MACROECONOMIC DETERMINANTS OF STOCK RETURNS

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Knowledge of sensitivity of stock returns is important for investment, trade and financial issues. It provides insights on stock market dynamics that are useful for policy makers, investors and traders. Using monthly data for the period January 2007 to April 2012, this study examines the stock returns sensitivity to four key macroeconomic variables namely industrial production, exports, exchange rate and interest rate. Index of industrial production and interest rate are significantly related to stock prices in the long run. It implies that growth in the real sector leads to the better returns in the financial sector as well. One possible explanation could be that well-performing real sector builds strong sentiments or expectations in the economy which drive stock returns. It also indicates that stock returns are driven by domestic industrial production rather than exports. The significant interest rate implies that monetary policy measures are crucial in determining the returns in the stock market in India.

Keywords: *Stock Returns, Macroeconomic Factors, Unit Root Test, Co-integration Test*

JEL classification: G1, F4, C22

1. Introduction

Economic fundamentals and the future expectations have a significant impact on the movement of stock indices. In today's globally integrated economy, the domestic factors as well as external factors such as exchange rate and interest rate effect the changes in stock market. The modern financial theory conjectures that long run return on an asset must reflect the changes in such factors. It argues that stock market is significantly interconnected with the real and financial sectors of the economy.

Many analyses have been done to find out the significant factors causing movements in the stock market. Recognizing such factors could provide useful insights to policy makers, traders and investors. In this regard, it is useful to investigate the significance of macroeconomic factors in explaining the movement of stock prices and the linkage between the stock market and the real and financial sectors of the economy. Therefore, the present study explores such causal relationship for India for the period January 2007 to April

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2012. The main aim is to investigate the existence of long run relationship between stock price and IIP (Index of industrial production), interest rate, exports and exchange rate.

2. Literature Review

There exists varying evidence of the causal link between the stock market and macroeconomic factors in the literature. Economists have used different asset pricing specifications to develop the aforementioned relationship. The widely used Capital Asset Pricing theory has been criticized on the grounds that financial factors also play an important role in determining security returns. The criticism led to the development of various asset pricing specifications, for instance Asset Pricing Theory (APT) and Present Value Model (PVM). In the context of macroeconomic dynamics, APT argues that stock market returns can be predicted by a number of macroeconomic factors. It allows multiple risk factors to explain asset returns. Chen, Roll and Ross (1986) have argued that any factor that influences future cash flows or the discount rate of those cash flows should cause changes to return. In an empirical study, they found yield spread between long and short term government bonds, expected and unexpected inflation, nominal industrial production growth and the yield spread between corporate high and low grade bonds, as significant factors determining security returns. PVM links stock returns to future expected cash flows and the future discount rate of the cash flows. According to PVM, all macroeconomic factors that influence future cash flows or the discount rate of those cash flows should explain stock returns. Thus, PVM has an advantage in the sense that it can be used to study long run relationship between stock returns and macroeconomic factors.

Several theoretical arguments linking stock prices to the macroeconomic changes are discussed in the literature. For instance, Dornbusch and Fischer (1980) suggested the linkage between the exchange rate and stock prices. They argued many firms borrow foreign currency for the investment purpose and thus, fluctuations in the exchange rate cause fluctuations in their returns and thus, in their stock price. Many empirical studies are also extant in the literature, investigating the relationship between the exchange rate and stock prices. Ma and Kao (1990) established the evidence in favor of Dornbusch and Fischer argument. They showed that stock market in an export dominant country is negatively affected by currency appreciation and vice-versa. Abdalla and Murinde (1997) investigated the same relationship in the emerging economies of India, Korea, Pakistan and the Philippines. They confirmed the stock market sensitivity to the changes in the exchange rates. It was found that a country's monthly exchange rate tends to lead its stock prices but not the other way round. Ajayi and Mougoue (1996) also studied stock market dynamics in relation with exchange rate for eight countries and they found the significant relationship between the two.

