ARBITRAGE PRICING THEORY AND RETURN GENERATING PROCESS: A MACROECONOMIC APPROACH TO INDIAN STOCK MARKET

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Under the Faculty of Social Sciences

by

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Under the guidance of

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Arbitrage Pricing Theory and Return Generating Process: A Macroeconomic Approach to Indian Stock Market

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Certificate

Certified that the thesis entitled **"Arbitrage Pricing Theory and Return Generating Process: A Macroeconomic Approach to Indian Stock Market"**, is based on the bonafide research work done by Shri. Shaji. P.N, under my guidance and supervision. It is further certified that the thesis is not previously used for the award of any Degree, Diploma and Fellowship or for awarding other similar titles of recognition.

He is permitted to submit the thesis to the university.

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Declaration

I, Shaji.P.N, do hereby declare that the thesis entitled "Arbitrage Pricing Theory and Return Generating Process: A Macroeconomic Approach to Indian Stock Market" submitted to Cochin University of Science and Technology, Kochi - 22, for the award of the Degree of Doctor of Philosophy under the faculty of Social Sciences, is the authentic record of original and independent research work done by me under the supervision and guidance of Dr. K. George Varghese, Professor (Rtd.), School of Management Studies, Kochi - 22. I further declare that this thesis has not previously formed the basis for the award of any Degree or Diploma or Fellowship or other similar titles of recognition.

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Abbreviations

ACF	Autocorrelation function
ADF	Augmented Dickey Fuller
AIC	Akaike Information Criteria
APT	Arbitrage Pricing Theory
AR	Autoregressive
ARIMA	Autoregressive Integrated Moving Average
ARMA	Autoregressive Moving Average
BCC	Reserve Bank's Credit to Commercial sector
BCG	Reserve Bank's Credit to Government sector
BSE	Bombay Stock Exchange
BSET	BSE Turnover
CALM	Call Money Rate
Canon Cor.	Canonical Correlation Coefficient
Cap	Capitalisation
CAPM	Capital Asset Pricing Model
CCA	Canonical Correlation Analysis
CPI	Consumer Price Index
CRR	Chen, Roll and Ross
CSO	Central Statistical Organization
EXP	Export
EXR	Rupee–US Dollar Exchange Rate
FDI	Foreign Direct Investment
FII	Foreign Institutional Investor's net investments
FORX	Foreign Exchange Reserve
FPM	Fellow Programme in Management
GOLD	Gold price

GDP	Gross Domestic Product
IIPE	Index of Industrial Production–Electricity
IIPG	Index of Industrial Production - General
IIPMF	Index of industrial Production–Manufacturing
IIPMI	Index of Industrial Production–Mining
IMP	Import
M3	Money Supply
MA	Moving Average
MATLAB	Matrix Laboratories
MSE	Mean Squared Error
NSE	National Stock Exchange
NV	Normalized Portfolio Variance
PACF	Partial Autocorrelation function
RBI	Reserve Bank of India
SEBI	Securities and Exchange Board of India
SIC	Schwarz Information Criteria
SPSS	Statistical Package for Social Science
Sq.Can Cor.	Squared Canonical Correlations
UK	United Kingdom
US	United States
VIF	Variance Inflation Factor
WPI	Wholesale Price Index
λ	Lambda

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Chapter

1

INTRODUCTON AND RESEARCH DESIGN

Contents

1.1 Introduction

Economic development of a nation depends on the process of circular flow of income and its dynamics. In an economy income derives from different sources. As a precaution for meeting the future contingencies and for growth, by making a sacrifice in consumption, savings are created. If savings are kept idle, that will hamper the circular flow of income and ultimately the development of the nation. So in the paradoxes of development of the nation, the role of savings and its channelization into investment plays a very important role.

Investments represent the employment of funds with the object of obtaining additional income or growth. In investment decision, the investor will reach a consensus regarding profitability, safety and liquidity. Every investment opportunity is attached with return and risk. Return is the expected income from an investment opportunity representing the reward for foregone consumption and risk taking, and risk represent the downward variability in the expected return. The risk-return relationship is a direct one- the higher the risk, the higher will be the return and vice -versa. Magnitude of risk varies from one investment opportunity to other.

Number of investment options is readily available in the investment arena and is increasing in tune with the introduction of innovative ideas of risk hedging and second generation securities like derivatives. Selection of Portfolios of investments is determined by the return expectations, its time, risk and risk bearing capacity of investors. For catering the needs of investors, short term as well as long term investment options are readily available in the market. It includes money market instruments like call money, notice money, treasury bills, certificate of deposits, commercial paper, commercial bill, Repo and reverse Repo and so on. In the long term segment, equity shares, preference shares, government bonds and derivative instruments like options, futures and swaps, etc. serve the purpose. Along with these, opportunities of investment in real estate, gold, silver, units of mutual funds, pension based schemes and life cover linked investment schemes of insurance companies enlarge the opportunity set. Return expectations, riskiness of investment, extend of risk bearing capacity, time related realization needs, and accessibility to investment opportunities and fund availability are basic determinants of investment decision.

Since investments are the backbone of economic development of every nation, among the various investment opportunities, investments in equity shares posses a prominent role. It is considered to be the cornerstone of the corporate entities and is characterized by ownership, pre-emptive rights and attached with high risk and high return. With the very nature of equity shares, for continuous investment follow up and for revision of portfolios, existence of an orderly growing stock market characterized by transparency, adequate depth and breadth is an essential one. It serves the purpose of discharging a variety of functions, like providing liquidity, helping price discovery and ultimately helping the corporate world for their long term investment decisions through the switching over mechanism. It channelizes the savings into profitable investments and gives an opportunity for switching from less profitable areas to more profitable areas, which enhances the productivity of the capital and leads to economic development of a nation.

As economic and financial environment keep changing, the risk-return characteristics of individual securities and portfolios are also changing. This necessitated continuous evaluation of securities and updating of portfolios, which help the investor in making the buying and selling decisions and to keep the investments intact with expectation of the investor about the return for a perceived level of risk.

Since, there is no assured income, the amount and timing of income are uncertain, compared to other types of securities, analyzing the risk return relationship and precise pricing of the ordinary security for investment decision is much more difficult. Analyzing the risk return relationship of securities, different approaches with varying assumptions are used. It includes fundamental analysis, technical analysis and market efficiency approach.

Fundamental approach advocates that every share possess an intrinsic value warranted by its fundamental factors and these factors are the outcome of economy characteristics, industry and company specific characteristics attached to the security. In this approach, in the light of risk and return, the true value of the security ascertained through economy analysis, industry analysis and company analysis. Comparing the intrinsic value with the market price, mispriced securities are identified. The mispriced information cashed in the market through buying and selling decisions.

Technical analysis based on the perception that share price movements are systematic and exhibit certain consistent patterns. This approach is based on the idea that the share prices are determined in the market by demand and supply factors. This stream of approach advocates that consistent patterns are visible in the movement of share prices and is due to changes in the attitude of investors reflected in the demand for and supply of securities. On the basis of historical share price patterns, future prices are predicted based on the assumption that the past will repeat in future on a patterned manner. Information gained through comparing the current market price with the predicted price, and by considering the market direction based on demand and supply factors, used for buying and selling decisions.

The third approach, efficient market hypothesis, based on the assumption that share price movements are random. The efficient market hypothesis propagates that the market prices instantaneously and fully reflect all relevant and available information and also argue that share price movements are random rather than systematic. The hypothesis of correct pricing and random behaviour of price movements discards the basis of fundamental analysis and technical analysis. The advocates of efficient market hypothesis argue that, it is possible for an investor to earn normal returns by randomly selected securities for an appropriate risk level.

Enquiry in to the risk reduction for a level of return gave the outcome of diversification and leads to the development of Modern Portfolio Theory.

Portfolio constructed by including securities carrying varying level of risk, i.e. combining assets which are not perfectly correlated with respect to risk and return, reduces the total risk without affecting the return. This is based on the risk classification followed by modern portfolio theory. The theory advocates that the total risk alienated into two. One is the systematic risk, which have a bearing on the fortune of almost every firm, as it is derived from economy wide factors. Impact of this kind of risk varying from firm to firm, but cannot be eliminated through diversification strategies. On the other hand, the second type of risk is the unsystematic risk which derived from firm and industry specific factors and be eliminated by creating a well diversified portfolio. So in a well diversified portfolio, there exists only non diversifiable risk. Modern portfolio theories are developed based on this.

Capital Asset Pricing Model developed in the mean variance framework of Harry Markowitz (1952), states that the return on a security or a portfolio is a function of risk free rate and risk premium. The theory advocates that there is only one kind of systematic risk, which is the market risk. In this single index model, changes in the market risk determine the price of the shares and resultant variations in return.

The multifactor Arbitrage Pricing Theory (APT) advocates that the return on any stock is linearly related to a set of economy wide risk factors and risk free rate. In this return generating process, based on the law of one price and absence of arbitrage opportunities, the return can be explained in terms of a small number of systematic risk factors.

On surveying the existing literature available on the equity research based on Arbitrage Pricing Theory, it is identified that APT has been investigated extensively in US and European markets, detailed literature review given in chapter 2. In Indian context, there are relatively few empirical investigations on the applications on Indian stocks.

