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INDIAN STOCK MARKET: A TEST OF A SEMI-STRONG FORM OF EFFICIENCY

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Abstract

This paper attempts to test the stock market efficiency (in a semi-strong form) by investigating the relationship between aggregate stock returns and a number of important macro variables including fiscal and monetary policy actions using the VAR methodology This exercise is carried out using a set of Indian monthly data spanning over 1990:01-1998:12. Based on the Impulse Response Functions and the Runkle-style confidence bands, the findings of the study support that the Indian stock market is efficient with regard to the monetary and fiscal policy variables.

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I. Introduction:

Movements in stock prices in general are believed to reflect the performance of the economy. For the policy makers. stock prices act as a feedback for the efficacy of the policy measures announced from time to time. In order that the feedback mechanism be effective, it is necessary that the stock market be an efficient processor of information. Stock market efficiency implies that stock prices fully and rapidly absorb all publicly available information (PAI) and reflect the same on its prices. Broadly speaking, the PAI set pertaining to stock/equities consists of past and contemporaneous information about the movements of stock prices and discontinuous sequence of monetary, fiscal and other important macro policy measures as well. The present study attempts to test the stock market efficiency (in a semi-strong form) by investigating the relationship between aggregate stock returns and a number of important macro variables including fiscal and monetary policy actions in India.

A number of single equation models have been available to explain the intricate relationship between the movements of stock prices and macro economic variables (see Amanulla *et al*, 1996). The underlying assumption of a unidirectional causality in a single equation framework may seem quite restrictive in typical situations of the kind wherein the macro policy variables and the stock market tend to have a feedback. Even simultaneous equation models may not entirely solve the problem as the implied exclusion restriction proves equally restrictive. In this context, Vector Auto Regressions (VARs) seem to be appropriate as they have a built-in generality in the model (see Ali and Hasan, 1993), and provide 'efficient' estimates in comparison to the classical regression framework. Keeping this rationale in mind, and also noting the fact that there is no such study to date in the Indian context, the present study intends to verify the stock market efficiency using the VAR framework.

The study is based on monthly data spanning from 1990:01 to 1998:12, which coincides with the period of liberalisation. This period marks the beginning of a massive privatisation drive and deregulation of the financial sector on a large scale to globalise the economy. All these changes tactically shifted the public eye to the stock market. This resulted in a boom in the stock market, which was short-lived. This period also witnessed the country's biggest stock scam. During this period of nine years, several Prime Ministers have ruled the country, signifying the extent of political instability. Since political stability is considered to be a pre-requisite for an efficient functioning of the stock market, the sample period assumes considerable importance.

While analysing the efficiency of the stock market where stock prices are calculated on a daily basis, the monthly data seems relevant. It is possible that the fiscal and monetary policy effects may be relevant in the extended quarterly period stock returns, but when monthly data are used, these effects will also be captured.

The rest of the paper is organized as follows. The methodology of the paper is discussed in Section II. Section III presents the empirical analysis. In section IV the results are presented. The concluding remarks appear in Section V.

II. Methodology

By the very construction, a VAR system consists of a set of variables, each of which is related to lags of itself and of all other variables in the system. In other words, a VAR system consists of a set of regression equations each of which has an adjustment mechanism such that even small changes in one variable component in the system may be accounted for automatically by possible adjustments in the rest of the variables in the system. Thus VARs provide a fairly unrestrictive approximation to a reduced form structural model without assuming beforehand any of the variables as exogenous. Thus, by avoiding the imposition of *a priori* restrictions on the model, the VARs add significantly to the flexibility of the model. Furthermore, by incorporating the lagged terms of the variables, the VARs become useful in capturing the empirical regularities embedded in the data, which consequently facilitate deeper insights into the channels through which the fiscal, monetary and other important macro policy variables percolate the system to influence the stock returns.

To start with, the VAR estimation procedure requires the selection of variables to be included in the system. Although a VAR system is *atheoretical* in nature, the choice of variables that constitute it cannot be arbitrary. The variables included in the model should fairly account for and explain the link between the real and financial sides of the economy. Since the present study deals with the Indian economy, the model formulated should be governed by considerations of major macro-economic variables affecting the Indian stock prices within the framework of a developing economy seriously pursuing the process of liberalisation.