Bernanke and Kuttner (2005) argued that stock price is determined both by the monetary value of an asset and the expected risk associated with that asset. Higher monetary value, however, raises the stock price and on the contrary, higher perceived risk decreases the stock price. They argued that the money supply affects the stock market through both the channels: monetary value and the perceived risk. The impact of money supply on the monetary value comes from its effect on the interest rate. The authors believed that tightening of money supply raises the interest rate, which in turn raises the discount rate and decreases the stock value.

Real sector relationship with the stock market has also been established in the literature. Mukherjee and Naka (1995) demonstrated a significant positive relationship between industrial production and stock prices for Japan. Bhattacharya and Mukherjee (2003) studied the interactions between the stock returns and macroeconomic variables in India in the period 1992-2001. They also revealed industrial production as a significant factor affecting stock returns in India.

Exports performance can also be expected to affect the stock market. Shahid Ahmed (2008) examined long run relationship between stock prices and key macroeconomic variables like exports, exchange rate, interest rate, IIP, money supply and FDI for the period March, 1995 to March, 2007 using quarterly data. The results revealed differential causal links between aggregate macroeconomic variables: FDI, money supply and IIP and stock indices in the long run.

Thus, extant literature shows distinct causal relationship between macroeconomic variables and stock prices. This relationship varies in different stock markets and time horizons in the literature. This paper will add to the existing literature by providing robust result about causal links for five years monthly data.

3. Empirical Model

Hypothesis: This study intends to explore the causal relationship between stock prices and the key macroeconomic variables representing real and financial sector of the Indian economy based on monthly data from January 2007 to April 2012.These variables are index of industrial production, exports, exchange rate, interest rate and Bombay Stock Exchange

Sensex. The functional form is represented by the following equation

$$BSEsensex_t = a_o + a_1 iip_t + a_2 exp_t + a_3 ex\_rate_t + a_4 int_t + e_t$$

$$a_1>0,\ a_2>0,\ a_3>0 \text{ and } a_4>0$$

where *iip* denotes index of industrial production , *exp* denotes exports(in billion rupees) , *ex_rate* denotes exchange rate (Rupees per unit of USD), *int* denotes interest (% p.a.) and *BSEsensex* denotes Bombay Stock Exchange Sensex, *t* denotes year.

4. Database and Methodology

The data set for the present study includes monthly BSE Sensex (Monthly and Annual Averages of BSE 100 Index), index of industrial production, interest rate (Yield of SGL Transactions in Treasury Bills for residual Maturities), exchange rate (average foreign exchange rate- Indian rupees vis-a-vis USD) and export earnings for India for the period January 2007 to April 2012. Bombay Stock Exchange (BSE) is taken as a proxy for capital market. All the data that is required is available on the RBI website[2].

Time series analysis has been used to determine the significance of macroeconomic variables that affect stock returns. Time series analysis gives useful results only if the data is stationary. The classical regression model requires that the dependent and independent variables in a regression be stationary in order to avoid the problem of what Granger and Newbold (1974) called 'spurious regression'. Two unit root tests have been applied to test whether a series is stationary or not: Augmented Dickey Fuller (ADF) and DF-GLS tests. The lag-lengths to be used for unit root testing are calculated. Co-integration analysis has been done in order to ascertain the long run relationship between the macro variables and stock return. Johansen's Maximum Likelihood procedure for Co-integration has been used. The detailed steps are given in the appendix.

5. Empirical Analysis

The descriptive statistics are reported in Table 1 for all five variables - export earnings, exchange rate, interest rate, index of industrial production and BSE Sensex. High or low kurtosis value indicates extreme leptokurtic or extreme platykurtic [Parkinson 1987]. Generally values for zero skewness and kurtosis at 3 represents that the observed distribution is normally distributed. It is seen that the frequency distribution of the above mentioned variables are not normal. The high standard deviation of BSE Sensex, exports and