1.2 Empirical studies – Indian context

Sood’s (1995), comparative study on Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory witnessed the first attempt made in this field. The study empirically tested the APT hypothesis using macroeconomic variables. Certain modifications are made in the Chen, Roll and Ross (CRR) methodology, especially in the case of stock returns. Basically APT is based and tested by taking excess return of portfolios. But in the Indian context, data relating to well diversified portfolios are not available, individual security raw return are taken into consideration. Macroeconomic variables and their proxies are selected considering the particular economic situation of India. The study reveals that the return generating process of the Indian capital market is characterized by a multifactor structure and that the risk-return relationship is consistent with the APT hypothesis. The study indicates that inflation, interest rate and growth risk factors, external sector performance and return on alternative assets can be considered as the systematic risk factors affecting security returns in the Indian markets for pre liberalized period of 1986-89.

Vipul and Gianchandani (1997) investigated the relevance of APT model in Indian context for the years of 1991 and 1992. They used wholesale price index, dollar-rupee conversion rates, price of gold and Bombay stock exchange (BSE) national index as variables explaining return generating process. Ten equally weighted industry specific portfolios, consisting of five shares from a random sample of 50 stocks traded in BSE in the specified group were used for the study. The study reveals that only two variables have significant betas in the pre- run test stage and none of the variable is identified as priced factors in the final analysis.

In a comparative study Rao and Rajeswari (2000) tested the capital asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) for 5 years from 1995-2000 by taking 28 variables in the context of a portfolio consisting of two and three shares. The study reveals that three factor economic model and five factor APT model give better explanation in the risk- return relationships of securities compared to CAPM. It also reveals that out of the five factors, two factors are priced significantly in the APT model. The study lacks the economic interpretation of the priced factors. .

For the period of 1992-2002, Dhanakar and Esq. (2005) empirically investigated the testability of Arbitrage Pricing Theory and Capital Asset Pricing Model in India. The study based on principal component analysis, revealed that the multifactor APT provides a better indication of asset risk and estimates of required return than the single systematic risk based CAPM.

In a comparative study, Singh (2008) investigated the CAPM and APT in the Indian market for the period of 1991 to 2002, considering 158 shares listed in BSE. The study used BSE 200 index, wholesale price index, Rupee-dollar exchange rate, difference in three and six months foreign exchange forward premium, call money rates, T-bill rates, gold price and three months foreign exchange premium for explaining the return generating process. He asserts that compared to CAPM, Arbitrage pricing theory model gives better explanation for the risk- return relationship. The study reveals that the dominant market factor proxied by BSE 200, call rate and exchange rate were priced in some sub periods.

1.3 Research gap

Almost 20 years have elapsed from the celebrated opening up of the economy and related liberalizing process. These years witnessed a lot of changes in the Indian economy and in the capital market, especially in the secondary market. With changes taking place at terrific pace in the field of investments, it has become a specialized activity demanding scientific plans and procedures for success. Policy measures and steps initiated in the economy on a phased manner definitely be affected the future cash flows of the companies and in turn affect the return expectations and risk tolerance of investors. This leads to investment decision making more complex.

On surveying the existing literature available on the equity research , it is identified that APT has been investigated in Indian context, however, there are relatively few empirical investigations on the applications in Indian stocks.

Most of the existing research works on APT in the Indian context are single phased one, covering relatively smaller period, either related to pre liberalization period or initial periods of liberalization. Though, these studies identified the risk factors concerned to that period, its magnitude and direction of relationship in the market was not reported. The reported studies are single period one, consequently, phased comparison of relationship between economic variables represented as systematic risk factors and stock market return under portfolio context, were not addressed. It is important in the light of liberalizing process and related developments in the Indian stock market, where risk perspective is changing.

Some of the studies reported in this area, failed to incorporate or neglected certain segments of systematic risk, in variable selection process and leads to low explanatory power for the return generating process of APT. However, these studies include company and industry specific variables, which will not give any economic interpretation of systematic risk.

Certain studies in this field of APT and its return generating process fails to report the basis of portfolio formation and its extent of diversification which have an impact on the magnitude of systematic risk, as well diversified portfolio is a basic condition for testing the APT. Studies in the Indian context could not investigate the size effect in the light of relationship between economy wide risk factors and its impact on portfolio return.

Studies reported so far, followed the methodology of Chen, Roll and Ross (1986), or its modified versions for testing the APT in India. The methodology is based on factor analytic approach and two stage regression. A new testing method, based on the advancement of statistical developments within the framework of macroeconomic APT testing methodology of CRR, advocated by Cheng (1996) pointed out that, the multiple regression analysis is very sensitive to the number of independent variable included in the regression. Moreover, separate multiple regression analysis of each set of variable fails to capture the interrelations of the sets. The new, widely quoted methodology based on factor analysis and canonical correlation analysis has not been applied in any of the previous research works in this area, in the Indian context.

In this background research gap to be addressed especially in the changing economic and investment environment which exposed to risk from national and international economic events. In this context, a study covering the entire period of liberalization and its impact on Indian stock market, getting attention from. Moreover new, APT testing method put forwarded by

Cheng (1995) is applied in the light of randomly selected, equally weighted, well diversified portfolio context, in this study. In addition to the APT risk factors, impact on size and for different time periods with reasonable span are also investigated in the study and are expected to fill the existing research gap.

1.4 Research problem

In the process of investment decision making, investors are much concerned about company and industry variables. As share prices are themselves dependent on the expectation regarding future earnings of the companies and that future earnings are themselves dependent on the performance of the whole economy. Identification and the extent of influence of macroeconomic variables in the return generating process of shares is not received considerable attention in the investment decision making in India. An attempt to identify the macroeconomic factors and its influence on share prices give a better tool for investment analysis in the hands of investors and thereby maximize their returns. A partially regulated economy like ours, the government can intervene and frame out the macroeconomic environment thorough policy decisions, for the orderly growth of the stock market and resultant economic development. Due to the lack of clarity regarding various macroeconomic variables and the extent of its influence on share prices, the desired result is not yet achieved. This is possible only through identification of various macroeconomic variables and its extent of influence on share prices.

The present study attempts to find out answers of the following research questions, in the framework of Arbitrage Pricing Theory.

1) What are the important economy-wide risk factors in India?

2) What is the magnitude and direction of the relationship of these risk factors?

3) Whether the magnitudes and direction of relationships are changing on the basis of size of capitalization and time period with a reasonable span?

1.5 Importance of the study

A study focusing on the identification of return generating factors and to the extent of their influence on share prices, the outcome will be a tool for investment analysis in the hands of investors, portfolio managers, and mutual funds, who are mostly concerned with changing share prices. Since the study takes into account the influence of macroeconomic variables on variations in share returns, by using the outcome, the government can frame out suitable policies on long term basis and that will help in nurturing a healthy economy and resultant stock market. As every company management tries to maximize the wealth of the share holders, a clear idea about the return generating variables and their influence will help the management to frame various policies to maximize the wealth of the shareholders.

1.6 Objectives of the study

The objectives of the study are:

Test the Arbitrage Pricing Theory in the Indian context and identify the suitable factor model.

Identify the major systematic risk factors in the Indian stock market and the extent of influence on share returns

Study the impact of systematic risk factors on size of capitalization and time period with reasonable span.

1.7 Hypothesis of the study

Based on the objectives of the study the following hypotheses are formulated.

Systematic risk factors are the determinants of security returns in India.

Risk premium for the APT risk factors are jointly influential.

Influence of economy-wide factors tends to vary on the basis of size of capitalization.

Influence of economy-wide factors tends to vary for different time periods with reasonable span.

1.8 Methodology

1.8.1 Framework

Based on the framework of macroeconomic APT testing methodology of CRR (1986), Cheng (1995) approach of factor identification and testing of APT is the basis of methodology used in the study. The approach proposes factor analysis for both set of variables, portfolio returns and selected macro economic variables. For factor identification and measuring the relationship, Canonical Correlation Analysis (CCA) is used. The approach of Cheng (1995) is modified on the ground that, in Canonical correlation analysis an internal factor analysis has been carried out and there by an additional factor analysis not warranted. It is based on the idea of duplication of the factor analysis highly reduces the explanatory power, as only the selected factor's factor scores used for further calculations of CCA. The methodology is further modified on the ground of the availability data on excess return of portfolios. As excess returns of portfolios are not available in the Indian context, instead of excess returns of portfolios, raw returns of securities are used for the study (Sood ,1995).

1.8.2 Period of study

The study covers 17 years starting from April 1994 to March 2011 comprising three phases in tune with the objectives of the study. The entire study period is divided in to three, by considering developments in the Indian capital market, as a result of opening of the economy and liberalizing process. The first phase comprises 6 years starting from April 1994 to March 2000. The selection of the period is related to the landmarks of fully automated, nationwide trading system with real time access of information and more transparent trading procedures. Along with this, policy change on Foreign Institutional investor's entry in to the secondary market (1993) is also happened and related flow of fund increased remarkably in the year 1994. These two major events and its impact on the stock market lead to the selection of the year 1994 as the starting period of the study.

In the year 2000 the second stage of economic liberalization activities are initiated and its impacts are clearly reflected in the capital market, represented by high volume of activities in the market, supported by the confidence of a stabilized market. These aspects lead to the selection of the period, April 2000 to march 2006 as the second phase. After that the more volatile period in the stock market in the liberalization era, falling in the third phase covering five years from April 2006 to March 2011.

1.8.3 Data and source

The study is based on secondary data. Time series data of share prices of the selected companies and selected macroeconomic variables are used. For the selection of the companies, BSE based indices are considered. Macroeconomic variables are selected on the basis of theoretical economic relationship with systematic risk elements.

