ISSN 0974-763X

SOUTH ASIAN JOURNAL OF MANAGEMENT RESEARCH (SAJMR)

Volume 2 Number 1 January 2010

Contents

CSC IBER KOLHAPUR

Chh. Shahu Institute of Business Education and Research (SIBER)
(An Autonomous Institute)
Kolhapur - 416 004, Maharashtra State, INDIA

SOUTH ASIAN JOURNAL OF MANAGEMENT RESEARCH (SAJMR)

ISSN 0974-763X

(An International Peer Reviewed Research Journal)

Published by

Chh. Shahu Institute of Business Education & Research (SIBER)

University Road, Kolhapur - 416 004, Maharashtra, India

Contact: 91-231-2535706 / 07 Fax: 91-231-2535708 Website: www.siberindia.co.in, Email: sajmr@siberindia.co.in

Editorial Note

Born in a Peasant Family, Dr. A.D. Shinde was known as a visionary educationist. Inspite of being a Chartered Accountant, he spent most of his life as a teacher and administrator. He established Chh. Shahu Institute of Business Education and Research (SIBER) and was the patron of South Asian Journal of Management Research (SAJMR). The Institute imparts Master of Business Administration (MBA), Master of Computer Application (MCA), Master of Social Work (MSW), Master of Environment Management (MEM) and certain Diploma courses. In addition to these the M.Phil in Commerce and Management, Economics, Social Work and Sociology is also being offered. Now Dr. Shinde is not with us.

We can talk many imbibed quality in him. He was a visionary and led a modest life style. He inspired many people and strengthened their lives. He was a role model of many people.

I worked under his guidance for about a quarter century beginning of my earlier carrier till his departure. I found in him the thirst for research. He was also concerned about quality research and the outcome is South Asian Journal of Management Research.

He is also responsible for establishing Vasantraodada Patil Institute of Management Studies and Research, Sangli, College of Non-Conventional Vocational Courses for Women, Kolhapur, Dinkarrao Shinde College of Education, Gadhinglaj and Radhabai Shinde English Medium School, Kolhapur.

He had a clear goal and a vision and was able to manage the complex situation from time to time. He was equally able to influence the followers towards reaching the vision. His ability to articulate his vision towards development of the Institute needs to be remembered the most.

His aura of Charisma, and optimistic view helped him to develop the legend he left before the people. Leaders typically make the difference. We the editorial members, management body, faculties and non-teaching staff salute him. We pray for him. Let his soul rest in peace.

Dr. Babu Thomas
Editor

The Impact of Changes in Macroeconomic Factors on the Indian Stock Returns

Aman Srivastava*[1], Furqan Qamar [2] and Masood Khan[3]
*[1]Jaipuria Institute of Management, Noida, INDIA
E-mail: amansri@hotmail.com
[2]Centre for Management Studies, Jamia Milia Islamia, New Delhi, INDIA
[3]Department of Economics, Jamia Millia Islamia, New Delhi, INDIA

Abstract
A dynamic capital market is an important segment of the financial system of any country as it plays a significant role in mobilizing savings and channeling them for productive purposes. The efficient fund allocation depends on the stock market efficiency in pricing different securities traded in it. The modern financial theory focuses upon systematic factors as sources of risk and contemplates that the long run return on an individual asset must reflect the changes in such factors. An enquiry into such factors through different methodologies suggested in finance literature would help the policy makers and investors, to design their investment strategies meaningfully. There are many different emerging and enduring financial issues in the stock markets in India. However, one important issue is the valuation of stocks. The objective of this paper is to investigate the performance of the Arbitrage Pricing Theory (APT) in the Indian Stock Exchanges for the period of 1997-2008 on monthly basis. The study develops seven prespecified macroeconomic variables. The term structure of the interest rate, the risk premium, the exchange rate, the money supply and the unanticipated inflation are similar to those derived in Chen, Roll and Ross (1986). This study extends the approach of Chen, Roll and Ross, by adding industry specific variables, such as sectoral dividend yield and sectoral unexpected production.

Keywords: Arbitrage pricing theory; Indian stock exchange; Macroeconomic factors

1. Introduction

A dynamic capital market is an important segment of the financial system of any country as it plays a significant role in mobilizing savings and channeling them for productive purposes. The efficient fund allocation depends on the stock market efficiency in pricing the different securities traded in it. The modern financial theory focuses upon systematic factors as sources of risk and contemplates that the long run return on an individual asset must reflect the changes in such factors. An enquiry into such factors through different methodologies suggested in finance literature would help the policy makers and investors, to design their investment strategies meaningfully. There are many different emerging and enduring financial issues in the stock markets in India. However, one important issue is the valuation of stocks. There are various models for valuating stocks in developing countries such as the discounted cash flows model (DCFM), the capital asset pricing model (CAPM), and the arbitrage-pricing model (APM). Limitations of the existing models are based on the concept of market equilibrium and the existence of a perfect market. In many developing countries, there are market imperfections and other market characteristics, which make the existing models unsuitable for developing countries like India. Therefore, there is a need to develop a suitable approach to valuation of stocks on the Stock Exchanges of India.

Both the national and international role of any security market is to provide a facility in which investors and enterprises can come together with confidence to create prosperity through sharing of risks and rewards. The security market helps facilitate the flow of funds from investors to productive enterprises; this eventually stimulates economic growth, creates national wealth, and generates employment and stability within society. An effective security market is therefore a necessary condition for corporate vitality in any national economy. It provides three principal opportunities: trading equities, debt securities, and equity and index derivatives. Additionally, the security market is an important conduit for the overseas flow of equity investments in any nation. Capital markets around the globe have an impact on the performance of national economies. Economic activities are interrelated with capital market movements. Capital markets are very volatile. When the market is bullish, it is generally a sign of a strong economy. On the other hand, a bearish market indicates a week economy. The volatility of security prices has become a real phenomenon. A capital market can crash and shake the whole economy. Whether the market crash is a signal for necessary correction or refers to a downturn in economic activities has been the subject of ongoing research in every country. How are securities being priced? Should the pricing mechanism rely on fundamental, technical or behavioural variables? Although there are a good number of theories and models available to explain some of these problems, shortcomings are still evident. The research here aims to identify and assess factors that contribute to changes in security market prices. This proposed research is an attempt to understand the prevailing theories and empirical approaches adopted to investigate the relationships among the variables, including their dynamic co-movement in the adjustment process to long-term equilibrium in the Indian stock market.

The objective of this paper is to investigate the performance of the Arbitrage Pricing Theory (APT) in Indian Stock Exchanges for the period of 1997-2008 on monthly basis. The study develops seven prespecified macroeconomic variables. The term structure of interest rate, the risk premium, the exchange rate, the money supply and unanticipated inflation are similar to those derived in Chen, Roll and Ross (1986). This study extends the approach of Chen, Roll and Ross, by adding industry specific variables, such as sectoral dividend yield and sectoral unexpected production. The paper proceeds along the following lines. Section II presents the review of literature, section III discusses the data, variables and the research methodology, section IV discusses data analysis and results and section V offers conclusions.

