ISSN 0971-1554

JOURNAL OF QUANTITATIVE ECONOMICS

New Series Volume 10, No.1 **January, 2012**
Old Series Volume 26, No. 1 *January, 2010*

JOURNAL OF QUANTITATIVE ECONOMICS

(Journal of the Indian Econometric Society)

New Series Volume 10, No. 1	***January, 2012***
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Managing Editor: **D.M. Nachane** and *Joint Managing Editors:* **G. Mythili and Rupayan Pal**

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SHORT PAPER

Journal of Quantitative Economics, Vol. 10, No. (1), January 2012

LONG RUN AND SHORT RUN LINKAGES BETWEEN STOCK INDICES IN BOMBAY STOCK EXCHANGE: A STRUCTURAL COINTEGRATION APPROACH

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Abstract

We have analyzed the short term and long term linkages between the sectoral indexes of Bombay Stock Exchange in India by using the daily data on nine sectoral indexes for the period 23rd August 2004 to 31st June 2010. After confirming the same order of integration of the study variables from the unit root test incorporating endogenously determined structural breaks, structural cointegration test has been carried out followed by VECM , Impulse response functions and variance decomposition analysis. The cointegration analysis results indicate that most of the sectoral indexes in India are cointegrated with at least one of the other indexes indicating that the sectoral indexes posses' useful information about the movements of other indexes. This is confirmed by the Impulse response function analysis also. The comovements between the sectoral indices indicate that the Bombay stock exchange is not weak form efficient and the possibility of sectoral portfolio diversification is limited.

Keywords: Stock Indices, Structural Breaks, Cointegration, Impulse Response Functions

JEL Classifications: C43, C53, F36

1. Introduction

Stock market efficiency is a necessary condition for the economic efficiency, as the stock prices provide signals on investor's assessment about the profitability of firm's investment opportunities. The concept of market efficiency is closely associated with Efficient Market Hypothesis (EMH). EMH postulates that the stock markets are informational efficient and the price of financial assets reflect all publically and privately disclosed information relevant to the value. The weak form EMH,[3] which is the focus of this study, asserts that the past prices, volume, and other market statistics does not provide any information for predicting future stock prices. In weak form of EMH, we are assuming that the price change follows a "Random walk" in the sense, price changes randomly to the new information arrives. This instantaneous price changes due to new information reduces the possibility of earning excess profit persistently.

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3 There are three forms of EMH depending upon the information used namely weak, semi-strong and strong form. The strong form deals with all public and private information available, while semi strong form EMH deals with publically information available.

Therefore the focus of this paper is to check the random walk hypothesis (RWH) in an emerging stock market such as Bombay Stock Exchange (BSE) in India. This study contributes to the literature by analyzing the informational efficiency characteristics of Indian stock market through examining the short-run and long-run linkage between the sectoral indexes as this type of an analysis has not been done in Indian context to best of our knowledge. Even if this type of analysis has been done in the context of Athens Stock market, Chinese stock market and Amman Stock market, we differ with those studies in terms of incorporation of the endogenously determined structural breaks in unit root and in cointegration. The empirical results of such a study is expected to provide policy implications to regulatory bodies on the efficiency of Indian stock market and directions to the investors about the possibility of attaining advantage from sectoral diversification of portfolios.

2. Data and Variables

The BSE has eleven sectoral indexes such as capital goods, consumer durables, FMCG, banking, Metal, Oil and gas, Healthcare, Auto and Information technology. All indexes were shifted to floating market capitalization method[4] on 23rd August 2004 and we have collected daily index data from the "Prowess" data base provided by Center for Monitoring Indian Economy (CMIE) for the period August 23rd 2004 to 31st June 2010 for the present study. Since the Power and realty indexes were launched in 2007, we have excluded these indexes from the study and we are considering the rest nine indexes. All variables have been converted in to natural logarithm form before conducting statistical analysis.