1.8.3.1 Stock market data

Theoretically APT is testable for any subset of the market. For the present study, closing share prices of 145 companies listed in the Bombay Stock Exchange are collected on a monthly basis. The companies are selected on the basis of certain criteria. The first criterion is the market capitalization, which is accepted as the representation of the size of the market. Survival of the companies in the entire study period serves as the second criterion. Third criterion is that the companies should be included in the same class based on Index classification of Bombay Stock Exchange for the entire study period. Index of BSE100, Mid Cap and Small cap are serving as a basis for selection of the companies based on size -large cap companies, medium cap and small cap respectively. Hence the companies included in the selection possess the characteristics of high market capitalization, survived in the entire study period and maintained in the respective category as per the index classification of Bombay Stock Exchange. Instead of National stock exchange (NSE) listed companies, BSE listed companies are selected and it is warranted by the comparison of influence of size included in the objective of the study. In NSE, there is no segment of small cap companies, where large and medium cap companies are listed. Out of the selected 145 companies, 61 belong to large cap, 37 companies are medium cap and 47 are small sized companies. Companies selected for the study covers major companies from almost all the main industries in the Indian economy (List of the selected companies given in the Appendix). The closing share price data collected on a monthly basis and the last trading day of the month is taken as the data point.

1.8.3.2 Macroeconomic data

Data pertaining to 17 macroeconomic variables are considered on the basis of the selection criteria comprising characteristics of economy, economic significance and its relation with systematic risk, Availability of published data, literature support and in tune with the objective of the study. All these selected variables have some impact on the future cash flows or discount rate of an organization. Berry's (1988) criteria is also serving as a basis of selection of economic variables, to limit the number of variables considered in the study. Details of selection of macroeconomic variables and its economic significance corresponding to various systematic risk factors are reported in the chapter 3.

1.8.3.3 Source of data

Data related to Indian economy have mainly collected from official publications and Websites of Government of India, Reserve Bank of India (RBI) Central Statistical Organization (CSO), and Securities and Exchange Board of India (SEBI). Share price data have obtained from BSE database.

1.8.4 Methods and tools

Share prices are adjusted for capital changes like bonus issue and stock split wherever necessary. Share returns are calculated by using the equation of P_1-P_0/P_0, log returns are calculated for making the data near normal and for endorsing the multivariate normality assumptions. For this technique of location change[1] have been used wherever necessary. Equally weighted Portfolios are constructed on a random basis. Well diversified

1 Location Change is a technique of converting a series consisting of positive and negative values, by adding a fixed value to it, makes them positive and facilitated the conversion of negative values in to log basis.

portfolios are identified and selected by using the measure of normalized portfolio variance and its related selection region, based on theoretical grounds.

For the selected series of macroeconomic variables, series are forecasted for identifying the unanticipated changes in the macroeconomic variables. For this, different forecasting techniques ranging from linear trend to ARIMA modeling techniques are used on the basis of the nature of data. Difference between original variables and forecasted variables are taken as unanticipated changes and an appropriate series is constructed for each variable. Box and Jenkins (1976) methodology is applied for forecasting the desired variables. Augmented Dickey Fuller (1979) test have been applied for checking the stationarity of the data in the forecasting process.

For testing the multicollinearity of independent macroeconomic variables, linear regressions are run for all combinations of independent variables, by taking one of the independent variable as dependent variable and Variance Inflation Factor (VIF) is taken as criterion. For assessing the multivariate normality Wilks Lambda's significance value is considered as the measure.

Canonical correlation analysis have been used for identifying the factor structure and establishing the relationship between portfolio's systematic risk and factors generated from unanticipated changes in macroeconomic variables. Eigen value weighted canonical cross loadings are used for analyzing the relative importance, overall effect and direction of relationship of priced variables on share return variations.

1.9 Limitations of the study

One of the limitations of the study is that, impact of lead and lag of the variables are not explored. Another limitation is that, due to the lag in reporting macroeconomic data, a testing period is not included in the study**.**

1.10 Organization of the research report

The report of the research work is divided into eight chapters with the first Chapter providing an introduction consisting of a brief description of investments and its avenues, different approaches to investment valuation, Modern portfolio theory, Capital asset pricing model and Arbitrage pricing theory. It also contains an abridged literature review of Indian studies and resultant research gap, importance and objectives of the study, hypothesis used, methodology adopted and limitations of the study. Theoretical background and detailed review of literature followed in chapter 2. Chapter 3 deals with macroeconomic variable selection, corresponding to systematic risk elements and its economic relationship. Forecasting methods used in the study and measures of forecasting of selected macroeconomic variables are given in chapter 4. Chapter 5 deals with diversification, portfolio construction and selection of well diversified portfolios. Chapter 6 analyses the result of canonical correlation analysis for testing the APT based hypothesis on 'market portfolio'[2] and its interpretation. Chapter 7 analyses the result of canonical correlation analysis for testing the size and time based hypothesis of return generating process within the framework of APT. The final chapter followed with conclusions and implications of the study.

[2] In this study 'market portfolio' refers to well diversified portfolio consisting shares of large, mid and small cap companies.

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Chapter 2

THEORETICAL BACKGROUND AND LITERATURE REVIEW

Contents

2.1 Introduction

A fundamental principle of investments is the tradeoff between risk and return and on this cornerstone the equilibrium models are developed. Investments represent the employment of funds with the object of obtaining additional income or growth in value. Return from an investment is the reward for foregone consumption and risk taking. Return is the realizable cash flow earned by the investor. Risk is measured as the variation in the expected return. There exist a direct relationship between risk and return, higher risk will be will be explained by the higher return and the case of lower risk, lower will be the return.

In investment scenario there are two kinds of risk i.e. systematic and diversifiable (idiosyncratic risk). Systematic risk of an investment stem from the influence of certain economy wide factors like money supply, inflation, level of government spending, industrial policy etc, which have a bearing on the fortune of almost every firm. On the other hand, diversifiable risk of an investment stem from firm specific factors. Risk arising from firm specific factors can be diversified away by creating a well diversified portfolio. Investors attempt to reduce the variability of returns through diversification of investment through portfolio creation. In a well diversified portfolio unsystematic risk is more or less eliminated. So in the context of Modern Portfolio Theory, there exists only systematic risk. All securities do not have the same degree of non diversifiable risk, because the magnitude of influence of economy wide factors tends to vary from one firm to another.

In the modern portfolio approaches, there are two theories, which provide a rigorous foundation for computing the tradeoff between risk and return, are Capital asset pricing model and Arbitrage pricing theory.

2.2 Capital Asset Pricing Model

Capital Asset Pricing Model (CAPM) was developed by William Sharp in 1964 and his parallel work was performed further by Jack Treynor, Jan Mossin and John Lintner independently, in tune with the mean variance frame work introduced by the father of Modern portfolio theory: Harry M Markowitz (1952).

Capital Asset Pricing Model (CAPM) is an equilibrium model and explains why different assets have different expected returns. CAPM extended Harry Markowitz's mean variance framework by introducing the concept of systematic and specific risks. It is based on the idea that investment should always include and take in both systematic and unsystematic risks. CAPM has evolved as an approach to measure systematic risk. The basic idea behind CAPM is that when investors make their investment choices, assets will be priced in the market place with respect to their risks.

According to this single index model, there is only one type of non diversifiable risk influences the expected security returns, and it is the market risk. The theory explains that return on a security or a portfolio is a function of risk free rate and a risk premium. Risk premium is measured as the sensitivity of beta coefficient. Beta is the sensitivity of the security's or portfolio's return to the market return.

CAPM provides (tradeoff between risk and return) a linear relationship between expected return and risk of an asset. CAPM which attempt to explain the return on an asset in terms of a single market risk factor, characterized by the following form

$$E(R_i) = R_f + \beta_i (R_m - R_f)$$

$E(R_i)$ is the expected return on security,

β_i is a measure of diversifiable risk,

$E(R_m)$ is the expected market return of a market portfolio and

R_f is the risk free return.

The beta coefficient is a function of

$$\beta = \frac{\text{cov}(R_i)E(R_m)}{\sigma^2 R_m}$$

Beta is equal to the covariance between the portfolio and market return divided by the variance of the market's returns.

Empirical testing of CAPM is based on the following assumptions.

Assets are infinitely divisible, investors are risk averse, no transaction cost, absence of personal income tax, (individual is indifferent to the form in which the return on investment is received i.e. dividend /capital gain), short selling is permitted, unlimited lending and borrowing at the risk free rate is possible, investors have homogeneous expectation regarding expected returns, investors are presumed to have identical holding periods, existence of a perfect market. No single investor can affect prices by an individual action; investors in total determine the market prices. Along with these, assumption of normality of returns and concept of market portfolio are also required.

CAPM is theoretically agreeable but it is not viewed as a perfect model. Many have argued that, while the predictions of the CAPM are qualitatively supported, researchers have contradictory opinion about its quantitative predictions**.** Some of the assumptions are untenable in the real world situations. Even though, the CAPM is accepted as one of the leading model that explains the risk return relationship**.**

2.3 Arbitrage Pricing Theory

The Arbitrage Pricing Theory originally developed by Stephen A Ross (1976) advocates that the return on any stock is linearly related to a set of systematic factors and risk free rate. APT begins by trying to identify the underlying sources of uncertainty that make securities risky. Any source of uncertainty that creates risk among many securities is called a factor. The APT suggests that the returns can be explained in terms of returns on a small number of systematic risk factors**.** APT agrees that, though many different firm-specific forces can influence the return on any individual stock, these idiosyncratic effects tend to cancel out in large and well diversified portfolios. This cancellation is called the principle of diversification, large, well-diversified portfolios are not risk free because there are common economic forces that pervasively influence all stock returns and that are not eliminated by diversification. In the APT, these common forces are called systematic or pervasive risks.