2. Literature Review

Asset prices are believed to react to economic events. Some macroeconomic changes affect asset prices stronger than others do and some do not affect them at all. Then, the theoretical question of "which economic factors have significant effects on the pricing mechanism?" is tried to be resolved by many empirical studies, which employ multifactor models. The APT approach essentially seeks to measure the risk premium attached to various risk factors and attempts to assess whether they are significant and priced into stock market returns. There are quite a few approaches to studying security-pricing behaviour, namely, standard factor analysis, cross-sectional regression analysis, principal component analysis, maximum likelihood analysis, multivariate analysis, and generalized method of moments. In recent years, multi-factor modeling has become a prominent tool for valuation of stocks. Multiple factor models attempt to describe asset returns and their covariance matrix as a function of a limited number of risk attributes. Factor models are thus based on one of the basic tenets of financial theory: no reward without risk. In contrast to the Capital Asset Pricing Model (CAPM) first presented by Sharpe (1964), Linder (1965) and Mossin (1966) that uses the stock beta as the only relevant risk measure, empirical studies – for instance Fama/French (1992) – could not confirm this very restrictive statement. The Arbitrage Pricing Theory presented by Ross (1976) already posited a more general multiple factor structure for the return generating processes. However, it specified neither the nature nor the number of these factors. Starting with the studies of Rossenberg, multiple factor models have been applied early in investment practice, mainly because they allow a differentiated risk-return analysis. The applications of multiple factor models are various and are based on the analysis and prognosis of portfolio risk. Multiple factor models can give valuable insights especially in performance and risk attribution. Chen, Roll and Ross (1986) who considered some significant economic variables to have systematic influence on asset returns implemented one of the most famous APT tests on this subject. These are the spread between long and short-term interest rates, expected and unexpected inflation, industrial production, and the spread between high- and low-grade bonds. Some other empirical studies of the APT are only focused on determining the number of risk factors that systematically explain the stock market returns by implementing Factor Analysis Methods. There are a great number of papers that employ factor analysis methods. For example, Roll and Ross (1980) found that three or four systematic risk factors are statistically adequate to explain the asset returns in the period of 1962-1972, while on the other hand Chen (1983) found five factors in the NYSE and AMEX during 1963-1978. Dhrymesetal (1985) found a changing number of factors depending on the period length and the size of the stock groups under analysis. Although the number of factors can be estimated in these kinds of analysis, the identification of priced factors is impossible. However, in the analysis which employs macroeconomic factors, additional information can be obtained by analyzing the links between asset returns and macroeconomic events. A research by Özcam (1997) can be considered an example of APT testing in Istanbul Stock Exchange. In this research, seven macroeconomic variables of Turkish economy are separated into expected and unexpected series by a regression process, and then two-step testing methodology is implemented on these series. A sample population of 54 stocks for the period of 01/1989-07/1995 is used. As a result, beta coefficients of expected factors are found significant for asset returns. Altay (2001) is another example of two different APT tests in Istanbul Stock Exchange. In the first test, factor analysis method is employed in daily returns of 121 to 265 stocks in the 1993-2000 period for each year and one dominant significant factor is found among several minor significant factors for each year. The second test employs multivariable regression process in order to examine the significance of macroeconomic variables on asset returns. As a result, only expected Treasury bill interest rate beta is found significant for explaining asset returns. All these above stated studies employ factor analysis methods in order to derive basic common factors from stock returns or utilize regression processes to test the significance of macroeconomic variables and their betas on asset returns. In this research, it is proposed to use a method for conceptualizing the effect of macroeconomic factors on asset prices in both markets, which has a similar idea with Cheng (1995). Cheng implemented factor analysis on both asset returns and macroeconomic variables in order to derive priced security factors and macroeconomic factors, and then compared these two categories of factors with a canonical correlation analysis in order to reach a statistically significant relation. This kind of analysis eliminates the problems of the multicolinearity and the sensitivity of the estimation results to the number of independent variables, in pricing model of classical multivariate regression testing techniques of APT. In Indian context, Naka, Atsuyuki, Mukherjee, Tarun K. Tufte, David R. (1998) analyzed relationships among selected macroeconomic variables and the Indian stock market. By employing a vector error correction model, they found that three long-term equilibrium relationships exist among these variables. Their results suggested that domestic inflation is the most severe deterrent to Indian stock market performance, and domestic output growth is its predominant driving force. For the Indian Economy, work in this area has not progressed much. Abhay Pethe and Ajit Karnik (2000) have examined the inter – relationships between stock prices and important macroeconomic variables, viz., exchange rate of rupee vis - a -vis the dollar, prime lending rate, narrow money supply, and index of industrial production. The study, of course, reported that in the absence of cointegration it is not legitimate to test for causality between a pair of variables and it does so in view of the significance attached to the relation between the state of the economy and stock markets. The study reports weak causality running from industrial production index to share price index (NIFTY and Nifty) but not the other way round. In other words, it holds the view that the state of economy affects stock prices. Chakradhara Panda and B. Kamaiah (2001) investigated the causal relations and dynamic interactions among monetary policy, expected wholesale price index, real activity and stock returns in the post liberalization period, using a vector –autoregression (VAR) approach. In another study, Mukhopadhyay and Sarkar (2002) conducted a systematic analysis of the Indian stock market returns prior to and after market liberalization and the influence of macroeconomic factors on returns.

3. Data and methodology

The first step in testing the multi-factor CAPM using macro economic variables is to construct independent factors from various key macro-economic variables. The present study has considered all major economic variables for which the data is available through CMIE's Economic Intelligence service. Major categories of variables considered are those representing the product, money and capital markets, external trade as well as the global stock markets. The tentative list of all proposed macro economic variables used in this study is given in Table I. The study has considered the recent period of economic activity starting from January 1997 to December 2008 to examine the more recent trends in the asset-pricing activity in India. S&P CNX Nifty is considered as the Market Proxy. To address the objective of this research, 16 initial *a priori* variables were considered. The data on wholesale price index (WPI), consumer price index (CPI), the industrial production index (IPI), money supply (M3), imports and exports to derive net exports (NX), Net foreign institutional investment (NFII), foreign exchange reserve of government, foreign exchange rate of Indian rupee against the US dollar, yield on 91-days treasury bills, average monthly call money rates, interest rate on 10 year government bond, average monthly prices of gold and International crude oil prices (ICOP) were collected for the study. The net export (NX) figures were derived from the imports and exports of all goods and services of India during the period under study as (NET EXPORTS = EXPORTS – IMPORTS). Finally, six factors including SENSEX were extracted from 16 initial *a priori* variables. Variables the study used are the *SENSEX, the Industrial Production Index (IPI), Inflation (Consumer Price Index), Money supply (M3),*

Table 1: Description of variables used in research

Variable	Definition
S&P CNX Nifty	Share price index of National stock Exchange (NSE) of India
Industrial Production index	The industrial production index of all commodities of India
Consumer Price index	The Price index based o consumer prices
Interest Rate	Annualized Yield on 91 Days Indian Treasury Bills
Foreign Exchange Rate	The exchange rate of Indian rupee with US dollar
Money Supply	Broad money supply M3

