{i=1}^{m} \alpha_{i1} Y_{t-i} + \sum_{i=1}^{m} \beta_{j1} X_{t-j} + u_{1t}$$

$$X_t = \theta_2 + \sum_{i=1}^{m} \alpha_{i2} Y_{t-i} + \sum_{i=1}^{m} \beta_{j2} X_{t-j} + u_{2t}$$

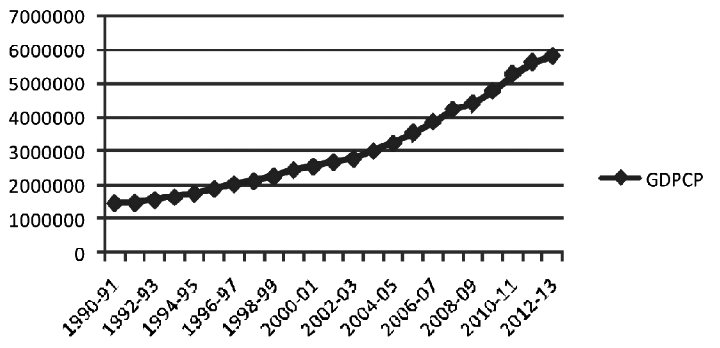
Lag structure, i.e., maximum lag is determined following Schwarz Information Criterion (SIC). Then Granger Causality is carried out to recheck the results obtained from VAR regarding direction of causality, if any.

Time series analysis has been carried out by using E-VIEWS 7.

Estimation & Analysis

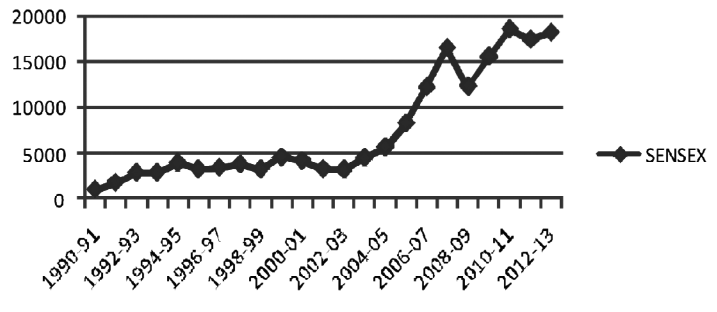
As mentioned earlier the values of GDP at constant price, annual average stock price indicesare transformed to their log values for analyses. Figure 1 represents the GDP at constant price over the period 1990-91 to 2012-13. Figure 2 and Figure 3 show the annual averages of SENSEX and BSE100 for the same period.

Figure 1: GDP at Constant (2004-05) Price over the period 1990-91 to 2012-13 (in Rs. Crore)



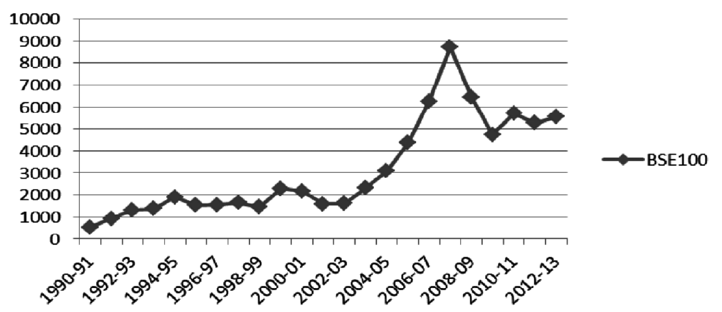
Source: NAS, EPWRF

Figure 2: Annual Averages of SENSEX over the period 1990-91 to 2012-13



Source: Database, RBI

Figure 3: Annual Averages of BSE100 over the Period 1990-91 to 2012-13.



Source: Database, RBI

Unit root test using ADF equation containing both intercept and trend has been used to start with.It shows presence of unit root. Hence, the variables are not stationary at level. However, result of unit root test of the first difference shows presence of stationarity. Therefore, all variables are integrated of order 1 or I(1). Table 1, Table 2 & Table 3 show the ADF and critical values for different variable.

Table 1: ADF and Critical Values

Variables	ADF	Critical Values	
lgdpcp	-2.573666 (Prob. 0.2940)#	1% level	-4.440739
		5% level	-3.632896
		10% level	-3.254671
∆lgdpcp	-4.032188 (Prob. 0.0059)#	1% level	-3.788030
		5% level	-3.012363
		10% level	-2.646119

#MacKinnon (1996) one-sided p-values.