This assumption of more than one factor determining the returns on an asset implies that the return generating process in the market is characterized by a multi factor model. The expected return on a security is a linear combination of a risk free rate of return and the factor premium, which is the equilibrium risk return relationship hypothesized by the Arbitrage Pricing Theory.

$$R_i = \alpha_i + \beta_{i1} I_1 + \beta_{i2} I_2 + \text{.........} \beta_{ij} I_j + e_i$$

Where

α_i = the expected level of return for stock i if all factors have a value of zero.

I_j = the value of the j^{th} factor that impacts the return on stock i.

β_{ij} = the sensitivity of stock i's return to the j^{th} factor.

e_i = a random error term with mean equal to zero and variance equal to σe_i^2

In the model specified above, the random error term and the factors are uncorrelated, which means that the outcome of the factor has no bearing on the outcome of the random error term. Random error terms of two securities are uncorrelated, means that the outcome of the random error term of one security has no bearings on the outcome of the random error term of any other security; the returns of two securities will be correlated only through common reactions to factor. If any of these conditions are not satisfied the model is an approximation.

For validating the risk return relationship of APT in its exact form the following assumption are required.

1) The market is assumed to be perfect.

2) Investors are risk averse and hold homogeneous expectations.

3) The number of assets in the market is infinite, so that assets specific risk for a portfolio asset is zero.

4) The elimination of arbitrage opportunity.

5) Asset returns are influenced and generated by multiple factors. The process of generating asset returns is expressed as a linear function of a set of K - multiple factors.

In a perfect market there are large number of buyers and sellers, and perfect information is available to both buyers and sellers. In such a market no single buyer and seller has control over the price of a security. Price of an asset is determined by the demand and supply forces. An individual cannot affect the price of a security by his buying and selling. Investors in total determine the market prices.

Investors are risk averse and hold homogeneous expectations i.e. they expect a higher compensation for bearing higher amount of risk. They also hold identical expectations with regard to decision period and decision input. Investors are presumed to have identical holding periods and also identical expectations regarding expected returns, variance of expected returns and covariance of all pairs of securities.

The assumption of non-specific risk is indefensible. In a finite asset economy, diversification holds only approximately. Consequently, the asset specific risk cannot be zero. A number of research papers demonstrate that the APT is a good approximation, when there are a sufficiently large number of assets in the market. That is, specific risk for well diversified portfolio tends to be zero with an increase in the number of assets in the portfolio. It implies that a well diversified portfolio will contain only the factor risk.

A necessary condition for financial markets to be in equilibrium is something economists have termed as the no arbitrage opportunity. It is based on the law of one price, i.e. two items that are the same cannot sell at different prices. It is assumed that, because of competition in financial markets, it is impossible for an investor to earn a positive expected rate of return on any combination of assets without undertaking some risk and without making some net investment of funds.

In detailed perspective, assets with identical risks must have the same expected rate of return. The possibility of arbitrage arises when mispricing among assets creates opportunities for risk free profits. With that, arbitrage is possible and can occur when an asset's price is not in equilibrium phase. Arbitrage allow investors to sell the assets with low return and go long on the other side using the proceeds of the sale of the first transaction, reaping theoretically infinite returns with no risk to the investors. An important remark here is the price differences between the assets will immediately disappear in an efficient market as arbitrage activities take place and equilibrium stage will be restored in a very short time manner. In an equilibrium market condition, the return of a zero-investment with zero-systematic risk portfolio is zero as the unique risks are diversified away.

APT explains the return generating process is to be characterized by a small number of independent factors, regarding the number of factors that can explain the return generating process; researchers have contradictory opinions with the originators of the APT. They argue that the number of factors would grow progressively with an increase in the number of assets.

Chamberlain and Rothschild (1983) reported that the arbitrage pricing relationship is valid even under an approximate factor structure. The number of factors to be extracted can be restricted to a point where the correlation among the residuals stops exploding even when there is an increase in the number of assets in the market.

APT requires no assumptions about investor's preferences other than that they are risk averse and does not require special assumptions about the probability distributions of returns. And it provides a rigorous logical foundation for the tradeoff between expected returns and risks.

The principal strength of the APT is that, it is based on the no arbitrage condition. Because the no arbitrage condition should hold for any subset of securities, it is not necessary to identify all risky assets or a market portfolio to test the APT.

The above mentioned results indicate that arbitrage pricing based arguments are tenable. Unlike CAPM, APT is a generalized one. Restrictive assumptions are very few compared to CAPM. The success of the attempts to relax the stricter conditions has led to the acceptance of the arbitrage pricing theory as an alternative equilibrium pricing model.

Developments and additions in the area of APT research mainly focused on methodologies and statistical tools, used for testing the APT theory, put forwarded by Ross in the year 1976. Apart from this, researchers also questioned some of the assumptions and conditions of APT, like infinite assets in the economy, exact and approximate factor structure, portfolio diversification and number of securities in a portfolio, naive and weighted methods of portfolio construction, number of factors extracted and priced factors, relationship between risk factors and macroeconomic variables etc. Researches carried out in US and European stock markets, most of the quires about the testability and its reliability is cleared. And as a result of this, APT has accepted by the research community and investment practitioners, as a more powerful multifactor model compared to the single factor model CAPM.

The Arbitrage Pricing Theory of Ross (1976) provides a theoretical framework to determine the expected returns on stocks, but it does not give any idea about the number of factors and their identity. Further researchers paid attention on two different methods to describe the stock returns, i.e. statistical APT and macroeconomic APT.

2.4 Statistical APT

In a statistical factor model, factors are not tied to any external data sources and the model is identified from the covariance of asset returns alone. The risk factors can be computed using statistical techniques such as factor analysis or principal components analysis.

The initial empirical test of statistical APT was conducted by Roll and Ross (1980). They follow the methodology of two stage process requiring an estimation of the factor loadings and then using these loadings as input for estimating the factor risk premium. They estimate the factor betas using a statistical technique called factor analysis. The input to the factor analysis is the covariance matrix among the returns to securities included in the portfolio.

Factor analysis determines the set of factor sensitivities. Then the factor risk premium are estimated by using factor loading estimates for each of the assets to explain the cross sectional variations of returns. For this, cross sectional generalized least squared regressions are used. A test of regression coefficient indicates that, it is a test for the size and the statistical significance of risk premium associated with each of the factors. The study reported a five factor structure of which two are priced after cross sectional testing.

Chen (1983) also follows the statistical APT and reported a five factor structure and finds that these factors are changing over time. Criticism rose by Elton and Gruber (1983) against the factor analysis technique to extract factors and identifying factor premium, their criticism mainly with respect to the order of factors between two different samples, their sign and related scaling problems. Chamberlin and Rothschild (1983) developed an alternative methodology to extract the systematic risk factors. They used asymptotic principal component analysis.

Cho (1984) by using US stock market data for the period of 1962 to 1982 conducted inter battery factor analysis for ascertaining the number of factors in two different industry groups of securities. They use the inter-battery factor analysis to establish the testing of APT in different industry groups on the ground of criticism relating to the factors of one group may not be same for another group. They argued that there is no such significant variation among the industry groups with respect to factors and assert that size of the group has no effect on the underlying factors of return generating process of APT. The study reported that 5 to 6 factors can explain the return generating process behind the APT and strongly supported the testability of APT.

In a comparative study of CAPM and APT, Dorothy et.al (1984) investigated the applicability of the APT in explaining the return generating process of utility stock returns. The result of the study shows that, APT explain the return generating process in a better way, multifactors' provide better estimates of expected return compared to the CAPM, where a single market beta determines the systematic risk of the portfolio.

Dybvig and Ross (1985) as a reply to the critique to the Shankan (1982) connected with testability of APT, by pointing out the approximation error and use of well diversified portfolio instead of market portfolio, assert that the APT is testable in sub set of market assets and is valid, but it is not possible in the case of CAPM.

Grinblatt et. al (1985), in their study examines the reliability of using the approximate factor structure in testing the APT, compared to the exact factor structure, which is one of the conditions of original theory put forwarded by Ross. They assert that APT is testable under approximate factor structures and almost same result will be obtained as in the case of exact factor structure conditions. They argue that the concept of approximate factor structure do not violate any assumptions of APT in the case of large number of assets in the market and in the case of large well diversified portfolios. The study also pointed out that principal component analysis is only one of the methods of factor extraction and factor analysis give a better result with adequate statistical properties helpful for further analysis.

Trzcinka (1986) pointing out that, the number of factors increases with the number of stocks included in the portfolio and criticized the existing testing methodology of APT. Brown (1989) reported that asymptotic principal component analysis procedure over estimates the number of factors. Formal comparisons of factor analysis and principal component analysis are made by Shukla and Trzcinka (1990), They analysed the factor extraction process by using the principal component analysis method and factor analysis method and reported that principal component analysis is preferred in some circumstances for factor extraction process and reported that there is no dominance of either technique over the other.

Dhrynes et. al. (1984), Cho and Taylor (1987), Gultekin and Gultekin (1987), Lehman and modest (1988) Trzcinka (1986), Brown (1989) are the main followers and advocators of the statistical APT.