3. Estimation Methodologies

Since we are using the daily data for six years and during the study period a number of economic events like the 2007 global crisis have happened, it is important to incorporate the potential structural breaks in the unit root. Saikkonen and Lütkepohl (2000a, b,c) and Lanne, Lütkepohl and Saikkonen (2002) provides a unit root procedure in which structural breaks are determined endogenously. The equation for the test is;

$$y = \mu_0 + \mu_1 t + f_t(\theta)'\gamma + x_t \qquad \text{... (1)}$$

where $f_t(\theta)'\gamma$ is a shift function and θ and γ are unknown parameters or parameter vectors and the errors x_t are generated by AR(p) process with possible unit root. We used a simple shift dummy variable with shift date T_B, $f_t^{(1)} = d_{1t} := \begin{cases} 0, & t < T_B \\ 1, & t \geq T_B \end{cases}$. The function does not involve any parameter θ. In the shift term $f_t^{(1)}\gamma$, the parameter γ is scalar. Differencing this function leads to an impulse dummy. Dates of structural breaks have been determined by following Lanne,

[4] Free-float market capitalization takes into consideration only those shares issued by the company that are readily available for trading in the market. It generally excludes promoters' holding, government holding, strategic holding and other locked-in shares that will not come to the market for trading in the normal course.

Lütkepohl and Saikkonen (2001). After confirming the first order integration, I(1), of variables, the next step is to go for cointegration.

We used Johansen et al. (2000) cointegration test, which incorporates two structural breaks and can incorporate seasonal dummy variables also. In this case optimum number of lags has been chosen on the basis of SIC. However, it is important to note that since there is no lag structure for the dummy series, dummy variable are included in the system, not in the cointegration space.

Since the cointegration and VECM provides only static relationships between the variables, we have carried out Variance decomposition and Impulse response function to get dynamic relationships between the variables.

4. Empirical Results

We have estimated the pair wise cointegration between the nine variables[5] as same order of integration of the variables allowed us to proceed for cointegration analysis. Out of the 37 models estimated, only in 6 models we found cointegration relationship. But out of the nine indexes, six indexes posses' cointegration relationship with at least one of the other indexes. These indexes are Auto, Oil and gas, health care, IT, consumer durables and capital goods. Among this Oil and Gas index is cointegrated with consumer durables and capital goods indexes. Similarly IT index is cointegrated with Auto index and consumer durables index. Three indexes such as Bankex, Metal, and FMCG do not show any long run relationship with any of the other sectors. To get the dynamics of the cointegration relationship we have carried out the VECM analysis.[6]

We have analyzed the Granger-causality between the variables for those models which are not showing cointegration relationship and the Granger causality results are given in Table 1. Interestingly the Banking, FMCG and Metal indexes (which are not showing any cointegration relationship with other variables) have Granger-causal relationship with other indexes. The FMCG index is Granger causing Banking, Oil and Gas and IT sectors, and FMCG index is Granger-caused by Capital goods. Similarly Metal index has a bidirectional Granger-causality relationship with capital goods and Metal index is Granger-caused by Auto, Health care and Consumer durable index. Banking index is Granger-causing IT and posses bidirectional Granger-causality with consumer durables. Similarly Auto index is Granger-causing Oil and Gas and has a bidirectional Granger-causal relationship with Banking and consumer durables.

The impulse response (IR) functions[7] of all models are within the confidence intervals. The IRF shown that one Standard Deviation (SD) shock/innovations in Auto index has initially negative impact on Bankex, FMCG, Metal and Oil and Gas but in latter period its impact turn out to be positive. The impact of Auto on Oil and gas is negative in the later days also, but on Bankex and Metal it is near to zero and on FMCG the impact turns out to be positive in the long run. But

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5 Cointegration analysis has been conducted by assuming that constant term is present in the cointegration process.

6 The results of cointegration and VECM are not provided here but can be obtained from the authors upon request.

7 The results of the impulse response and variance decomposition analysis are not provided but can be accessed by sending a request to the authors.

the impact of shocks in Auto on Capital goods and Health care are positive in the later days. On the other hand the impact of one SD shocks/innovations in FMCG, Metal, Oil and Gas, Health care, capital goods, Consumer goods on Auto index is negative.