In the next step, the lag-length of each of the components in the system is to be fixed, after which the model is estimated. It may be noted that the coefficients obtained from the estimation of the VAR model cannot be interpreted directly. To overcome this problem, Litterman (1979) had suggested the use of Innovation Accounting Techniques, of which impulse response function (IRFs) is one. The IRFs are used to assess the impact of a temporary one standard deviation shock in each of the component variables in the system on the system itself. For computing the IRFs it is essential that the variables in the system must be ordered and the latter represented by a moving average process.

III. Empirical Analysis:

The variables considered in the present study are (i) return of stock prices (RETURN), (ii) stock of real broad money (RM3), (iii) high employment budget deficit (HIGHEMPBD) as a proxy for the fiscal policy measure, (iv) call money rate as a proxy for the short-term interest rate (CALLRATE), (v) index of industrial production (IIP) as a proxy for real gross domestic product, and (vi) wholesale price index (WPI) to account for the general level of prices. These six variables taken together form the VAR system which is formulated in levels of the variables.

In this study the monthly return on stock prices (RETURN) is calculated by taking a percentage change in the BSE sensitive index. The adjustments in RETURN will be the determining factor in testing the efficiency of the Indian stock market. The rate of stock returns is defined as the dividend plus the percentage change in stock prices. Thus, the only difference between stock returns and growth rates of stock prices as Cooper (1974) showed, is the mean of the dividend yield. Granger (1975) has also pointed out that the variance of dividends is almost entirely dominated by stock price changes. As an approximation, the growth rates of stock prices used above are referred to as nominal stock returns.

Theoretically, fiscal policy is supposed to have important effects on the returns of equities (Tobin, 1969, Blanchard, 1981). To account for the fiscal policy measure, we also constructed a series of high-employment budget deficits (HIGHEMPBD). This variable is generated as residuals from regressing actual real budget deficit figures (nominal budget deficit deflated by all India wholesale price index) on a constant and current and one period lagged values of index of industrial production. The estimated HIGHEMPBD series which is used as a proxy for fiscal policy measure is expected to filter out the effects of movements in reported budget deficit figures resulting from changes in business conditions.

The inclusion of WPI in the model is meant to capture the possible indirect effects of HIGHEMPBD on returns via WPI (see Kaul, 1987; Murthy, 1996). For a vastly populated country like India, where still a large segment of the population lives below poverty line, development programmes become imperative. This triggers off the government expenditure, ultimately leading to a large budget deficit. A high budget deficit ratio to GDP would mean higher rate of inflation, eventually depressing the real stock returns.

On the other hand, inclusion of broadly defined real money stock RM3 (nominal M3 deflated by all India whole sale price index) is expected to capture not only the impact of monetary policy on stock returns but also expected to help explain the indirect relationship between inflation and stock returns. With the increase in money stock, if the real side of the economy fails to catch up with increased production, then in the short run prices tend to rise. Assuming that nominal stock returns increase less than proportionately as compared to rise in prices, then increase in price level will have an adverse effect on the real stock returns. Moreover, money stock measure is one of the important tools in the hands of the monetary authority to regulate economy.

Another important variable included in the model is the index of industrial production (IIP) which is expected to serve as a proxy for the real GNP. Because of non-availability of monthly data on real gross domestic production in India, the use of IIP as a proxy became inevitable. The fiscal policy variable (HIGHEMPBD) is expected to influence the IIP, which is an important indicator of the performance of the economy. If the stock prices are sensitive to the economic conditions, then the inclusion of IIP in the model may help to capture the possible indirect effects of the fiscal policy action on the stock returns.

The model also incorporates short-term interest rate, i.e., call money rate. In the Indian context, two variables viz., bank rate and call money rate are generally used for short term interest rates. Further, bank rate is administered in the light of money demand and supply between banks only and hence, it may give only a partial picture of general market movements. However, CALLRATE is a market determined rate based on demand and supply of money in the money market and can represent the general market movements. As Yalawar (1988) also suggested, CALLRATE is better proxy for riskless-rate for the Indian stock market.