Statistical APT method is useful for determining the number of relevant risk factors and its premium. That is, for determining the numerical value of K systematic factors and its premium. The main criticism against this is that, information from stock returns are used to explain stock returns. Number of factors identified and systematic risk premium extracted using factor analysis or principal components analysis are experiencing intricacy to give a meaningful interpretation.

2.5 Macroeconomic APT

Early stages of APT research focused on identifying the number of systematic factors common to a group of securities and its risk premium. Building a relationship among the factors identified and its premium to the real economic situations kept as an unsolved problem.

In this direction the first attempt was made by Chen, Roll and Rose (1986) hereafter CRR. They introduced the idea of multifactor macroeconomic model characterized by a small number of macroeconomic variables and return on non equity asset as a set of independent variables to explain returns on equity shares. Their premise is that stock prices are nothing but discounted cash flows. Therefore, any factor affects either the cash flow or the discount rate or both are considered to be a constituent of systematic factors relevant for asset pricing. On this basis, the macroeconomic variables are selected. CRR use a two step procedure to test the macroeconomic APT. As a first step, they estimate the factor sensitivity coefficients for each of the portfolios by regressing asset return for a given period with the unexpected movements in the selected macroeconomic series. The factor sensitivity coefficients are then used as independent variable in the second stage regression. The average of the second stage regression coefficients over the sample period are the estimates of risk premium.

The macroeconomic variables selection is mainly based on the general nature of the economy and the proxies are selected on the basis of its relation with the future cash flows or the discount rate which have an impact on the share prices. The empirical literature on the APT measures the macroeconomic variable in two different ways to analyse the relationship with share prices. Some of the researchers used the rate of change in the actual macroeconomic variables to get variations in the macroeconomic variables. The other line of researchers uses the innovations in a time series process. They argued that unanticipated changes in the macroeconomic variables are important and relevant for factor pricing. They forecasted a series from the original series of macroeconomic variables relevant for the time period of study. The difference between forecasted series and original series, i.e. the residuals are treated as the unanticipated changes in the macroeconomic variables.

Different types of forecasting methods including linear trend, exponential trend, quadratic trend, autoregressive moving average (ARMA), autoregressive integrated moving average (ARIMA), etc, are used for estimating the forecasted series.

Chen, Roll and Ross (1986) in their empirical testing of macroeconomic model APT construct a set of measures of unanticipated changes in the following macroeconomic variables:

1) Inflation
2) The term structure of interest rate
3) Default Risk premium
4) Industrial production

The result indicates that, inflation risk has a negative premium for unexpected changes in prices. CRR argue that the negative premium could be the result of the proposition that equity assets are considered to be a complete hedge against inflation. The negative relationship between the risk premium coefficient and asset returns implies that the higher inflation risk need not be compensated in the form of higher risk premium, for the unanticipated changes in inflation in one period get adjusted in equity returns for the following periods.

The proxy used for the term structure of interest rate risk is the excess of return on long term government bonds over the Treasury bill return series. The study report a negative premium for the term structure risk factors, which means that there exist an inverse relationship between return and term structure premium.

CRR, in their study measured default risk as the excess of return on low quality long term corporate bonds over the government bonds of the same maturity. They observe a significantly positive premium for this risk factor, which means that, investors would expect a compensation for increase in the aggregate risk level in the market.

CRR use monthly growth series of industrial production as a proxy for the growth risk factor. The result of the study reveals that the monthly growth series had a positive premium. This positive relationship would imply that the systematic growth risk would fetch a premium in the market.

Arbitrage Pricing Theory get its wide spread acceptance only after it is tested by using macroeconomic variables. It gives some insight into the return generating process and macroeconomic variables influence on the systematic risk factors behind the return generating process.

Beenstock et. al (1986), tested the APT for the UK market and identified that, four factors describing the return generating process. The factors are interest rate, sterling M3 and two inflation measures are priced for the period of 1977 to 1983 in the UK market.

Research in line with the macroeconomic variables is further supplemented by similar studies across different countries. Berry, et. al (1988), Chang (1991), Poon and Taylor (1991), etc.

Mei (1993) in his study used a semi auto regression approach to test the APT in the US market. He advocated that a five factor model explain the return generating process in a better way compared to CAPM. The study used macroeconomic variables and industry specific variables, for explaining the relationship with share returns.

Fama and French (1993) introduced a three factor model in tune with the Arbitrage pricing theory. They argued that the effects of size and book equity to market equity could be explained as surrogate of risk premiums. Using an arbitrage pricing type model they show that stocks with higher sensitivity on size or book-to-market factors have higher average returns. They assert that the risk is determined by sensitivity of a stock to three factors of Market portfolio, a portfolio that reflects relative returns of firms with high verses low book –to- market ratio firms, and a portfolio that reflects relative returns of small verses large firms. They argued that even though size and book- to-market equity ratios are not direct factors affecting returns, they perhaps might be proxies for more fundamental determinants of risk.

Hauda and Linn (1993), Examines the effect of incomplete information on the parameters generating assets returns under APT. The analysis reveals that risky asset with high informations are priced relatively higher and vice versa. Maximum likelihood estimates of factor betas, which are based on normality assumptions, are too high for high information assets and vice versa. They also argued that increasing the sample size by adding new securities to a factor analysis procedure can result in the detection of additional priced factors when they do not really exist.

Clare et.al, (1994) used beta and size sorted portfolio for testing APT in the UK stock market for the period 1983 to 1990 by considering 20 variables from the economy. They reported that 7 factors are priced in the UK economy and the priced factors are oil prices, two measures of corporate default, the retail price index, private sector bank lending, current account balance and redemption yield on an index of UK corporate debentures and loans.

A major development occurred in the testing procedure of APT in the year 1995. The multifactor macroeconomic APT tested in the UK market. Cheng (1995) in his unique work applied the factor analysis for both security returns and macroeconomic variables and introduced canonical correlation analysis in the first time. In order to overcome the limitations and difficulty of testing the APT by following CRR methodology, which left unsatisfied the economic interpretations of the factors, he argued that the new method of testing the APT is an innovative contribution. For testing the APT, the theory itself does not offer any theoretical framework or empirical grounds for identifying the economic nature of factors. By pointing out, various drawbacks and difficulties experienced in testing the APT by using CRR methodology, mainly related to the multicollinearity among economic variables and sensitivity of multiple regression analysis related to number of independent variables included in the regression; he remarked that a particular factor may appear to be significant in one multivariate analysis, but not, when other independent variables have been changed.

Based on the foundations of the APT, the researcher used the canonical correlation analysis to analyse the factor loadings of security returns and those of a set of economic variables. He advocates that canonical correlation analysis is an appropriate technique to link economic factors with the stock market returns. Using UK stock market data and economic indicators for the period of 1965 to 1988 tested the APT theory and the study reveals that there are two prominent factors behind the return generating process and canonical variate related to the market indices are prominent one. The result of the study imply that security returns are correlated to the longer leading indicators, money supply, government security price index and unemployment rate. It also reveals that there is a small negative correlation between security returns with the lagging indicator and interest rate.

Garvett and Priestly (1997) focused their study on the assumption about factor structure, i.e. approximate factor structure or extract factor structure and its implications on testing the APT. They investigated, whether returns have a strict or an approximate factor structure and to analyze the empirical importance of the assumption about the factor structure that returns are assumed to follow. The study by using the returns on securities traded on the London stock exchange, reported an approximate factor structure and identified six factors are priced significantly. It also reported that under the assumption of exact factor structure, none of the factors are significantly priced.

Empirical applications on the APT have either focused on extracting the latent factors by factor analysis technique, without specifying the underlying state variables or equated the K factor with observable variables on a priori ground. The former procedure facing a criticism of too many factors and the second procedure does not provide a test of the number of factors. Costa et.al, (1997) focused on reduced rank regression approach to test the asset pricing models. The reduced rank structure allows the researcher to test for the number factors in asset returns and also for the given number of factors. It gives a frame work to analyze the relation between financial market and each economic indicator. The study reported that results are consistent with the APT return generating process, the number of factors is greater than four and some of the selected variables have correlation with the latent factors.

Nguyen (1999) studied the relationship between stock price changes in Thailand stock market and economic indicators in tune with the APT frame work. The study considered, a market index, changes in the exchange rate, industrial growth rate, unexpected change in the inflation, changes in current account balance, difference between domestic interest rate and international interest rate. The study reveals that exchange rate and industrial growth are priced factors in the Thailand stock market, with a negative premium.

The APT argues that the expected return on a security could be affected by its covariance with other macroeconomic factors. The APT assumes that in a well diversified economy with no arbitrage opportunities, a linear relationship exists between the expected return on securities and the factor loadings of the systematic risk factors. Factor analysis is a statistical tool that attempts to identify a relatively small number of factors that represents the relationship that exists between a large numbers of interrelated variables. Morelli (1999) investigated the impact of using the factor analysis tool for extracting the factors by principal component method and maximum likelihood method, in the light of a structural change like a market crash, in stock market returns. The study reveals that structural changes have no impact on the factors and the factors extracted from security returns in the framework of APT did not suffer a structural break.

Middleton and Satchell (2001) examined the use of proxies for the true factors in the arbitrage pricing theory. They pointed out that when there are more reference variables than the true factors, the APT holds its validity and if the possibility of fewer reference variables than the true factors, the APT does not get its validity and testability. He commented that model builders should be generous with the number of factors they use and excessively parsimonious models suffer from inaccuracy.