[2] https://www.**rbi**.org.in

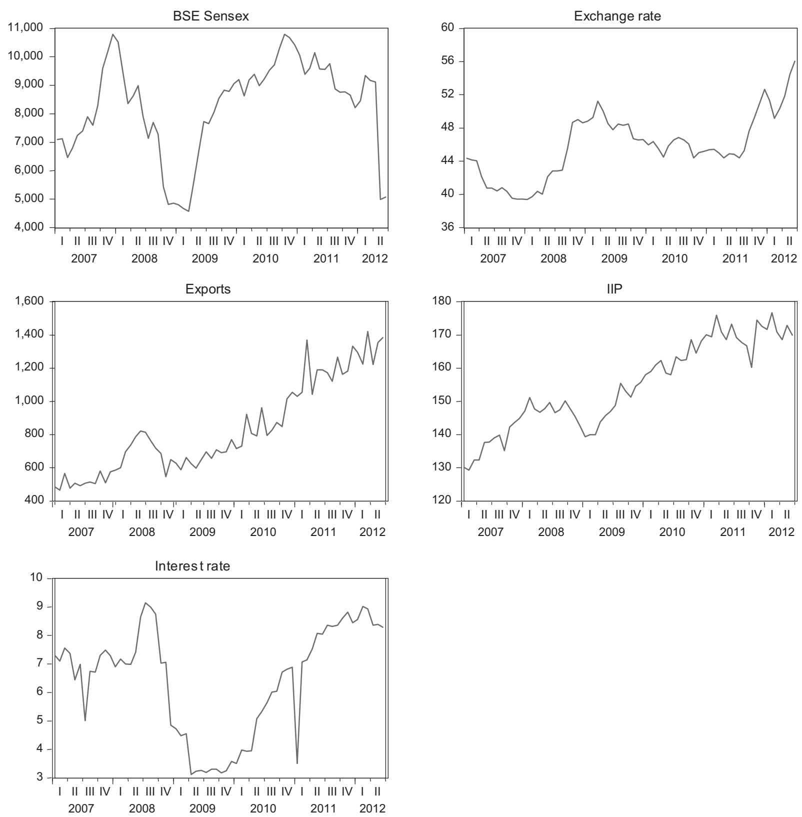
deseasonalized index of industrial production implies that these variables are relatively more volatile compared to exchange rate and interest rate.

Table 1: Descriptive Statistics

No. of Observations =66

	BSE Sensex	Exchange Rate	Exports *(in billion rupees)*	IIP (% p.a.)	Interest
Mean	8274.465	45.77299	832.2716	154.6329	6.424604
Median	8703.555	45.53	750.6835	153.8275	6.9969
Maximum	10795.3	56.0302	1421.7	176.6702	9.1502
Minimum	4569.09	39.3737	466.363	129.3501	3.1159
Std. Dev.	1678.951	3.855989	277.7378	13.16335	1.921708
Skewness	-0.75099	0.213183	0.610598	-0.04922	-0.46413
Kurtosis	2.749247	2.722928	2.127764	1.834728	1.884161

Figure 1: Plot of Time-Series Data of the Variables



Further, time series for all the variables considered are plotted to check the stationarity of data (Figure 1). In these plots, evidence of trend in mean, variance, autocorrelation and seasonality are analyzed. A continuous upward or downward sloping line represents a trend in mean and the vertical fluctuations in the series from one portion of the series to the other represents the trend in variance. Here, exports and IIP have a trend in mean. On the other hand, exchange rate, interest rate and BSE sensex show trend in both mean and variance. This implies the data is non stationary.

However, a formal test for stationarity has also been done. ADF and DF-GLS unit root tests have been done for all five variables. The tests have been shown in the appendix. The unit root tests suggest non-stationarity of data at levels but stationarity at first difference.

Furthermore, to investigate the long run relationship between the stock returns and key macroeconomic variables considered, Johansen's co-integration test has been applied. To determine the number of lags in co-integration analysis, Akaike Information Criteria is used by running unrestricted VAR on the series with the lag values taken from p=1 to p=6. AIC value started stabilizing after 2 and hence, this was selected as the appropriate lag (shown in the appendix)

Maximum eigenvalue test gives only one co-integrating equation as follows:

$$BSE\ Sensex = b_1 + b_2\,ex\_rate + b_3\,exp + b_4\,iip + b_5\,int + b_6\,t + e_t$$