Though there is economic information content between stock price-fiscal relation or stock price-monetary relation, the timing of release of data on these variables is also considered to be important to prove these relations empirically. It is expected that information on a particular month is released for all variables such as returns, IIP, fiscal and monetary variables simultaneously. A lag in the release of information on any of the fiscal or monetary variables may provide a spurious stock price relationship empirically. In India, it is possible to get data on all variables on a particular month but the release of IIP and HIGHEMPBD for the specific month is delayed by a few months. Hence, relating RETURNS with IIP and HIGHEMPBD involve an element of arbitrariness. However, this study attempts to relate these variables considering that the auto-regressive terms in the VAR model may possibly account for the delay in release of information.

The data relating to all macro variables are collected from the various issues of *RBI* bulletins. Monthly averages of BSE sensitive index are collected from various issues of the bulletin of Centre for Monitoring Indian Economy (CMIE). The data finally used in the analysis has been de-seasonalised using an additive procedure.

Each of the six data series included in the VAR system was tested individually for the optimum lag lengths using the Akaike Information Content criterion and others[1]. The average lag length for most of the series using different criteria ranged from 4 to 6.

For the VAR system as a whole, we have also experimented with lag lengths ranging from 3 to 8. The likelihood ratio tests for dropping lags confirm that lag 6 is more appropriate for the estimated models and hence the results are presented only for lag 6. A lag of 6 months seems appropriate for an analysis of the stock market where stock prices are calculated on a daily basis. The fact that monetary policies are being revised twice every year in India, a lag of more than 6 months would be misleading. Furthermore, in a bid to deregulate the economy and strengthen the market forces; policy changes have become frequent during the period of this study. Under such circumstances a lag of 6 months is justifiable.

We also tried several orderings of the variables with policy variables appearing first and target variables at the bottom. Since, varying the order did not substantially alter the results, we have reported the results for only one ordering in this paper, which is as follows:

{ HIGHEMPBD, RM3, WPI,
CALLRATE, IIP and RETURN } ...Version 1

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1. The other criterions employed in determining the optimum lag length are Schwarz criterion, LB (Ljung-Box test for serial correlation) criterion, LM (Lagrange Multiplier test for residual serial correlation) criterion and GS (General-to-simple reduction test) criterion.

The implication for such an ordering is that current innovations in HIGHEMPBD can affect the entire system, but a shock in RM3 cannot affect the current period HIGHEMPBD. Similarly, by the assumed ordering a shock in WPI cannot affect the current period HIGHEMPBD and RM3 but affects all the remaining variables in the system. With this logic the variable RETURN has been placed at the end of the ordering with the presumption that current innovation in all variables affects the current period returns whereas innovation in RETURNS cannot affect the current period of any of the variables in the model, except itself.

The above ordering, to some extent is in conformity with the macro economic logic. Assuming that a positive shock is injected to budget deficit, it will force the authorities to pump more money into the economy. A sudden increase in supply of money, in the very short-run will have the dual effect of raising the general level of prices and forcing the short-term interest rate down. Rising prices and low interest rates will promote investment as a result of which IIP will increase. The ultimate effect would be a boom in the stock market resulting in higher returns from stocks.

IV. Findings

In the present study, the effects of fiscal policy, monetary policy and other important macro economic variables on stock returns are examined using the Impulse Response Functions (IRFs) obtained from the moving average representations of the VAR model. In fact, this IRFs will enable to analyse the dynamic behaviour of the stock returns due to unanticipated shocks given to the policy variables[2]. Since IRFs are only point estimates, we have also constructed Runkle-style confidence-bands around these point estimates using the Monte-Carlo simulation technique as described by Doan (1988). If the IRFs of the stock returns (due to a one standard deviation random shock in one of the policy variables) turns out to be significant (insignificant) then the stock market will be deemed inefficient (efficient) with regard to that policy variable. In fact, generating confidence bands[3] around the estimated impulse response coefficients will prove to be a useful device to test the efficiency of the stock market in this context. In other words, if the impulse response of the stock return (RETURN) due to a policy variable (HIGHEMPBD or RM3) overflows the confidence band around the IRF, then the response turns out to be