Sivapulle and Granger (2001) investigated the possibility of portfolio diversification, when there are negative large movements in the stock returns. The results suggest that the possibility of portfolio diversification would be eroded when the market is bearish. In usual or bullish market possibility of portfolio diversification is much beneficial.

Reisman (2002) examined the model testability of Arbitrage Pricing Theory in the light of approximate pricing under the assumption of finite number of assets and pointed out its violation of assumptions and impacts on testability.

Aquunio (2005) investigated the relationship between stock market prices and exchange rates in the light of Asian financial crisis by using two factor Arbitrage pricing theory model. The study reveals that stock returns did not meet significantly to foreign exchange rate fluctuations before that period of crisis. After the onset of crisis, the exchange rate is a priced function in Philippines stock market, indicating the investors expect a risk premium on their investment for their added exposure to exchange rate risk.

From the above observations, it is evident that the APT is stretching its wings to all over the world and researchers and investment practitioners accepted this theory along with the CAPM, in the light of its capacity to explain the return generating process and more realistic assumptions. Researchers are testing the APT in different countries by using different methodologies and statistical techniques. They are trying to identify the risk factors and its magnitude, irrespective of the nature of the economy, whether it is developed, emerging, or under developed. The outcome of the research is very helpful to investors for their decision making. Moreover, the relationship between stock market risk factors and macroeconomic variables are identified and its changes are mapped, that will help the government, in appropriate policy making with an objective of nurturing an orderly growing stock market with adequate depth and breadth; leading to a stable economy.

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Chapter **3**

SYSTEMATIC RISKS AND ECONOMIC VARIABLE SELECTION

Contents

As human wants are unlimited, from the limited income, how in this respect savings are created? As a precaution for meeting the future contingencies and for growth, by making a sacrifice in consumption, savings are created. If savings are kept idle, that will hamper the circular flow of income and ultimately the development of the nation. So in the paradoxes of development of the nation, the role of savings and its channelization into investment plays a very important role.

Investments represent the employment of funds with the object of obtaining additional income or growth. Every investment opportunity is attached with return and risk. Among the various investment opportunities investment in equity shares posses a prominent role, they are the cornerstone of the corporate entities .For the economic development of a nation, orderly growth of a stock market is an essential one. The price movements in the stock market are measured and reported through indices and it is presumed that the volatility and changes occurred in the market as a result of investment climate (internal and external factors) theoretically are driven by macroeconomic variables. Changes in the macroeconomic situation will be reflected in the stock market, based on temporal nature of their relationship and thereby stock exchanges are termed as economic barometers of an economy. Share prices themselves are dependent on the expectation regarding future earnings of the companies, which in turn depends on the performance of the economy.

As mentioned, share prices themselves are dependent on the expectation regarding future earnings of the companies, and that future earnings are themselves dependent on the performance of the whole economy. The crux of the Fundamental analysis based on the idea that, in an economy, variations in the expected return on shares, i.e. total risk, arise due to various factors. It may be the result of the combined effect of company specific factors, industry specific factors and economy wide factors.

In the portfolio context, the total risk can be sorted out into two i.e. systematic risk and diversifiable risk. As an outcome of diversification strategies, in a well diversified portfolio, the influence of company specific and industry specific risk factors i.e., diversifiable risk can be more or less eliminated (approximately). So there exist only systematic risks, which will have bearing on all securities in the market.

In securities market, any source of economy wide uncertainty that creates downward variation in return among many securities is called a systematic risk factor. The systematic risk consist of growth risk, , inflation risk, interest rate risk, exchange rate risk, default risk, liquidity risk and other risks.

Growth risk

From the point of view of risk averse investors, with homogeneous expectations based on portfolio theories, they expect a growth in value of securities (positive return) from the expectation that the company will make profit in tune with the expectation prevailing in the economy towards growth. Economic growth is experienced in the economy with higher production, generation of additional employment opportunities, higher income and resultant higher profitability. So in a growing economy the expectation towards the reward from the investment is also high. If anything happened inconsistent with the economic expectation, that turned in to a risk factor in the investment market, related to growth, especially in equity shares market.

Inflation risk

Investment is one of the important determinants of long run growth of a country. Recent developments in the theory of investment behaviour have focused on the role of instability and uncertainty in determining investment. Inflation as an indicator of macroeconomic instability is hypothesized to have an adverse impact on investments. The short run relationship between growth and inflation is usually positive due to Phillips Curve, but in the long run it erodes all the benefits and adversely affects growth. A rise in inflation much above the natural rate would affect both nominal cash flows and interest rates, thereby reducing the profitability of the firm and the real return on investments. As a result of instability created by unanticipated inflation in an economy, it is turned to be a risk factor.

Interest rate risk

Interest rates play an important role in a market economy. It changes in response to the expectation of borrowers and lenders have about the future level of prices. Changes in the quantity of funds available to finance the spending plans of borrowers as well as changes in borrowers' demand for funds alter interest rate, which in turn affect the levels of consumers and business spending, income, the gross national product, the employment resources and level of prices.

Interest rates in the money and capital market are related and usually move in the same direction. In addition the rate on short term financial instruments are often lower than those on longer term. All lenders have an eye to the future; their understanding of the present and near future is more accurate than a longer period. Therefore the uncertainty is more in longer period compared to a shorter period, lenders demanded higher rate of interest for long term investments.

Both borrowing and lending typically involve a degree of rate of risk and uncertainty which are reflected in the level of interest rates and in the tempo of activity in financial markets. Interest rate fluctuations directly affected the bond market. Depending up on the demand and supply forces and related economic cycles, change in the market interest rate relative to the coupon rate of a bond causes changes in its market value.

Variation in the interest rate indirectly affects the return on equity shares. An increase in the market rate of interest reduced the profitability of a levered firm by increasing the overall cost of capital that leads to downward variation in the actual return from the securities compared to the expected return. On the other hand, increase in the interest rate in the debt market, forces the equity investors to re-fix their expectation level of returns at high for assuming high risk. In level with these expectations, if the returns are not increased, there arises a risk formed from interest rate variation. And thus the variation in the interest rate affects the value of a firm and market price of shares indirectly and turned into a risk factor.

Exchange rate risk

In a dependent financial world, exchange rate risk plays an important role. Exchange rate is one of the important economic variables; a change in exchange rate will affect the value of foreign earnings and export performance of the firms. For an export oriented economy currency depreciation will have a favorable impact on the domestic stock market. As a result of the increase in the demand for the product in the international market, coupled with the impact of currency depreciation, increases the cash flows and profits of the domestic firms, leads to an increase in stock price. An inverse relationship is also expected, as currency depreciates the cost of imports of raw materials and technology increases and ultimately rising the cost of production, which in turn results a decrease in the profitability of firms. Unfavorable variation of the exchange rate affects the profitability of the firms belongs to the host economy and turned in to a risk factor.

Default risk

Default risk is the risk of losses resulting from failure by its counter parties. It is relevant and more important in debt market. A firm defaults when it fails to service its debt obligations. Therefore default risk induces lenders to require from borrowers a spread over the risk free rate of interest. This spread is an increasing function of the probability of default of the individual firms. The effect that default risk may have on equity returns is not obvious, since equity holders are the residual claimants on firm's cash flows and there is no promised nominal return in equities.

Liquidity risk

Liquidity risk refers to the inability of an investor to liquidate his holdings due to non availability of buyers for the security. In the market there is no possibility to realize the investments quickly for a price that is close to the true underlying value of asset. This situation denies the investor to utilize the best opportunities available in the market on a timely manner and thus the lack of liquidity turned in to a risk factor in the market.

Other risk factors

In an economy, any unforeseen events like natural calamities, political turmoil, extreme climatic changes and also international obstructions etc, affect the economy as a whole and its effect will definitely reflected in the stock market, keeping the expectations of investors as expectations, and not a reality. Any factor that creates uncertainties in the economy as whole is termed as risk factor.

Macroeconomic Variable Selection

The multifactor macroeconomic APT states that a small number of macroeconomic variables can explain the return generating process in a well diversified portfolio context. But the theory does not give any explanation about the number of factors and the selection of suitable systematic state variables. The co-movements of asset prices suggest the presence of underlying exogenous influences, but not determined which economic variables are responsible for it. (Chen et. al, 1986) Thus, there is no formal theoretical guidance in choosing the appropriate group of economic factors to be included in the APT model (Azeez and Yonoezawa, 2003).

Groenewold and Fraser (1997) observed that as the APT does not give any formal theoretical guidance in choosing the appropriate group of economic factors, is both its strength and weakness. It is strength in empirical work since it permits the researcher to select whatever factors provide the best explanation for the particular sample at hand; it is weakness in practical applications because it cannot explain variation in asset returns in terms of limited and easily identifiable factors.

Berry et.al (1988) put forwarded three important properties to qualify the macroeconomic variables as legitimate risk factors in the APT framework. They state that legitimate risk factors must possess three important properties:

The first property is very important to the APT and has been widely discussed in literature and deals with forecasting of variables. The property means that the variable selected for testing the APT cannot be forecasted either from its own past value or from any other publicly available information. It means that forecasted information were already priced in the expectations of the investors and hence unanticipated changes in macroeconomic variables are important that turned into systematic risk factors, ultimately affecting the share returns. The second property means that firm-specific variables do not constitute as a variable, for testing APT. An investor might earn excess returns if he or she is able to identify firms with favorable firm-specific events. But this fact is not relevant for APT based Portfolio management strategies, because firm-specific (non-systematic) risks can be diversified away while creating a well diversified portfolio by following the modern portfolio approach. The third property suggests that the selected variable must influence the expected return of the assets, either affecting the future cash flow or discount rate which means that factors should be a priced one.