Interest Rate (Annualized yield of 91 days Indian Treasury bills) and foreign exchange rate (exchange rate of Indian rupee against the US dollar). All data sets were extracted from the database of Reserve Bank of India (RBI). Similar sets of variables have been used by Chen, et. al. (1986), Darrel and Mukherjee (1987), Hamao (1988), Brown and Otsuki (1988), Darrat (1990), Lee (1992), and Mukherjee and Naka (1995). All variables are transformed into natural logs. Logged values of the SENSEX, industrial production, inflation (CPI), exchange rate of Indian rupee against US dollar and interest rate are denoted as *LNSENSEX, LNINDPROD, LNCPI, LNM3, LNINT and LNEXRATE.*

This study employed the Johansen multivariate cointegration test and vector error correction mechanism (VECM) to determine whether selected macroeconomic variables are cointegrated (hence possibly causally related) with share prices in the Indian stock exchange. Furthermore, the vector error correction mechanism is used to examine the dynamic relations between stock indices and various macroeconomic variables. The Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) approaches are used to pre-test the order of integration for all time series variables. The lag length for the time series analysis is determined by choosing the lag length given by the minimum Akaike Information Criteria and Schwarz Information Criteria. Lagrange Multiplier tests are run to ensure that the residuals from the chosen lag length are serially uncorrelated.

3.1. Unit root tests

For cointegration analysis, it is important to check whether all the time series variables are nonstationary with unit root $I(1)$ and stationary with unit root $I(0)$ at difference before using them in cointegration analyses. This is because the standard inference procedures that are relevant to the standard regression model do not apply in cointegration analysis. It bypasses the standard regression modelling structure. Cointegration analysis requires us to use only those variables that are nonstationary with unit root $I(1)$. The study has tested the stationary of all these series using EViews 5.0 econometric software. The study tested for unit roots in both levels and first differences for all three possible states of the model in relation to intercept and trend. The tested models were with intercept but no trend, intercept with trend, and no intercept or trend. The study used both the Augmented Dickey-Fuller and the Phillips-Perron test procedures in Eviews 5.0.

3.2. Lag length selection method

As the autoregressive model is sensitive to the lag operator chosen, the study had to ascertain the appropriate lag length before the study conducted the cointegration analysis in line with Johansen. The study has used Eviews 5 to determine the optimal lag length based on the Akaike Information Criteria (AIC) or Schwarz Bayesian Criteria (SBC criteria).

3.3. Mathematical presentation of model used

The tests used to investigate the existence of unit roots in the level variables as well as in their first differences are the augmented Dickey-Fuller (ADF) test [Dickey and Fuller, (1979, 1981)] and Phillips and Perron (P-P) test [Phillips and Perron (1988)]. These tests are based on the following two regressions:

$$\Delta x_{it} = \mu + \alpha x_{it-1} + \sum_{j=1}^{m} \Box\Box b_j \Box \Delta x_{it-j} + \varepsilon_{it} \quad (1)$$

and the second unit root test which allows for the existence of a deterministic trend

$$\Delta x_{it} = \mu + \beta t + \alpha x_{it-1} + \sum_{j=1}^{m} \Box\Box b_j \Box \Delta x_{it-j} + \varepsilon_{it} \quad (2)$$

Where is the share price series, text is the residual term and T is a time trend. The null hypothesis is that the variable under consideration has a unit root. In each case the lag-length is chosen by minimizing the final prediction error (FPE). We also tested for the tenth order serial correlation in the residuals of each regression using the Lungs-Box Q statistics.

The next stage in the analysis is to test for the presence of cointegration in the three-variable vector of share price indices. We employ the approach of Johansen (1988) and Johansen and

Juselius (1990). Their approach is to consider the vector autoregressive (VAR) model of the form

$$X_t = \mu + \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + \ldots\ldots + \Phi_k X_{t-k} + \eta_t \ , \quad t= 1,2,\ldots\ldots,T. \qquad (3)$$

Where X_t is a n x 1 vector containing logarithm of share price indices or macroeconomic variables. Suppose that all share price series are I(0) after applying the differencing filter once. If we exploit the idea that there may exist co-movements of these variables and possibilities that they will trend together towards a long-run equilibrium state, then by the Granger representation theorem, we may posit the following testing relationships that represent a vector error-correction (VEC) model

$$\Delta X_t = \mu + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \eta_t, \qquad (4)$$
$$t = 1,\ldots,T$$

Where ΔX_t is the vector of first differences of the variables, the Γ's are estimable parameters, Δ is a difference operator, η_t is a vector of impulses which represent the unanticipated movements in X_t, with $\eta_t \sim$ niid $(0, \Sigma)$ and Π is the long-run parameter matrix. With r cointegrating vectors $(1 \le r \le 3)$, Π has rank r and can be decomposed as $\Pi = \alpha\beta'$, with α and β both 3 x r matrices. β's are the parameters in the cointegrating relationships and α are the adjustment coefficients which measure the strength of the cointegrating vectors in the VEC model. Attention focuses on the long-run parameter matrix Π. The Johansen (1988, 1991) approach estimates the long-run or cointegrating relationships between the non-stationary variables using a maximum likelihood procedure which tests for the cointegrating rank r and estimates the parameters β of these cointegrating relationships. As proved in Johansen (1991, 1992b), the intercept terms in the VEC model should be associated with the existence of a deterministic linear time trend in the data. If, however, the data do not contain a time trend, the VEC model should include a restricted intercept term associated to the cointegrating vectors.

The VEC model describes how the system adjusts in each time period towards its long-run equilibrium state. Since the variables are supposed to be cointegrated, deviations in the short-term, from the long-run equilibrium will feed back on the changes in the dependent variables in order to force their movements towards the long-run equilibrium state. Hence the cointegrating vectors from which the error-correction terms are derived are each indicating an independent direction where a stable, meaningful long-run equilibrium state exists. The coefficients of the error-correction terms, however, represent the proportion by which the long-run disequilibrium in the dependent variables is corrected in each short-term period.

4. Empirical results

4.1. Descriptive statistics

The descriptive statistics of the six variables (*which include the five independent variables and the NIFTY*) are reported in Table 2. Table 2 shows no major discrepancies, meaning that the selected six variables are consistent with conventional research norms.