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2. *It should be noted that before computing the impulse response functions, one should first orthogonalise the innovations. In this paper, we have used BLANCHARD-QUAH (BQ) long-run decomposition method to orthogonalise the variance-covariance matrix of the innovations. This yields impulse responses such that the 1st variable may have long-run effects on all variables in the system, the 2nd may have-long effects on all but the 1st, etc... In BQ decomposition shocks are assigned as "supply" and "demand" shocks, without reference to a variable ordering.*

3. *As the confidence interval, Runkle-style error bands with 95 percentile standard error coverage, are constructed on the impulse responses. In this study, the confidence interval is constructed by 500 Bootstrap draws. This process of placing standard errors on the impulse responses involves bootstrapping of a sequence of residuals of the original VAR, while keeping the timing same across equations, i.e., the residuals from the same time period are used for each variable in the system to preserve contemporaneous correlations.*

significant (insignificant) and the stock market would be deemed inefficient (efficient). In this paper we have computed a 36 period (3 years) ahead impulse responses for the VAR system.

Figure–1 presents the IRF of stock return (RETURN) due to one standard deviation independent shock given to all other variables in the VAR system (version-1), except to RETURN itself. Inspection of figure–1, reveals that the normalised random one standard deviation independent structural shock to each of the variables in the VAR system (excluding RETURN), produces fluctuating responses in stock returns during the 36 period ahead time frame. Except for RM3, none of these IRFs is significant during this period as measured by the confidence bands around them. However, in the case of a shock to RM3 the IRF for RETURN turns out to be significant for a brief period, i.e., during the last three-quarters of the first year. But interestingly, immediately after this brief significant fluctuation, the IRF of RETURN restricts itself within the confidence band implying its insignificance in the latter periods. This implies that the stock return fully absorbs and reflects the available fiscal, monetary and other macro economic policy information, thereby providing support for the stock market efficiency hypothesis.

Finally, in order to test the consistency of the results obtained from the VAR model (version-1), we generated IRFs with two different orderings of the variables in the system. They are:

{ RM3, HIGHEMPBD, WPI, CALLRATE,
IIP and RETURN } ...Version – 2

{ RM3, HIGHEMPBD, WPI, IIP,
CALLRATE and RETURN } ...Version – 3

Figures – 2a, 2b and 3a, 3b present the IRFs of RETURN due to HIGHEMPBD and RM3 respectively for versions 2 and 3. It can be clearly observed from the figures that changing the ordering of the variables left the findings of version-1 unchanged. It may be possible now to conclude that Indian stock market remained efficient with regard to both monetary and fiscal policy actions irrespective of the ordering of the variables in the VAR system.

V. Concluding Remarks

The objective of this paper is to test the semi-strong version of the stock market efficiency hypothesis for the Indian stock market by employing the VAR methodology. This exercise is carried out using a set of monthly data in levels over the period 1990:01-1998:12. The findings of the study based on impulse response functions support the stock market efficiency hypothesis with regard to both fiscal and monetary variables. In other words, the findings of the study show that the Indian stock market is an efficient processor of both fiscal and monetary policy information.

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Figure-1

Impulse response of RETURN due to one standard deviation shock to the following:

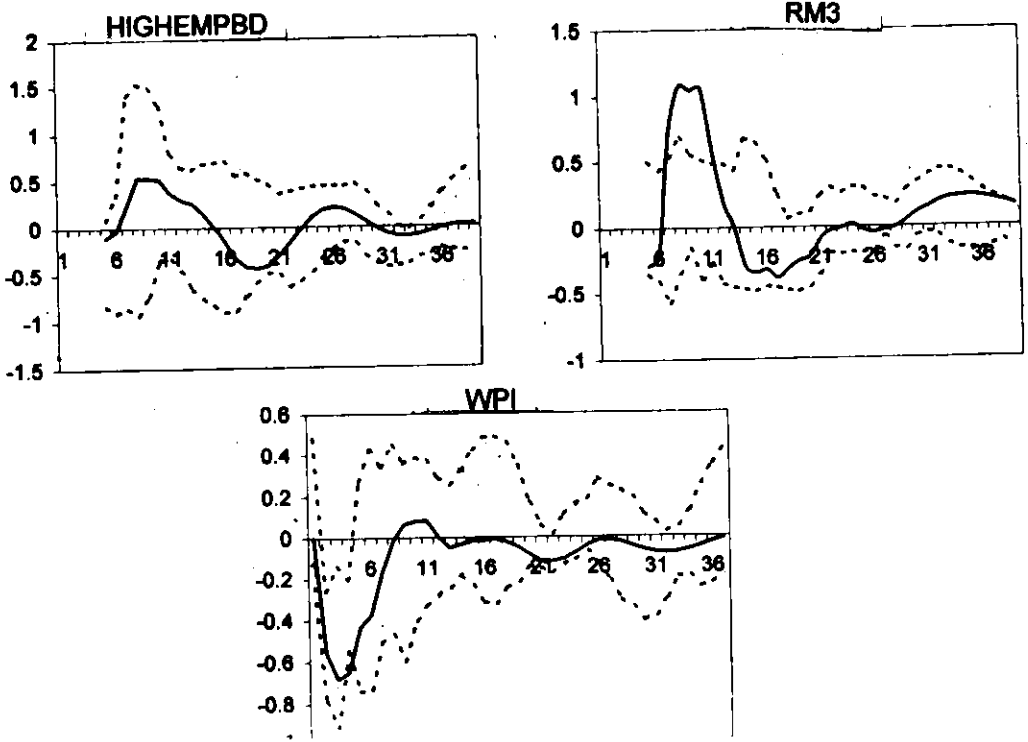


Figure-1

Impulse response of RETURN due to one standard deviation shock to the following:

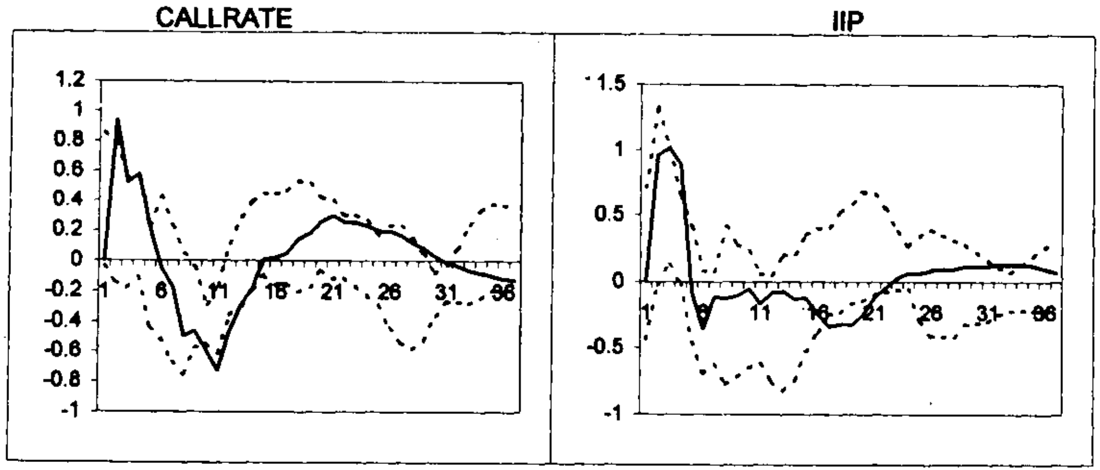


Figure-2a
Impulse Response of Return due to HIGHEMPBD
(Version-2)