As already observed, the APT nothing says about the selection of the macroeconomic variables for testing. In most of the studies the variables are selected on the basis of the macro econometric modeling of the concerned economy. Nature of the economy, its openness, size and linkage with the world economy, etc. are serving as a basis for selection of the state variables to test the multifactor macroeconomic APT.

In testing the APT empirical research witnessed the selection of the variables ranging from economy specific to international market variables. The variable selection is made by considering the specific nature of the economy, integration with global market and availability of data. These variables includes, pure economic variables like index of industrial production, money supply, exchange rate, wholesale price index, interest rates, current account balance, measures of corporate default, GDP, budget deficit, etc. Along with these, international variables like oil price, international interest rate are also considered.

In India, macro econometric modeling not incorporated stock market variables (Bhattacharya, 1984). So, the expected return and its variation due to macroeconomic variables' effect on future cash flow or discount rate serve as theoretical basis for selection of macroeconomic variables. Along with this, the selection of macroeconomic variables also considers the specific nature of the economy, its linkages with world economy, size and availability of data. The same set of variables selected in the US and European countries for testing the macroeconomic APT are not serving the purpose of the study in India, especially in a rapidly growing economy. So a different set of economic variables by following the guideline of Berry et. al (1988) considering the specific economic nature of the economy, are selected for the study.

As stated earlier investment in equity shares are made with an expectation of positive future earnings or growth in value determined by future cash flows and discount rate. Any economy wide factors that affect the future cash flows or discount rate or both may be termed as a systematic risk factor. The relationship between variability in future cash flows or discount rate and economic variables are explaining in the study by using more general and understandable terms instead of using the theoretical classification of systematic risk, which have isolated and combined effect on future cash flows and discount rate**.** For this purpose, the systematic risk effects are mentioned as environment determining the investment and expected return from that investment in an economy.

3.1 Investment climate and Credibility of Economy

3.1.1 FII investments

In the globalized scenario, interdependency among the world wide economies is a matter of fact. In the investment arena, the funds are flowed from less profitable area to a destination that offer high returns. The flow of fund is a result of the international diversification strategies pursued by foreign investors in their effort to minimize the risk and maximize the return from their investment. Generally the funds are flowed in two ways, namely foreign direct investment and foreign institutional investment. The impact of the FDI on economy is directly reflected in the growth indicator of gross domestic product, which is measured with the help of Index of Industrial Production.

Foreign institutional investments are not permanent in nature and its net flow may be positive or negative on the basis of investment climate and profit booking attitudes. There exists a difference of opinion among researchers with respect to the contribution of FII inflow in the development of the Indian stock market. Kishor (1997) argued that FII have largely influenced the equity price movements in India but their influence on India’s equity market development is questionable. Studies of Chakrabarti (2001), Griffin (2004) reveal that foreign portfolio investment and resultant cash flow could be treated as a major source of growth and development of market in emerging economies like India.

It is argued that FII investments have no real contribution in terms of resource mobilisation. However, it could have a crowding in effect on domestic savings and investment mobilisation. Ultimately, the domestic investment mobilisation enhances the stock market activities. This is based on the presumption that foreign investment inflows reduce the cost of capital to the corporations of the host country in the primary market and resultantly increase the share prices. On the basis of the above stated viewpoints, foreign institutional investor’s net investments (FII) included as a proxy variable in the study, corresponding to the investment climate in the economy.

3.1.2 Foreign exchange reserve

In the globalised market scenario, host country’s foreign exchange reserve plays a crucial role in the economic development. The ratio of foreign exchange reserve to short term external debt measures the capacity of a country to service its external liabilities in the forthcoming year. A ratio above one signals that, the country holds an adequate level of reserves to face the risk of financial crisis. A ratio below one may indicate a vulnerable capital account facing difficulties to pay off its external liabilities. The ratio of foreign exchange reserve to import is considered as a proxy for a country’s current account vulnerability. Gosselin and Parent (2005) observe that a ratio of three to four is considered as a safe bet.

Firms that relay upon foreign countries for their raw materials for production and technology for modernization will be affected by any constrains imposed by the government in the utilization of foreign exchange, due to inadequate foreign exchange reserves. This situation jeopardizes the plans of the firms, caused for a drop in the earnings and ultimately affects the stock returns. Moreover foreign investments are received in an economy considering investment climate comprising credibility and repaying capacity of a nation on a timely manner. To an extent, the quantity of foreign exchange reserve serves as a basis for evaluating the credibility and repaying capacity of the economy. These arguments lead the inclusion of foreign exchange reserve in the study as a proxy variable to assess the impact of credibility of the economy and investment climate on stock returns.

3.2 Investment and credit Environment

3.2.1 Money supply

The price of a stock is determined by the present value of the future cash flows. The present value of the future cash flows is calculated by discounting the future cash flows at a discount rate. Money supply has a significant relationship with the discount rate and, hence, with the price of a share. There are competing views on how money supply affects stock market prices. Keynesian economists argue that there is a negative relationship between stock prices and money supply, whereas real activity theorists argue that the relationship between the two variables is positive (Sellin, 2001).

Keynesian economists argue that money supply will affect stock prices only if the change in money supply alters expectations about future monetary policy. They argued that a positive money supply shock will lead people to anticipate tightening monetary policy in the future. The subsequent increase in bidding for bonds will drive up the current rate of interest. As the interest rate goes up, the discount rate also increases. Increasing interest rates leads to slowdown in economic activities. Slowdown in overall economic activities reduced the profitability of firms and shows a decline in the market price of shares.

On the other hand, the real activity economists argue that a positive money supply shock will lead to an increase in stock prices. They argue that a change in the money supply provides information on money demand, which is caused by future output expectations. If the money supply increases, it means that money demand is increasing, which, in effect, signals an increase in economic activity. Higher economic activity implies higher cash flows and profit, which causes a rise in the stock prices. They also argue that tightening the money supply raises the real interest rate. An increase in the interest rate would in turn raise the discount rate, which would decrease the value of the stock.

Bernanke and Kuttner (2005) argue that the money supply affects the stock market through its effect on both the monetary value and the perceived risk. Money supply affects the monetary value of a stock through its effect on the interest rate. They argue that tightening of the money supply would increase the risk premium that would be needed to compensate the investor for holding the risky assets. They believe that tightening the money supply symbolizes a slowing down of economic activity, which reduces the potential of firms to make a profit. Investors would be bearing more risk in such a situation and, hence, demand more risk premium. The risk premium makes the stock unattractive, which would lower the price of the stock.

The proponents of the efficient market hypothesis hold that all available information is already reflected in the price of a stock. Their argument is that, anticipated changes in money supply would not affect the stock prices and only the unanticipated component of a change in money supply would affect the stock market prices. Sorensen (1982) reported that unanticipated changes in the money supply have a larger impact on the stock market than anticipated changes, supporting the efficient market hypothesis. The opponents of the efficient market hypothesis, on the other hand, argued that all available information is not embedded in the prices and hence, the anticipated changes in money supply would affect the stock prices (Corrado and Jordan, 2005), Biniv,(2007) also supported the importance of anticipated changes in the money supply and its influence on share prices.

From the above discussions, it is justifiable one that, money supply have an impact on share prices either it is negative or positive or warranted by efficient market hypothesis or not. So in this study money supply (M3) included as a proxy variable, under credit and investment conditions, as it is closely related to the monetary policy of the government which determines the credit, money in circulation and interest rates.

3.2.2 Banking systems Credit to Government (BCG)

Bhattacharya (1984) and Krishnamurthy (1985) report that the output growth in India is directly as well as indirectly, related to the public sector investments, which is complemented by the private sector. In the liberalized scenario, though, the role of public sector investments are slightly reducing and the role of private sector investments and foreign direct investments are getting upper hand, the importance of public sector investments still exist in the lime light. Therefore it is essential that these investment variables are part of this study. However, monthly data on these variables are not available for the entire study period. Therefore, a proxy must be selected. Since a large part of the government investment is financed either through mobilisation of savings from the public or from the banking system through the instruments like SLR (statutory liquid reserve). Therefore in this study banking systems credit to government (BCG) taken as a variable representing the public sector investments, as a proxy for the credit condition of the economy (Sood, 1995).

3.2.3 Banking system's Credit to the Commercial sector (BCC)

Fund availability plays a crucial role in the industrial development of a country. In the private sector developments, bank credit extended to the sector is treated as one of the major source of the fund. Therefore, banking system's Credit to the commercial sector (BCC) is included in the study as a proxy variable related to the private sector investments.

3.3 Cost Environment

It is considered that interest rate changes have an impact on discount rate as well as profit expectation in the economy. Higher interest rates and its resultant discounting rate reduce the value of future cash flows and make the investment and return less attractive. Shahid Ahamad (2008) reported an inverse relationship between stock returns and interest rate movement. Bhattacharya (1984) observes that demand for monetary as well as financial assets is dependent on interest rates compared to other variables. Therefore, it is essential that the interest rate changes are included in the set of macroeconomic variables for this study.