4.2. Optimal lag length selection

In selecting the optimal lag length for our analysis, the research has conducted the necessary tests using EViews 5, as presented in Tables 3 and 4. The results of the correlogram in Tables 2 and 3 indicate that the appropriate lag length is two, while the lag length selection test statistics of LR, FPE, SBC and

Table 2: Descriptive statistics

Parameters	LNNIFTY	LNIP	LNM3	LNINT	LNCPI	LNEXRATE
Mean	8.551941	5.188535	14.22532	2.124889	5.107389	3.765406
Median	8.355753	5.147783	14.2343	2.055653	5.090367	3.783763
Maximum	9.894814	5.719984	15.20347	2.623811	5.41832	3.891755
Minimum	5.960859	4.822698	13.31999	1.571008	4.817856	3.536602
Std. Dev.	0.537707	0.22559	0.526554	0.304738	0.16726	0.094746
Skewness	1.03695	0.383945	-0.000636	-0.030818	0.038067	-0.91074
Kurtosis	2.847213	2.167705	1.930354	1.823969	1.822499	2.853989
Jarque-Bera	25.94644	5.694218	6.864869	8.321087	8.353833	20.03467
Probability	0.000002	0.021341	0.032308	0.015599	0.015346	0.000045
Sum	1231.479	745.149	2048.446	305.984	735.4639	542.2185
Sum Sq. Dev.	41.3455	5.277388	39.6481	13.27972	4.000537	1.283693
Observations	144	144	144	144	144	144

HQ in Tables 3 & 4 clearly suggest that a lag of one period is the optimal lag length. Although the AIC and correlogram criteria suggested differently, the other tests suggested that a lag of one month is appropriate. The available literature also suggests that optimal length with such type of studies can be considered as one. Accordingly, the study takes the lag length as one in the model for analysis.

4.3. Unit toot test for stationary data series

In econometric analysis if two or more stock market price indices are found to be *cointegrated*, it implies that there is a long-run equilibrium relationship between them or that they will move very strongly together eventually. In econometric time series analysis, a stationary series has time independent mean, variance, and autocorrelation that are

Table 3: Correlogramme of variables

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>.|*** |</td><td>.|*** |</td><td>1</td><td>0.359</td><td>0.359</td><td>16.891</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|* |</td><td>2</td><td>0.223</td><td>0.108</td><td>23.464</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>*|. |</td><td>3</td><td>0.017</td><td>-0.109</td><td>23.501</td><td>0.000</td></tr>
<tr><td>**|. |</td><td>***|. |</td><td>4</td><td>-0.280</td><td>-0.328</td><td>34.046</td><td>0.000</td></tr>
<tr><td>***|. |</td><td>**|. |</td><td>5</td><td>-0.350</td><td>-0.201</td><td>50.646</td><td>0.000</td></tr>
<tr><td>***|. |</td><td>*|. |</td><td>6</td><td>-0.340</td><td>-0.102</td><td>66.371</td><td>0.000</td></tr>
<tr><td>***|. |</td><td>*|. |</td><td>7</td><td>-0.344</td><td>-0.171</td><td>82.606</td><td>0.000</td></tr>
<tr><td>**|. |</td><td>**|. |</td><td>8</td><td>-0.265</td><td>-0.205</td><td>92.366</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>9</td><td>-0.001</td><td>0.046</td><td>92.366</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|* |</td><td>10</td><td>0.187</td><td>0.132</td><td>95.288</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>11</td><td>0.270</td><td>0.023</td><td>105.66</td><td>0.000</td></tr>
<tr><td>.|***** |</td><td>.|**** |</td><td>12</td><td>0.694</td><td>0.554</td><td>176.69</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>**|. |</td><td>13</td><td>0.253</td><td>-0.229</td><td>185.98</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>*|. |</td><td>14</td><td>0.103</td><td>-0.179</td><td>185.53</td><td>0.000</td></tr>
<tr><td>*|. |</td><td>*|. |</td><td>15</td><td>-0.073</td><td>-0.121</td><td>188.31</td><td>0.000</td></tr>
<tr><td>**|. |</td><td>.|. |</td><td>16</td><td>-0.300</td><td>-0.000</td><td>201.70</td><td>0.000</td></tr>
<tr><td>***|. |</td><td>*|. |</td><td>17</td><td>-0.368</td><td>-0.066</td><td>222.01</td><td>0.000</td></tr>
<tr><td>**|. |</td><td>.|. |</td><td>18</td><td>-0.306</td><td>0.014</td><td>236.14</td><td>0.000</td></tr>
<tr><td>**|. |</td><td>*|. |</td><td>19</td><td>-0.304</td><td>-0.061</td><td>250.29</td><td>0.000</td></tr>
<tr><td>*|. |</td><td>.|. |</td><td>20</td><td>-0.172</td><td>0.062</td><td>254.86</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>*|. |</td><td>21</td><td>0.018</td><td>-0.086</td><td>254.91</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|. |</td><td>22</td><td>0.189</td><td>-0.032</td><td>260.54</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>23</td><td>0.258</td><td>0.003</td><td>271.07</td><td>0.000</td></tr>
<tr><td>.|**** |</td><td>.|. |</td><td>24</td><td>0.538</td><td>0.041</td><td>315.36</td><td>0.000</td></tr>
<tr><td>.|** |</td><td>.|. |</td><td>25</td><td>0.210</td><td>-0.052</td><td>324.51</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|. |</td><td>26</td><td>0.081</td><td>0.028</td><td>325.59</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>27</td><td>-0.053</td><td>0.056</td><td>326.07</td><td>0.000</td></tr>
<tr><td>**|. |</td><td>.|* |</td><td>28</td><td>-0.205</td><td>0.108</td><td>333.08</td><td>0.000</td></tr>
<tr><td>**|. |</td><td>.|. |</td><td>29</td><td>-0.269</td><td>0.030</td><td>345.20</td><td>0.000</td></tr>
<tr><td>**|. |</td><td>.|. |</td><td>30</td><td>-0.222</td><td>-0.039</td><td>353.55</td><td>0.000</td></tr>
<tr><td>*|. |</td><td>.|* |</td><td>31</td><td>-0.177</td><td>0.113</td><td>358.91</td><td>0.000</td></tr>
<tr><td>*|. |</td><td>.|. |</td><td>32</td><td>-0.097</td><td>-0.043</td><td>360.53</td><td>0.000</td></tr>
<tr><td>.|. |</td><td>.|. |</td><td>33</td><td>0.035</td><td>-0.036</td><td>360.74</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>*|. |</td><td>34</td><td>0.139</td><td>-0.093</td><td>364.14</td><td>0.000</td></tr>
<tr><td>.|* |</td><td>.|. |</td><td>35</td><td>0.180</td><td>0.003</td><td>369.95</td><td>0.000</td></tr>
<tr><td>.|*** |</td><td>.|. |</td><td>36</td><td>0.368</td><td>-0.009</td><td>394.39</td><td>0.000</td></tr>
</table>

Table 4: Var lag order selection criteria

Endogenous variables: LNNIFTY LNINDPROD LNEXRATE INTRATE LNCPI LNM3				
Lag	**LogL**	**LR**	**FPE**	**AIC**
0	558.1279	NA	5.08e-12	-8.977689
1	1654.114	2065.225	1.66e-19	-26.21323
2	1698.783	79.89674	1.45e-19*	-26.35420
3	1725.393	44.99822	1.71e-19	-26.20151
4	1772.016	74.29326	1.47e-19	-26.37424
5	1801.628	44.29747	1.68e-19	-26.27037
6	1826.706	35.06892	2.10e-19	-26.09278
7	1873.173	60.44465	1.90e-19	-26.26297
8	1923.700	60.79661*	1.65e-19	-26.49918*
* indicates lag order selected by the criterion				

constant through time. The major problem associated with regression of non-stationary variables are the 'spurious regressions' resulting from the non-stationary of a particular time series. To avoid the problem of spurious regressions, it is necessary to test the order of integration of each variable in time series analyses. For examining the stationary property of stock prices linkage among the sampled Asian stock markets and the US market, both the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit-root tests were employed. These are presented in Table 5. The test results reported in Table 5 are compared against the MacKinnon (1990) critical values for rejection of the null hypothesis of no unit root. It clearly suggests that all of the seven series are integrated to order one *I*(1) in levels and are of order zero *I*(0) in first differences, meaning that they are nonstationary in levels and stationary in first differences.