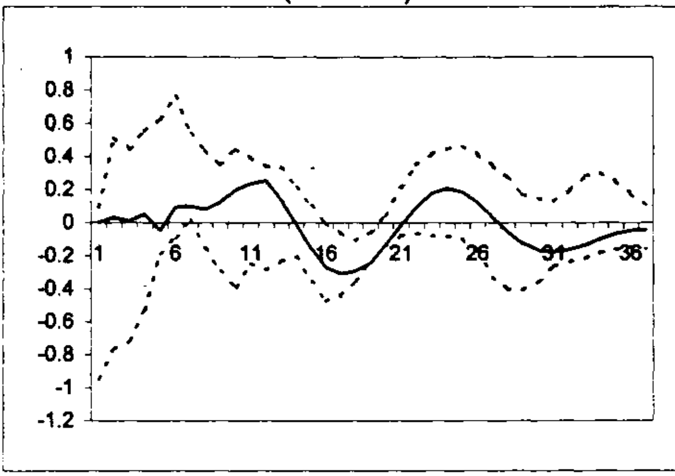


Figure-2b
Impulse Response of Return due to HIGHEMPBD
(Version-3)

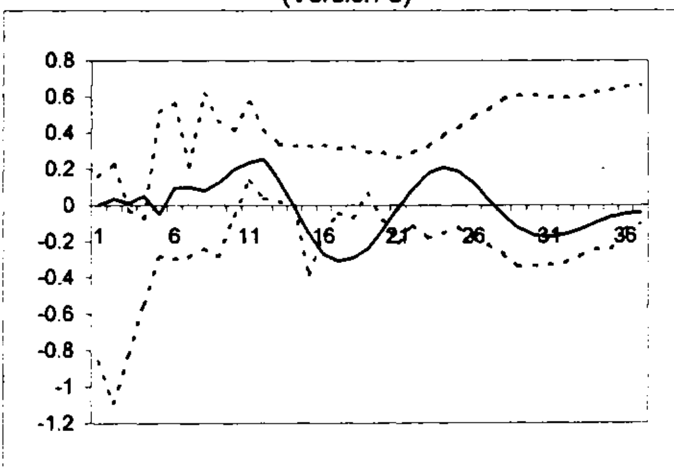


Figure-3a

Impulse Response of Return due to RM3

(Version-2)

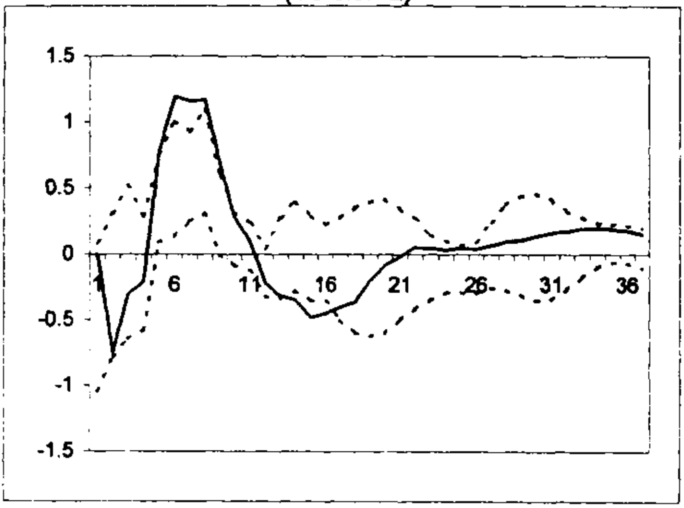
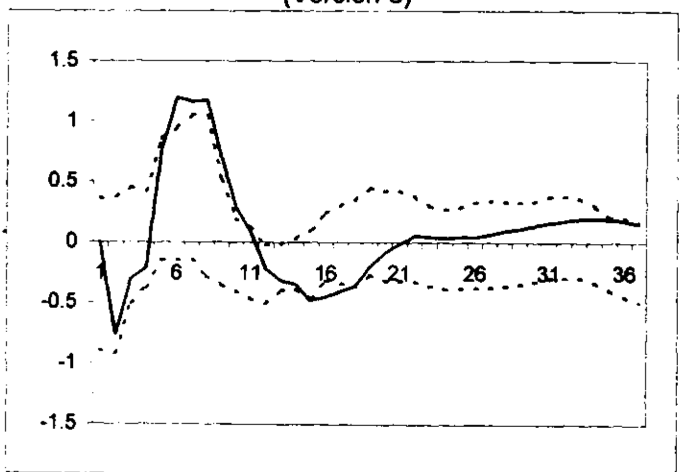


Figure-3b

Impulse Response of Return due to RM3

(Version-3)



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