Table 2: Results of Estimated Equation

BSE Sensex	**-152.6661** ***ex_rate***	**-12.95805** ***exp***	**148.7658** ***iip***	**567.6509** ***int***	**108.1001** ***t***
S. E.	85.2950	2.57885	56.4745	132.817	51.6285
t-statistic	-1.789	-5.0247	2.634	4.273	2.093

The results indicated in Table 2 Show that IIP and interest rate coefficients have expected signs and are statistically significant. The coefficients of exchange rate and exports do not have expected sign and are insignificant as well. Thus, results reveal a long run relationship between stock returns and interest rate and industrial production. Therefore, results show that an increase in the growth rate of real sector is factoring in the positive movements of stock market. Further, an increase in the yield on treasury bills is also contributing positively to the stock market.

6. Conclusion

This study investigates the relationships between stock prices (BSE Sensex) and four key macroeconomic variables - index of industrial production, exports, exchange rate and interest rate. The results show a long run relationship between stock prices and the index of industrial production and interest rate. It implies that growth in the real sector leads to the better returns in the financial sector as well. It could be because that well-performing real sector builds strong sentiments or expectations in the economy which drive stock market and also, this study reveals that stock returns are driven by the domestic industrial production rather than exports. Further, interest rate is also found to be significantly affecting stock market. This implies that monetary policy measures related to interest rate are crucial in determining the returns in the stock market in India.

References

Abdalla, I. S. A. and V. Murinde (1997), "Exchange Rate and Stock Price Interactions in Emerging Financial Markets: Evidence on India, Korea, Pakistan, and Philippines", *Applied Financial Economics*, Vol. 7, pp. 25-35.

Ajayi, R. A. and M. Mougoue (1996), "On the Dynamic Relation between Stock Prices and Exchange Rates", *Journal of Financial Research*, Vol. 19, pp. 193-207.

Bernanke, Ben S. and K.N. Kuttner (2005), "What Explains the Stock Market's Reaction to Federal Reserve Policy", *Journal of Finance*, Vol. 60, No. 3, pp. 1221-1257.

Bhattacharya, B. and J. Mukherjee (2003), "Causal Relationship between Stock Market and Exchange Rate, Foreign Exchange Reserves and Value of Trade Balance: A Case Study for India". Paper presented at the Fifth Annual Conference on Money and Finance in the Indian Economy, January 2003.

Chen, N., R. Roll and S. Ross (1986), "Economic Forces and the Stock Market", *Journal of Business*, Vol. 59, No. 3, pp. 383-403.

Dornbusch, R. and S. Fischer (1980), "Exchange Rates and Current Account", *American Economic Review*, Vol. 70, pp. 960-971.

Enders, W. (1995), "Applied Economic Time Series", Wiley, New York.

Ma, C. K. and G. W. Kao (1990), "On Exchange Rate Changes and Stock Price Reactions", *Journal of Business Finance and Accounting*, Vol. 17, pp. 441-449.

Mukherjee, T.K. and A. Naka, (1995), "Dynamic Relations between Macroeconomic Variables and the Japanese Stock Market: An Application of a Vector Error Correction Model", The Journal of Financial Research, Vol.18, No. 2, pp. 223-237.

Shahid Ahmed (2008), "Aggregate Economic Variables and Stock Markets in India", *International Research Journal of Finance and Economics*, Vol. 14, pp.141-164.

Appendix

Unit Root Testing

1. BSE: Both test shows that BSE is a unit root process and is integrated of order one.When conducted serial correlation testing for the residuals, it was found that it's better to go with zero lag. Both Trend and intercept are significant and hence, both have to be there in the equation. We start with the full model, and conduct unit root testing in sequential way. The following results come through:

Only levels							1^{st} difference	
ADF Test	Full Model: **Null: γ=0: τ_t**	Null: **γ=a2=0: Φ3**	Only Intercept: τ_μ	**Φ1**	None	Conclusion on Unit root	Full Model: **Null: γ=0: τ_t**	Conclusion on Unit root
Calculated	-1.093141	1.367843	-1.457610	1.115355	-0.595810	BSE sensex is a unit root process	-6.669526	BSE sensex is 1^{st} difference stationary
1%	-4.105534	9.31	-3.534868	7.06	-2.601024		-4.107947	
5%	-3.480463	6.73	-2.906923	4.71	-1.945903		-3.481595	
10%	-3.168039	5.61	-2.591006	3.86	-1.613543		-3.168695	
DFGLS Test Calculated	-1.389801		-1.455621			BSE sensex is a unit root process	-6.749426	BSE sensex is 1^{st}differnce stationary.
1%	-3.713000		-2.601024				-3.716800	
5%	-3.142000		-1.945903				-3.145200	
10%	-2.845000		-1.613543				-2.848000	

Source: Values are derived using EViews

2. Exchange Rate: Both test shows that exchange rate is a unit root process and is integrated of order one.

Only levels							1^{st} difference	
ADF Test	Full Model: **Null: γ=0: τ_t**	Null: **γ=a2=0: Φ3**	Only Intercept: τ_μ	**Φ1**	None	Conclusion on Unit root	Full Model: **Null: γ=0: τ_t**	Conclusion on Unit root
Calculated	-1.933313	2.619734	-0.660792	0.643579	0.871690	Exchange rate is a unit root process	-5.329346	Exchange rate is 1^{st} difference stationary
1%	-3.168695	9.31	-3.536587	7.06	-2.601596		-4.107947	
5%	-3.481595	6.73	-2.907660	4.71	-1.945987		-3.481595	
10%	-3.168695	5.61	-2.591396	3.86	-1.613496		-3.168695	
DFGLS Test Calculated	-1.936504		-0.690753			Exchange rate is a unit root process	-5.402927	Exchange rate is 1^{st}differnce stationary.
1%	-3.716800		-2.601596				-3.716800	
5%	-3.145200		-1.945903				-3.145200	
10%	-2.848000		-1.613496				-2.848000	

Source: Values are derived using EViews

3. Exports: Both test shows that exports is a unit root process and is integrated of order one.

Only levels							1st difference	
ADF Test	Full Model: **Null: γ=0: τ_t**	Null: **γ=a2=0: Φ3**	Only Intercept: τ_μ	**Φ1**	None	Conclusion on Unit root	Full Model: **Null: γ=0: τ_t**	Conclusion on Unit root
Calculated	-2.447736	3.158568	-0.061277	2.018112	1.884974	Exports is a unit root process	-3.672136	Exports is 1st difference stationary
1%	-4.115684	9.31	-3.544063	7.06	-2.604073		-4.118444	
5%	-3.485218	6.73	-2.910860	4.71	-1.946348		-3.486509	
10%	-3.170793	5.61	-2.593090	3.86	-1.613293		-3.171541	
DFGLS Test						Exports is a unit root process		Exports is 1st differnce stationary.
Calculated	-2.380792		0.625892				-3.513289	
1%	-3.728200		-2.604073				-3.732000	
5%	-3.154800		-1.946348				-3.158000	
10%	-2.857000		-1.613293				-2.860000	

Source: Values are derived using EViews

4. IIP: Both test shows that IIP is a unit root process and is integrated of order one**.**

Only Levels							1st difference	
ADF Test	Full Model: **Null: γ=0: τ_t**	Null: **γ=a2=0: Φ3**	Only Intercept: τ_μ	**Φ1**	None	Conclusion on Unit root	Full Model: **Null: γ=0: τ_t**	Conclusion on Unit root
Calculated	-2.267475	2.591796	-0.753027	0.727530	0.871987	Iip is a unit root process	-4.071896	Iip is 1st difference stationary
1%	-4.140858	9.31	-3.560019	7.06	-2.609324		-4.113017	
5%	-3.496960	6.73	-2.917650	4.71	-1.947119		-3.483970	
10%	-3.177579	5.61	-2.596689	3.86	-1.612867		-3.170071	
DFGLS Test						iip is a unit root process		Iip is 1stdiffernce stationary.
Calculated	-2.380792		-0.063390				-3.513289	
1%	-3.728200		-2.604073				-3.732000	
5%	-3.154800		-1.946348				-3.158000	
10%	-2.857000		-1.613293				-2.860000	