4.4. Cointegration analysis

For the cointegration analysis, the study considered a vector autoregressive (VAR) model, which has a constant (but no trend) as exogenous. In view of the previously identified lag length one as the order of the VAR, The study has employed Eviews 5 to perform the analysis following Johansen (1991). Accordingly, the study has performed a likelihood ratio (LR) test, the maximum Eigen value test and the trace test for the cointegration analysis. The cointegration results along with test statistics are presented in Table 6.

It is evident from the results in Table 6 that the study can reject the null hypothesis of r=0 against the alternative r=1 from the λ_{max} test. The same outcome is achieved from the λ_{trace} test, which has rejected r=0 against $r \geq 1$. The study has ascertained that in its model only one stationary linear combination of variables is cointegrated in the long-run. Coefficients of the cointegrating equation (B) in Table are normalized by $\beta_{11}\ S_{11}\ \beta_{11} = I$, as an identification process of the Johansen (1995) procedure, since the long-run multiplier matrix Π_y does not generally lead to a unique choice for the cointegrating relations. The identification of β in $\Pi_y = \acute{\alpha}_y \beta'$ requires at least r restrictions per cointegrating relation (r). As The study has found that r =1, one restriction should be enough to identify the cointegrating relationship which is the normalizing restriction applied to the LNNIFTY variable. LNNIFTY is considered as the cointegrating equation, because it is the vector that contains the maximum Eigen value.

Although the normalization is convenient from the mathematical point of view, it may not always be meaningful otherwise. It has an advantage because such normalization is made without assuming anything about which variables are cointegrated, that is, it serves the purpose without normalizing β. It appears from the likelihood ratio (LR) test results of restrictions concerning each variable in equation (B) of Table 6 that the study can reject the null hypothesis of no significance (β does not significantly differ from zero) in relation to four macroeconomic variables, including Industrial exchange rate (LNEXRATE) interest rate (LNINTRATE), money supply (LNM3) and exchange rate (LNEXRATE) at the 5% level of significance. From these results, the study can see that on the basis of LR test statistics only one *variable* (inflation) has significant long-run influence on Indian stock price movements or returns. The results therefore suggest that although the linear combination of all four variables of our model are found cointegrated, not all variables are equally influential. The only significantly

Table 5: Unit root test results

Variables	Augmented Dickey Fuller (ADF) Test			Phillips Perron Test (PP)		
	Intercept No Trend	Intercept with Trend	No Intercept No Trend	Intercept No Trend	Intercept with Trend	No intercept No Trend
	Model A	Model B	Model C	Model A	Model B	Model C
At Levels						
LNNIFTY	0.5518	-1.2001	1.7303	0.5518	-0.2001	1.5825
LNINDPROD	2.6160	2.0805	1.0977	0.0235	-0.2669	1.2086
LNEXRATE	-2.3598	-1.1873	1.2903	-2.7025	-0.2898	1.5744
INTRATE	-1.8150	-0.6768	-1.8697	-1.8411	-0.5839	-0.9778
LNCPI	-0.3519	-3.0923	1.1065	-0.3758	-0.2661	1.4213
LNM3	0.3460	-1.8365	1.1872	0.7215	-0.8259	1.0848
At 1 Difference						
? LNNIFTY	-9.2608	-9.3921	-9.1401	-9.2917	-0.4063	-0.1401
? LNINDPROD	-3.1567	-4.0584	-2.2665	-34.9869	-3.2883	-8.5943
? LNEXRATE	-8.3789	-8.7853	-8.2461	-8.3723	-0.2898	1.5744
INTRATE	-10.7910	-9.6169	-10.6879	-10.7838	-0.9791	-0.6656
? LNCPI	-8.7274	-8.6939	-6.4593	-9.4933	-0.4006	-0.3755
? LNM3	-3.1415	-4.0091	2.0031	-9.5964	-5.58401	-0.3432

Note: MacKinnon Critical values at level: for model A. -2.9851; model B. -3.469; model C. -1.9439, and at 1st difference: for model A. -2.8955; model B. -3.4626; model C. -1.9445

Table 6: Cointegration test results

Hypothesized No. of CE(s)	Test Statistics	Critical Value		*Eigen value*
		5%	1%	
A. Cointegration Test				
Test Statistics : *Unrestricted Cointegration Rank Test (Maximum Eigenvalue)*				
Maximum Eigenvalue (λ_{max})				
None *	71.3554	36.6302	0.0000	*0.4835*
At most 1 *	60.1985	30.4396	0.0000	*0.4273*
At most 2	26.4040	24.1592	0.0245	*0.2169*
At most 3	15.3824	15.7973	0.1113	*0.1328*
At most 4	4.2341	11.2248	0.5914	*0.0384*
At most 5	0.0070	4.1299	0.9454	*0.0001*
Test Statistics : *Unrestricted Cointegration Rank Test (Trace)*				
Trace (λ_{max})				
None *	175.5813	83.9371	0.0000	*0.4835*
At most 1 *	106.2259	60.0614	0.0000	*0.4273*
At most 2 *	46.0274	40.1749	0.0116	*0.2169*
At most 3 *	19.6234	24.2760	0.1728	*0.1328*
At most 4	4.2411	12.3209	0.6760	*0.0384*
At most 5	0.0070	4.1299	0.9454	*0.0001*

The long run equation

LNNIFTY = 9.84 LNINDPROD $_{(-3.210)}$ -5.63 LNM3 $_{(-2.816)}$ – 1.29 LN INT$_{(-0.4247)}$ + 5.97 LNCPI $_{(-4.628)}$ + 6.17 LNEXRATE $_{(1.950)}$

Or

LNNIFTY - 9.84 LNINDPROD $_{(-3.210)}$ + 5.63 LNM3$_{(-2.816)}$ + 1.29 LNINT$_{(-0.4247)}$ - 5.97 LNCPI $_{(-4.628)}$ - 6.17 LNEXRATE $_{(1.950)}$ = 0

r = number of cointegrating vectors

(a) Optimal lag structure is 1 and the VAR contains a constant without trend and breakpoint dummy as exogenous to the model.

(b) The cointegrating vector is normalized on the Indian stock price index (LNNIFTY).