Table 2 : ADF and Critical Values

Variables	ADF		Critical Values	
lsensex	-2.308104	(0.4128)#		
			1% level	-4.440739
			5% level	-3.632896
			10%level	-3.254671
∆lsensex	-3.896978	(0.0005)#		
			1% level	-2.679735
			5% level	-1.958088
			10%level	-1.607830

#MacKinnon (1996) one-sided p-values.

Table 3 : ADF and Critical Values

Variables	ADF		Critical Values	
lbse100	-2.572853	(0.2943)#		
			1% level	-4.467895
			5% level	-3.644963
			10%level	-3.261452
∆lbse100	-3.773308	(0.0007)#		
			1% level	-2.679735
			5% level	-1.958088
			10%level	-1.607830

#MacKinnon (1996) one-sided p-values.

Residuals obtained through OLS estimation procedure regressing first lsensex on lgdpcp and then lbse100 on lgdpcp are also subjected to stationarity test. The results of unit root test are given in Table 4. Both the series are found to be stationary at level. Therefore, it is clear that Gross Domestic Product and SENSEX are co-integrated . Same is true for GDP and BSE100. The short term dynamics which gets reflected through Error Correction Mechanism is presented in Table 5 and Table 6. The co-efficient of one period lagged residual is found to be negative and significant. Results thus ensures that errors get corrected in a significant way to achieve long run relationship or long run stability.

Table 4: ADF and Critical values for estimated residuals

Variables	ADF	Critical Values
Estimated residuals of regression of **lsensex on lgdpcp**	-2.907662 (0.0057)#	1%level -2.674290 5% level -1.957204 10%level -1.608175
Estimated residuals of regression of **lbse100 on lgdpcp**	-2.779917 (0.0079)#	1% level -2.679735 5% level -1.958088 10%level -1.607830

#MacKinnon (1996) one-sided p-values.

Table 5: Estimated coefficients of ECM when dependent variable is D(LSENSEX)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ξ	-0.102283	0.127014	-0.805288	0.4306
D(LGDPCP)	3.764534	1.927404	1.953163	0.0657
$\hat{e}_{t-1}$	-0.484886	0.160981	-3.012065	0.0072

Table 6: Estimated coefficients of ECM when dependent variable is D(LBSE100)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ξ	-0.132097	0.143242	-0.922193	0.3680
D(LGDPCP)	3.946326	2.186368	1.804969	0.0870
$\hat{e}_{t-1}$	-0.498116	0.171341	-2.907166	0.0090

VAR model is fitted with the data after checking the lag structure. It is found that following Schwarz Criterion the loss of information is minimum for one period lag (Table 7 & Table 8) for both cases. For the first case we consider D(LSENSEX) & D(LGDPCP) as endogenous variables. On the other hand, in the second case D(LBSE100) & D(LGDPCP) are considered as endogenous variables. Results given in the mentioned tables force us to fit VAR (1) for both cases. Table 9 and Table 12 represent the VAR results.The results given in these tables show that the coefficients are insignificant.VAR Granger Causality / Block Exogeneity Wald test also corroborates the same result for first as well as second case (Table 10 and Table 13). Granger Causality test using F-statistics repeats the same outcome again for two cases (Table 11 and Table 14).

Table 7: Lag Structure of VAR when Endogenous Variables are D(LSENSEX) & D(LGDPCP)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	46.61174	NA*	1.30e-05*	-5.576467*	-5.479893*	5.571522*
1	47.68693	1.747198	1.89e-05	-5.210867	-4.921146	-5.196031
2	49.82970	2.946307	2.46e-05	-4.978713	-4.495845	-4.953986
3	53.59185	4.232417	2.76e-05	-4.948981	-4.272966	-4.914364
4	62.24883	7.574854	1.83e-05	-5.531103	-4.661941	-5.486595
5	62.56645	0.198515	4.01e-05	-5.070807	-4.008497	-5.016408
6	70.34474	2.916858	4.86e-05	-5.543093	-4.287636	-5.478803

* indicates lag order selected by the 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