Source: Values are derived using EViews

5. **Interest Rate**: Both test shows that interest rate is a unit root process and is integrated of order one**.**

Only levels							1st difference	
ADF Test	Full Model: **Null: γ=0: τ_t**	Null: **γ=a2=0: Φ3**	Only Intercept: τ_μ	**Φ1**	None	Conclusion on Unit root	Full Model: **Null: γ=0: τ_t**	Conclusion on Unit root
Calculated	-1.860015	1.969293	-1.742043	1.527586	-0.355518	Int is a unit root process	-10.82208	Int is 1st difference stationary
1%	-4.105534	9.31	-3.534868	7.06	-2.601024		-4.107947	
5%	-3.480463	6.73	-2.906923	4.71	-1.945903		-3.481595	
10%	-3.168039	5.61	-2.591006	3.86	-1.613543		-3.168695	
DFGLS Test						Int is a unit root process		Int is 1stdiffernce stationary.
Calculated	-1.795044		-1.795044				-10.98020	
1%	-3.716800		-3.713000				-3.716800	
5%	-3.145200		-3.142000				-3.145200	
10%	-2.848000		-2.845000				-2.848000	

Source: Values are derived using EViews

Johansen Co-integration Test Results: Johansen Methodology has four steps:

Step 1: Find the optimal lag length using unrestricted VAR framework.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1349.005	NA	2.75e+13	45.13350	45.30803	45.20177
1	-1114.884	421.4177	2.59e+10	38.16281	39.20998*	38.57241*
2	-1081.260	54.91995	1.98e+10	37.87532	39.79514	38.62627
3	-1047.338	49.75130*	1.54e+10*	37.57795	40.37040	38.67023
4	-1021.517	33.56734	1.63e+10	37.55058*	41.21568	38.98420
5	-1003.636	20.26607	2.41e+10	37.78785	42.32560	39.56281
6	-982.9829	19.96417	3.56e+10	37.93276	43.34315	40.04906

Using AIC criterion, the optimal lag length is 2.

Source: Table is derived using Eviews

Step 2: Asses the order of integration for each variable under consideration

λ-trace Test				
Ho:	H1:	Statistics	Critical Values 95%	Results
r=0	r>0	107.8447	76.97277	Reject Ho
r<=1	r>1	69.35434	54.07904	Reject Ho
r<=2	r>2	42.54446	35.19275	Reject Ho
r<=3	r>3	20.07337	25.87211	Do not Reject Ho
r<=4	r>4	6.625451	12.51798	Do not Reject Ho
λ-max Test				
Ho:	H1:	Statistics	Critical Values 95%	Results
r=0	r=1	38.49034	38.33101	Reject H_O
r<=1	r=2	26.80988	32.11832	Do not Reject H_0
r=2	r=3	22.47109	25.82321	Do not Reject H_O

Source: Table is derived using Eviews

Note: r is the order of co-integrating vector

Here, both the trace test and maximum eigenvalue test show the rejection of no co-integrating vector. Since maximum eigenvalue is superior to trace test, so we will go with maximum eigenvalue test which says there is one co-integrating vector.

Step 3: Estimate co-integration regression and Construct Error Correction Model, using variables with same order of integration.

The following equation is estimated

$$BSEsensex_t = a_o + a_1 iip_t + a_2 exp_t + a_3 ex\_rate_t + a_4 int_t + e_t$$

BSE=	-152.6661 ex_rate	-12.95805 exports	148.7658 iip	567.6509 int	108.1001 t
SE	85.2950	2.57885	56.4745	132.817	51.6285
t-statistic	1.789	5.0247	2.634	4.273	2.093

Source: Coefficients are derived using Eviews

Step 4: Analyze co-integrating vector (CV) with r=1, the co-integrating Vector is (-152.6661, -12.95805**,** 148.7658 , 567.6509 , 108.1001) The coefficients of *iip* and *int* have correct signs and are statistically significant. Also, *ex_rate* and *exp* have opposite signs but are statistically insignificant.