(c) The LR test statistics, given in parentheses, are used to test the null hypothesis that each coefficient is statistically zero. The test statistic is asymptotically distributed as a chi-square distribution with 1 degree of freedom. The critical values of chi-square distribution at 5% and 10% significance levels are 3.841 and 2.706 respectively.

Table 7: Multivariate dynamic time series (Short-run) models

LHS VARIA BLE: ?LNNIFTY	Coefficient	Standard Error	t-statistics (Probability)
D(LNNIFTY(-1))	0.090483	-0.10865	0.83283
D(LNIP(-1))	0.166668	-0.18583	0.89689
D(LNM3(-1))	-0.14999	-0.65784	-0.22801
D(LNGSEC(-1))	-0.007194	-0.04792	-0.15013
D(LNCPI(-1))	0.118967	-0.6686	0.17794
D(LNEXRATE(-1))	0.001282	-0.00606	0.21145
ECM-1	0.001282	-0.10865	0.83283
LHS VARIABLE: ?LNIP			
D(LNNIFTY(-1))	0.047439	-0.06049	0.78420
D(LNIP(-1))	-0.517605	-0.12402	-4.17340
D(LNM3(-1))	-0.776875	-0.34523	-2.25029
D(LNGSEC(-1))	0.053452	-0.08745	0.61124
D(LNCPI(-1))	-1.710502	-0.71966	-2.37681
D(LNEXRATE(-1))	0.242711	-0.34074	0.71230
ECM-1	0.008285	-0.00417	1.98528
LHS VARIABLE: ?LNM3			
D(LNNIFTY(-1))	-0.033929	-0.01491	-2.27612
D(LNIP(-1))	-0.104285	-0.03056	-3.41224
D(LNM3(-1))	-0.101421	-0.08507	-1.19218
D(LNGSEC(-1))	0.001639	-0.02155	0.07608
D(LNCPI(-1))	-0.164754	-0.17734	-0.92904
D(LNEXRATE(-1))	0.026549	-0.08397	0.31619
ECM-1	0.006289	-0.00085	5.44176
LHS VARIABLE: ?LNINT			
D(LNNIFTY(-1))	0.072117	-0.06093	1.18354
D(LNIP(-1))	-0.233067	-0.12493	-1.86562
D(LNM3(-1))	-0.36894	-0.34774	-1.06095
D(LNGSEC(-1))	0.006626	-0.08809	0.07522
D(LNCPI(-1))	0.265793	-0.7249	0.36666
D(LNEXRATE(-1))	0.900477	-0.34322	2.62359
ECM-1	0.01227	-0.01257	0.9762
LHS VARIABLE: ?LNCPI			
D(LNNIFTY(-1))	0.011252	-0.00778	1.44638
D(LNIP(-1))	-0.027559	-0.01595	-1.72786
D(LNM3(-1))	0.079771	-0.0444	1.79676
D(LNGSEC(-1))	0.006318	-0.01125	0.56177
D(LNCPI(-1))	0.324975	-0.09255	3.51140
D(LNEXRATE(-1))	0.160314	-0.04382	3.65850
ECM-1	0.000741	-0.00046	1.59938
LHS VARIABLE: ?LNEXRATE			
D(LNNIFTY(-1))	-0.000118	-0.0167	-0.00704
D(LNIP(-1))	-0.049253	-0.03425	-1.43812
D(LNM3(-1))	-0.006001	-0.09533	-0.06295
D(LNGSEC(-1))	-0.029169	-0.02415	-1.20790
D(LNCPI(-1))	-0.033901	-0.19873	-0.17059
D(LNEXRATE(-1))	0.377619	-0.09409	4.01323
ECM-1	-0.0000955	-0.00095	-0.10071

Note: Critical values for t-statistics (2-sided test) are 1.64, 1.96 and 1.58 at10%, 5% and 1% significance levels, respectively influential macroeconomic variable in the long-run cointegrating relationship for the Indian stock market is the Inflation (LNCPI). But at 10% level of significance industrial production and money supply also have significant long run influence on Indian stock returns. Results of dynamic time series models and their corresponding error correction mechanisms (ECM -1) are presented in Table 7.

The identified long-run cointegrating relation amongst five variables in this study from the perspective of the Indian stock market is plotted in Figure 1.

Taking ΔLNNIFTY as the left hand side variable in the short-run model in Table 7 (which may be thought as the dependent variable in structural time series), it may be suggested that the Indian stock market is not very dynamic and has not been continually corrected from its own disequilibrium of the previous month. The speed of correction from previous month is .090 % and the t statistics suggests that it is not very significant. All individual variables contribute to the process of adjustment for equilibrium. The money supply and industrial production and the previous performance of Indian market itself (ΔLNNIFTY) are also found tobe significant in the dynamic adjustment process, and also the error correction mechanism (ECM_{-1}) is very efficient. The exchange rate (LNEXRATE) and inflation (LNCPI) are found to significantly contribute towards long-run equilibrium, as their related error correction mechanisms are significant.

From another angle, coefficients of our long-run parameter β' upon normalization for LNNIFTY are 1, 9.84, -5.63, -1.29, 5.97 and 6.17 for LNNIFTY, LNINDPROD, LNM3, LNINT, LNCPI and LNEXRATE respectively. Resulted corresponding *t*-statistics are -3.210, -2.816, -0.4247, -4.628 and 1.950. Thus, our estimated values are normalized.

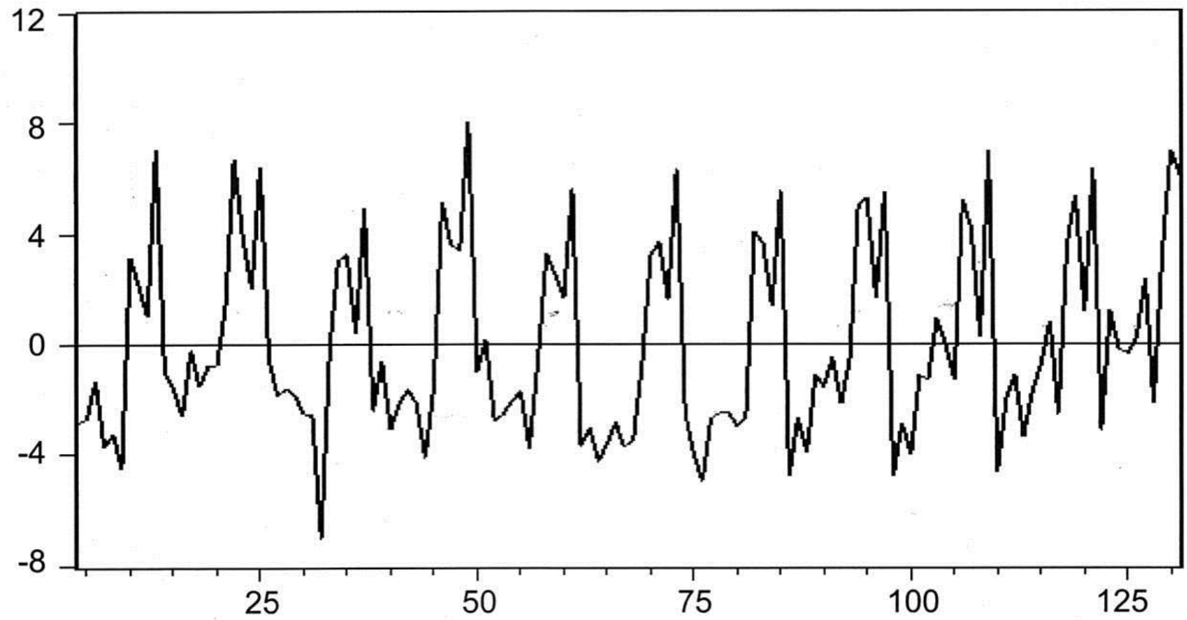
$$\boldsymbol{\beta}_{NIFTY} = (\beta_{11}, \beta_{21}, \beta_{31}, \beta_{41}, \beta_{51}, \beta_{61}) = (1.00, 9.84, -5.63, -1.29, 5.97, 6.17) \quad (5)$$