The impact of one SD innovations/shocks in Bankex on Durables, FMCG and Health care are positive, but the impacts of one SD shocks/innovations in Durables, Health care and FMCG have negative impact on Bankex in first few days. However, the impact of one SD shocks in FMCG and Health care have a negative impact on Bankex in latter days and the impact of one SD shocks in Health care on Durable is near to zero. The impact of one SD shocks in IT has negative impact on Bankex in initial few days which turns out to be positive in the latter days. The impact of one SD shock in Bankex is negative on Oil and gas sector, but the impact of one SD shock in Oil and gas on Bankex is positive.

Table 1. Granger Causality Analysis Results

Direction of causality	*F statistic*	*Direction of causality*	*F Statistic*
Auto →Bankex	4.28**	FMCG→ Durable	0.43
Bankex→ Auto	5.04*	Durables→ IT	1.75
Auto →Durable	4.41**	IT→ Durable	2.42
Durable →Auto	4.1294**	Durable→ Metal	7.22*
Auto→ FMCG	1.1104	Metal→ Durable	1.83
FMCG→Auto	1.2583	FMCG→ Healthcare	0.02
Auto→ Metal	3.32**	Healthcare→ FMCG	1.05
Metal→ Auto	2.935	FMCG→IT	3.23**
Auto→ Oil and Gas	3.77**	IT→FMCG	1.85
Oil and Gas→ Auto	5.004*	FMCG→ Metal	2.46
Bankex →Durable	3.98**	Metal→ FMCG	0.72
Durable→ Bankex	6.90*	FMCG→ Oil and Gas	8.80*
Bankex→ FMCG	0.1769	Oil and Gas→ FMCG	0.52
FMCG→ Bankex	3.48**	Health care→ IT	1.52
Bankex→ Healthcare	0.27	IT→ Healthcare	2.23
Healthcare→ Bankex	4.10**	healthcare→ Metal	9.21*
Bankex→ IT	4.48*	Metal→ healthcare	0.97
IT→ bankex	2.20	Healthcare→ Oil and gas	9.71*
Capital goods→ Durables	0.59	Oil and gas→ Healthcare	1.00
Durables→ Capital goods	1.29	IT→ Metal	0.52
Capital goods→ FMCG	5.06*	Metal→ IT	1.31
FMCG→ Capital goods	2.35	IT→ Oil and gas	1.09
Capital goods→ Metal	3.58**	Oil and Gas→ IT	1.73
Metal →Capital goods	4.06*	Metal→ Oil and gas	1.24
Durables→ FMCG	3.25**	Oil and Gas→ Metal	2.55

*, ** indicates significance at 1% and 5% respectively

The impact of one SD shocks in Capital goods on Consumer durables and vice versa is positive in the 20 days whereas the impact of one SD shock in Capital goods on metal and vice versa is negative. Impact of one SD shocks in capital goods on IT is negative however, the impact of one SD shock in IT on capital goods is positive. The impact of one SD shocks in capital

goods on Oil and gas is negative in initial days but it turns out to be positive in the latter days. However, the impact of one SD shocks in Oil and Gas on Capital goods is positive and moving to negative direction in the latter days. The impact of one SD shocks in Capital goods on Health care is negative.

5. Conclusions

As per the study results, the sectoral indexes in Indian stock market are related either in the long run or in the short run indicating that the sectoral indexes posses' useful information about the movements of other sectoral indexes and this is further confirmed by the significant Impulse response functions. This shows that the Indian stock market is informationally inefficient and the Random Walk hypothesis (RWH) is not valid in Indian context. The inferences from this study are useful in accessing the possibility of gaining advantage from the sectoral portfolio diversification. The possibility of attaining advantage from sectoral diversification is limited in Indian context, as most of the sectoral indexes in India posses either a long term or short term relationship with each other.

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