Table 8: Lag Structure of VAR when Endogenous Variables are D(LBSE100) & D(LGDPCP)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	40.86853	NA*	2.66e-05*	-4.858567	-4.761993*	-4.853621
1	41.53060	1.075855	4.07e-05	-4.441325	-4.151604	-4.426489
2	45.14399	4.968415	4.43e-05	-4.392999	-3.910131	-4.368272
3	45.36678	0.250643	7.71e-05	-3.920848	-3.244833	-3.886230
4	54.60370	8.082303	4.75e-05	-4.575463	-3.706300	-4.530954
5	57.06819	1.540307	7.98e-05	-4.383524	-3.321215	-4.329125
6	69.49641	4.660580	5.41e-05	-5.437051*	-4.181594	-5.372761*

* indicates lag order selected by the 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

Table 9: Vector Auto-regression Estimates

Variable	D(LSENSEX)	D(LGDPCP)
D(LSENSEX(-1))	0.138073	(0.21700)
	[0.63629]	0.002728
	(0.01999)	[0.13648]
D(LGDPCP(-1))	-1.979029	(2.35140)
	[-0.84164]	0.169960
	(0.21657)	[0.78478]
Intercept	0.215098	(0.15316)
	[1.40438]	0.053305
	(0.01411)	[3.77872]

Standard errors in ( ) & t-statistics in [ ]

Table 10: VAR Granger Causality/Block Exogeneity Wald Tests Results

Dependent variable: D(LSENSEX)			
Excluded	**Chi-sq**	**df**	**Prob.**
D(LGDPCP)	0.708354	1	0.4000
All	0.708354	1	0.4000
Dependent variable: D(LGDPCP)			
Excluded	**Chi-sq**	**df**	**Prob.**
D(LSENSEX)	0.018626	1	0.8914
All	0.018626	1	0.8914

Table 11: Pairwise Granger Causality Tests Results

Null Hypothesis:	**F-Statistic**	**Prob.**
D(LGDPCP) does not Granger Cause D(LSENSEX)	0.70835	0.4110
D(LSENSEX) does not Granger Cause D(LGDPCP)	0.01863	0.8930

Table 12: Vector Auto-regression Estimates

Variable	D(LBSE100)	D(LGDPCP)
D(LBSE100(-1))	0.181743	(0.21979)
	[0.82690]	-0.009928
	(0.01809)	[-0.54895]
D(LGDPCP(-1))	-0.564316	(2.57416)
	[-0.21922]	0.199854
	(0.21181)	[0.94354]
Intercept	0.101661	(0.16999)
	[0.59803]	0.052856
	(0.01399)	[3.77870]

Standard errors in ( ) & t-statistics in [ ]

Table 13: VAR Granger Causality/Block Exogeneity Wald Tests Results

Dependent variable: D(LBSE100)			
Excluded	Chi-sq	df	Prob.
D(LGDPCP)	0.048059	1	0.8265
All	0.048059	1	0.8265
Dependent variable: D(LGDPCP)			
Excluded	Chi-sq	df	Prob.
D(LBSE100)	0.301347	1	0.5830
All	0.301347	1	0.5830

Table 14: Pairwise Granger Causality Tests Results

Null Hypothesis:	F-Statistic	Prob.
D(LGDPCP) does not Granger Cause D(LBSE100)	0.04806	0.8289
D(LBSE100) does not Granger Cause D(LGDPCP)	0.30135	0.5898

Hence, it is clear that although the variables SENSEX and BSE100 move together with GDP and hence, are interrelated, no causal relation has been detected.

Conclusion

As far as the general understanding is concerned time series data are thought to be non-stationary. In our case the relevant tests uphold this beliefas GDP, SENSEX and BSE100 are found to be stationary not at level, but in their first differences. However, residual series obtained through regression are found to be integrated of order zero, which ensures co-integration between GDP & stock indices as per Granger theorem.

Error Correction Model reveals the right kind of short term dynamics which leads to long run stable relation between macroeconomic variable and financial variables. However,VAR(1) and causality test reject the causal relation between selected real macroeconomic variable and the selected financial variable despite the presence of interrelation between variables. Therefore, as far as our study reveals, although importance of stock indices certainly must not be ignored but too much of emphasis put on stock indicesas a deciding factor having any significant effect on the movement of GDP is misplaced and, therefore, should be ignored.

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