This suggests that the inflation (LNCPI) variable is more significant in the long-run cointegrating relationship for India as it is significant when compared with the critical value for the *LR*-statistic (3.841) at the 5% significance level. But industrial production and money supply variables are also significant at 10% level of significance. The short-run dynamic system provided us with coefficients of corresponding to ΔLNNIFTY, ΔLNINDPROD, ΔLNM3, ΔLNINT, ΔLNCPI and ΔLNEXRATE. The coefficients of $\acute{\alpha}$ in respective order are 0.001282, 0.008285, 0.006289, 0.01227, 0.000741, -0.0000955. Corresponding *t*-values for $\acute{\alpha}$ are 0.21145, 1.98528, 5.44176, 0.9762, 1.59938, -0.10071 respectively. This information can be presented as:

$$\boldsymbol{\alpha}_{NIFTY} = (\alpha_{11}, \alpha_{21}, \alpha_{31}, \alpha_{41}, \alpha_{51}, \alpha_{61}) = (0.0013, 0.0083, 0.0063, 0.0123, 0.0007, -0.0001) \quad (6)$$

Wherein the ECM-1 for the LNNIFTY is $\alpha_{NIFTY} = \alpha_{11} = 0.0013$, which is the adjustment parameter in the cointegrating equation for India. The *t*-statistic in parentheses corresponding to $\acute{\alpha}_{11}$ indicates that ECM-1 for LNNIFTY is not very significant and the linear combination of all variables is found

Fig. 1: Cointegrating relationship of Indian stock market and priori variables



cointegrated. This might mean that the Indian stock market is not efficient in terms of its auto correction. The study has obtained the estimates of the short-run parameters for the Indian market ΔLNNIFTY as 0.090483, -0.166668, -0.14999, -0.007194, 3.1325 and 0.118967 for $\Delta LNNIFTY_{-1}$, $\Delta LNINDPROD_{-1}$, $\Delta LNM3_{-1}$, $\Delta LNINT_{-1}$, $\Delta LNCPI_{-1}$ and $\Delta LNEXRATE_{-1}$ respectively. The corresponding *t*-statistics for ΔLNNIFTY are 0.83283 0.89689-0.22801-0.150130.17794. This suggests that in the process of the short-run adjustment for the Indian stock market, $\Delta LNNIFTY_{(-1)}$, $\Delta LNINDPROD_{(-1)}$, $\Delta LNEXRATE_{(-1)}$, ΔLNINTRATE (-1), and ΔLNCPI (-1) are not significant at 5% level. This means that Indian stock market prices are being adjusted each month dominantly by the influences of the market's own performance. The study thus presents the short-run estimated parameter ΔLNNIFTY as:

$$\Delta LNNIFTY = (0.09, 0.17, -0.15, -0.01, -3.13, 0.12) \quad (7)$$

Based on the above results, the study presents the estimated model (VECM) for India in equations 8.1 and 8.2. Our estimated model takes the following shape:

$$\Delta LNNIFTY_t = -0.0013*[1*LNNIFTY_{-1} - 9.84*LNINDPROD_{-1} + 5.63*LNM3_{-1} + 1.29*LNINT_{-1} - 5.97*LNCPI_{-1} \; -6.17*LNEXRATE_{-1}] - [0..09*\Delta LNNIFTY_{-1} + .17*\Delta LNINDPROD_{-1} -.15*\Delta LNM3_{-1} - 0..01*\Delta LNINT_{-1} \; _{-}3.13*\Delta LNCPI_{-1} + 0.12*\Delta LNEXRATE_{-1}] \; (8.1)$$

Or

$$\Delta LNNIFTY_t = -0.0013*LNNIFTY_{-1} - 0.0127*LNINDPROD_{-1} - 0.0099*LNM3_{-1} - 0.0017*LNINT_{-1} + 0.0077*LNCPI_{-1} + .008*LNEXRATE_{-1} - 0.14043*\Delta LNNIFTY_{-1} - .41922*\Delta LNINDPROD_{-1} + .08495*\Delta LNM3_{-1} + 0.13062*\Delta LNINT_{-1} + .80672*\Delta LNCPI_{-1} - 0.43205*\Delta LNEXRATE_{-1}$$

In the long-run equilibrium, the second part of the above model would not exist; therefore, our solved model in reduced form is as follows:

$$\Delta LNNIFTY_t = -0.0013*LNNIFTY_{-1} - 0.0127*LNINDPROD_{-1} - 0.0099*LNM3_{-1} - 0.0017*LNINT_{-1} + 0.0077*LNCPI_{-1} + .008*LNEXRATE_{-1}$$

These results are interesting and useful in understanding the Indian stock market pricing mechanism as well as its return generating process. The cointegrating analysis presented in above equation shows that three out of five variables are cointegrated in the long-run, and these variables are influential in the pricing process. These variables are *Industrial Production (LNINDPROD), Inflation (LNCPI) and Money Supply (LNM3)*,

5. Findings and conclusion

The results of this analysis should not be treated as conclusive for an investment. Apart from understanding Indian stock market pricing based on the contributions of the significant variables, there remain other important issues that affect the return generating process. These issues are the cost of equity capital, asset valuation, industry analysis, a firm's management and operational efficiency analysis, and so on. Any investor should consider all relevant sources of information when making an investment decision. Even within the arena of systematic risk analysis for assets, one should identify both business and financial risks and analyze them while selecting a stock in their portfolio for investment. The business risk of a firm depends on the systematic risk of a firm's assets. The greater a firm's business risk, the greater the firm's cost of equity. The other component in the cost of equity is determined by a firm's financial structure, which also needs assessment while selecting stocks for an investment portfolio. The extra risk that arises from the use of debt financing is called the financial risk of a firm's equity. The well-known propositions of Franco Modigliani and Merton Mills are useful in analyzing the value of a firm as well as its cost of equity. Their first proposition is that the value of a firm is independent of a firm's capital structure, while their second proposition states that the cost of equity depends on the required rate of return on a firm's assets, its firm's cost of debt, and its firm's debt equity ratio. When investigating portfolio investment, an investor should analyze two types of risks, the total systematic risk of the firm's equity consisting of business risk, and financial risk (Ross, et. al. (1998)). It is more useful for the purposes of investment to know that the linear combination of modeled variables contains a relationship. The variables are cointegrated and the sampled variables explain the price movements as well as the return generating process of the Indian stock market in both the long- and short-runs. These results are interesting and useful in understanding the Indian stock market pricing mechanism as well as its return generating process. These variables are Industrial Production (LNINDPROD), Inflation (LNCPI) and Money Supply (LNM3),. The study observes that out of five factors three are more significant and likely to influence the stock market more than other factors. These factors are industrial production, Inflation (CPI) and money supply. The study suggests that these factors are likely to influence the long term pricing mechanism of the Indian stock market.

References

Chen, N. F.; Roll, R. and Ross, S. A., 1986. Economic forces and the stock market, *Journal of Business*, vol. 59(3), pp. 383-403.

Darrat, A.F. and T.K. Mukherjee, 1987, The Behavior of the Stock Market in a Developing Economy, *Economics Letters* 22, 273-278.

Dickey, D. A. and Fuller, W. A., 1979. Distribution of Estimators for Autoregressive Time Series Regression with a Unit Root, *Journal of the American Statistical Association*, vol. 74, pp. 423-431.

Dickey, D. A. and Fuller, W.A., 1981. Likelihood ratio statistics for autoregressive time-series with a unit-root, *Econometrica*, vol. 49, pp. 1057-1072.

Engle, R. F. and Granger, C. W. J., 1987. Co-integration and Error Correction: Representation, Estimation and Testing, *Econometrica*, vol. 55(2), pp. 251-276.

Fama, E. F. and French, K. R., 1992. The economic fundamentals of size and book-to-market equity, *Working Paper*, Graduate School of Business, University of Chicago, Chicago, IL, USA.

Granger, C. W. J., 1969. Investigating Causal Relations by Econometric Models and Cross-Spectra. Methods, *Econometrica*, vol. 37(3), pp. 424-438.

Johansen, S. and Juselius, K., 1990. Maximum likelihood estimation and inference on cointegration with application to the demand for money, *Oxford Bulletin of Economics and Statistics*, vol. 52, pp. 169-210.

Johansen, S. and Juselius, K., 1991. Some structural hypotheses in a multivariate cointegration analysis of the purchasing power parity and uncovered interest parity for UK, *Manuscript* for the Journal of Econometrics.

Johansen, S. and Juselius, K., 1992. Testing structural hypotheses in a multivariate cointegration analysis of the PPP and UIP for UK, *Journal of Econometrics*, vol. 53, pp. 211-244.

Johansen, S. and Juselius, K., 1994. Identification of the long-run and short-run structure: An application to the IS/LM model, *Journal of Econometrics*, vol. 63, pp. 7-36.

Johansen, S. and Lando, D., 1996. *Multi-period models as cointegration models*, University of Copenhagen.

Johansen, S. and Schaumberg, E., 1999. Likelihood analysis of seasonal cointegration, *Journal of Econometrics*, vol. 88, pp. 301-339.

Johansen, S. and Swensen, A. R., 1999. Testing some exact rational expectations in vector autoregressive models, *Journal of Econometrics*, vol. 93, pp. 73-91.

Johansen, S., 1988. Statistical analysis of cointegration vectors, *Journal of Economic Dynamics and Control*, vol. 12, pp. 231-254.

Johansen, S., 1988a. The mathematical structure of error correction models, *Contemporary Mathematics*, vol. 80, pp. 259-386.

Johansen, S., 1990. A representation of vector autoregressive processes integrated of order 2, *Manuscript* for the Journal of Econometric Theory.

Johansen, S., 1991. Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models, *Econometrica*, vol. 59(6), pp. 1551-1580.

Johansen, S., 1991a. The Power Function for the Likelihood Ratio Test for Cointegration, In: Gruber, J., Ed., *Economic Decision Models: New Methods of Modeling and Application.*

Johansen, S., 1991b. The statistical analysis of *I*(2) variables, *Discussion Paper*, University of Copenhagen.

Johansen, S., 1992. Determination of cointegration rank in the presence of a linear trend, *Oxford Bulletin of Economics and Statistics*, vol. 54(3), pp. 383-397.

Johansen, S., 1992a. Cointegration in partial system and the efficiency of single equation analysis, *Journal of Econometrics*, vol. 52, pp. 389-402.

Johansen, S., 1994. The role of the constant and linear terms in cointegration analysis of nonstationary time series, *EconometricReviews*, vol. 13, pp. 205-231.

Johansen, S., 1995. *Likelihood-based Inference in Cointegrated Vector Autoregressive Models*, Oxford University Press, Oxford.

Johansen, S., 1995a. Identifying Restrictions of Linear Equations with Applications to Simultaneous Equations and Cointegration, *Journal of Econometrics*, vol. 69, pp. 111-132.

Johansen, S., 1996. *Likelihood based inference in Cointegrated Vector Autoregressive Models*, Oxford University Press, Oxford.

Johansen, S., 2000. Modelling of cointegration in the vector autoregressive model, *Economic Modelling*, vol. 17, pp. 359-373.

McMillan, D. G., 2001. Cointegration Relationships between Stock Market Indices and Economic Activity: Evidence from US Data, *Discussion Paper*, Issue No. 0104, Centre for Research into Industry, Enterprise, Finance and the Firm (CRIEFF), University of St. Andrews, Scotland.

Mossin, J., 1966. Equilibrium in a capital asset market, *Econometrica*, vol. 34 (4), pp. 768-783.

Mukharjee, T. K. and Naka, A., 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 (2), pp. 223-237.

Naka, Atsuyuki & Mukherjee, Tarun K. & Tufte, David R., 1998. "Macroeconomic variables and the performance of the Indian Stock Market," Working Papers 1998-06, University of New Orleans, Department of Economics and Finance.

Panda, C. and Kamaiah, B., "Monetary policy, Expected Wholesale price index, real Activity and Stock Returns in India: An Empirical Analysis", *Asian – African Journal of Economics and Econometrics*, Vol. 1, 2001, 191-200.

Pethe, A., and Karnik, A., "Do Indian Stock Markets Matter? Stock Market Indices and Macro-Economic Variables", *Economic and Political Weekly*, Vol. 35, 2000, 349-356.

Ross, S. A., 1976. The arbitrage theory of capital asset pricing, *Journal of Economic Theory*, vol. 13, pp. 341-360.

Sharma, J.L. and R.E. Kennedy (1977), "Comparative analysis of stock price behavior on the Bombay, London & New York Stock Exchanges", JFQA, Sept 1977, pp. 391-403.

Sharpe, W. F., 1964. Capital asset prices: A theory of market equilibrium under conditions of risk, *Journal of Finance*, vol. 19(3), pp. 425-442.