In the pre liberalized period all the interest rates are administered by the RBI. The interest rates in the organized financial sector of the economy are determined by the monetary policy of the government and trend in money supply.These rates are thus controlled and varied within certain ranges. Still in the deregulated phase, in India, RBI and the monetary policy of the government regulated the interest rate by fixing an upper ceiling. In the Indian context the only interest rate driven by the market is the call money rate. So the call money rate (CALM) is taken as a proxy for the interest rate risk in this study. All other interest rates are partially administered or static for a long period of time due to the government policies or data with same underlying characteristics are not available for the entire study period. Therefore, in the present study only call money rate is included as macroeconomic variable corresponding to interest rate risk covering under cost environment.

3.4 Inflation Environment

Investment is one of the important determinants of long run growth of a country. Inflation as an indicator of macroeconomic instability is hypothesized to have an adverse impact on investments. A rise in inflation much above the natural rate would affect both nominal cash flows and interest rates, thereby reducing the profitability of the firm and the real return on investments. The inflation rate is an important element in determining stock returns due to the fact that during the times of high inflation, demand for the product decreases due to price rises, people tends to buy only the essential items. This results a decrease in production and employment opportunities. A decrease in demand for the products forced to cut short the production even further. This affects the corporate profits, which in turn makes unattractive low dividend. When dividend decreases, the expected return of stocks also decreases, causing decrease in share prices. It leads to a negative relationship between share price and inflation. (Fama 1981).

In India for measuring the inflation, wholesale price index (WPI) is commonly followed in majority of the cases with its features of single index on country basis, larger coverage of items and shorter lag compared to consumer price index (Kaushik 2011). In contrast Patnaik et.al (2011), Rakshit

(2011) criticized the use of WPI as a measure for inflation in the changing scenario, by highlighting that, WPI does not track the price of services, which is increasingly the major part of India's value added in GDP. They argued for using the consumer price index (CPI) as a measure of mapping inflation. Consumer price index is also not free from limitations. It is criticized on the ground that, there is no single index representing the entire segment of the country. At present there are three separate indexes, representing urban industrial workers, rural labourers, and agricultural labourers. It is also criticized on the basis of longer time lag and lower number of items included in the basket up on which the index is constructed. On the basis of this difference of opinion, for the present study, both WPI and CPI of urban industrial workers are included as proxies for inflation prevailed in the country.

3.5 Alternative investment Environment

In the investment arena, there are several substitutes for equity share investment, with varying magnitude of risk and return. It includes investment in gold and silver, the investment in life insurance policies, real estate, mutual fund units, provident fund, debt instruments of corporate sector, government bonds etc. Inclusion of the return on all these substitute assets is not possible on account of the very nature of these assets. Some of these instruments have no secondary market and interest or return on most of these assets have not determined by the market. Along with these, certain assets like government bonds are attached with some additional benefits in the form of tax concessions, which is varying in accordance with the tax bracket of the investors. In view of the above particulars of these alternative investment opportunities, it is not possible to generate a monthly series of return on all these assets.

Barua and Reghunatan (1982) assert that investment in gold provides a complete hedge against inflation. This would imply that investment in gold is a substitute for investment in equity shares. Since gold is an important alternative investment option in India, and is very often used as a hedge against inflation, it expected that gold may be looked up on as alternative asset for investors. Moreover the price of the gold is a market determined one. On the basis of the above reported characteristics, gold (GOLD) is included in the study as an additional variable to examine, whether variation in the gold price contain any significant information about price variation of equity share investment, along with other macroeconomic variables considered in this study.

3.6 Growth Environment

Investment is one of the important determinants of long run growth of a country. A good performance in the industrial sector is an indication of the growing economy and such a trend coupled with induced performance in other sectors enhance the economic growth. Various studies aimed to examine the relationship between Index of Industrial Production (IIP) and stock market reveal that rise in IIP would produce upspring in the stock market.

Economic growth is experienced in the economy with higher production, generation of employment opportunities, higher income and resultant higher profitability. In the investment process, investors expect a growth in value of securities from the expectation that the company will make profit in tune with the expectation prevailing in the economy towards growth. Growth measures in an economy generally represented by indicators like, Gross Domestic Product (GDP) and level of employment. Data relating to GDP and employment generated on monthly basis is not available for the study period. So, for studying the influence of growth risk on equity share investment, general Index of Industrial Production (IIPG) is selected as a proxy variable in the study representing growth expectation of the economy. Along with this Index of Mining and quarrying (IIPMI), manufacturing (IIPM) and Electricity (IIPE) are included in the study as sectoral counterparts.

3.7 Dependency Environment

3.7.1 Exchange Rate

Exchange rate is one of the important economic variables; a change in exchange rate will affect the value of foreign earnings and export performance of the firms. For an export oriented economy currency depreciation will have a favorable impact on the domestic stock market. Exported products become cheaper on the world market and thus increasing demand for them. As a result of increase in the demand for the product in the world market, increased cash flows and profits generally increase the stock price of the domestic firms. An inverse relationship is also expected, because as currency depreciates, the cost of imports of raw materials and technology increases and ultimately rising the cost of production, which in turn results a decreases in the profitability of firms. In a nut shell, the impact of the exchange rate fluctuations on the economy mainly depend on balance of payment positions i.e. favorable or unfavorable.

Alternately, in a liberalized scenario, exchange rates are determined by the demand and supply forces, a growing stock market would attract capital flows from foreign investors, which may cause an increase in the demand for the host country’s currency. In a falling stock market foreign investors try to realize their investment either for reducing loss or for future profit booking. These situations induce the demand for foreign currency and ultimately depreciate the home currency, which leads to changes in the currency exchange rates.

In India, after the introduction of new economic policy and liberalization of economy, to an extent the exchange rate is a market driven one compared to the pre liberalization period where the exchange rate was a highly pegged one. In extreme situations, government through the central bank intervened in the foreign exchange market to avoid the extreme volatility in the market by appropriate measures. It is argued that regulated exchange rate may not be meaningful for an asset pricing study. In the changed scenario exchange rates are partially deregulated, and considering the impact of exchange rate in the economy and stock prices, Rupee Dollar Exchange rate is included in the study as a macroeconomic variable for the exchange rate risk covering under the dependency environment.

3.7.2 Export and Import

Krishnamurthy (1985) reports that the prices, output and investment in the domestic sector is influenced by import prices as well as the import quantities. The relevance of this argument augmented in the liberalized scenario, with the concept of world as a single market, is capable to affect the profitability of firms and share prices. Therefore, along with Rupee dollar exchange rate, export and import are also included in the study as macroeconomic variable which determines the balance of payment positions together with the exchange rate, indicating the environment of dependency to the world economy.

3.8 Liquidity environment

Liquidity is an important feature of the financial market. It determines the level of ease and cost with which an investor can convert his or her investment in to cash (Chamberlain and Rothschild, 1983). Therefore transaction cost serve as a proxy for the level of liquidity in the market. However it is not really feasible to generate an aggregate measure of transaction cost for the market as a whole. More over after the deregulation of the economy transaction cost is a fixed percentage. With an assumption that an increase in the trading volume of a selected number of securities or by an increase in number of traded securities that would enlarge the opportunity set and also help to reduce the spread required by the market makers, market turnover is taken as a proxy for liquidity risk by some of the researchers (Sood, 1995). So, in the present study, market turnover (BSET) in Bombay Stock Exchange included as a variable in the study, even though it is a stock market variable and do not fulfill the essential properties of a macroeconomic variable, advocated by Berry et.al (1988).

It is important to comprehend that all variables mentioned above are not exclusive or inclusive for APT. The theory itself gives no direction or guidance on the choice of factors and does not provide information on the factors that determine risk premium. As a general rule of thumb the APT factors must correlate with major source of uncertainty which is a concern to all investors and related with primary consumption and investment opportunities. For the present study, the variables are selected on the basis of special nature of the Indian economy, its economic significance and relation with stock market. Availability of reliable and sufficient data with adequate time interval is also serving as a basis for selection of the variables.

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Chapter

4

FORECASTING OF SELECTED MACRO ECONOMIC VARIABLES

Contents

4.1 Introduction

As mentioned earlier, the empirical literature on the APT measures the macroeconomic variables in two different ways to analyse the relationship with stock prices. One stream of researchers used the rate of change in the actual macroeconomic variables and these rates of changes in macroeconomic variables are taken as a basis for analyzing the relationship with share prices. The other group of researchers argued that unanticipated changes in the macroeconomic variables are important for factor pricing and they used the innovations in a time series process to study the relationships. This is mainly based on the view that anticipated changes in the macroeconomic environment are already incorporated in analyzing the risk in the investment process. Thus, only unanticipated changes in macroeconomic variables are considered as systematic risk factors affecting the share prices. In tune with this argument, in the present study, forecast series are created for relevant macroeconomic variables from actual time series data. Then the differences between actual and forecast series, i.e. residuals are taken as unanticipated changes in the macroeconomic variables. These residuals are used as input for further analysis to study the relationship with the stock prices.

4.2 Forecasting: Theory and Methodology

The fundamental concept underlying forecasting a series is that by examining the past data, map out the future path of the series based on the patterns in the historical data. Time series forecasting techniques are widely used for forecasting different financial and economic variables. Time series forecasting refers to predicting the future values based on the past values which is measured regularly over time.

In time series forecasting different methods are employed ranging from linear trend to more advanced Auto Regressive Integrated Moving Average (ARIMA) models. Selection of a method should be based on the objective of the study and nature of the data. There is no single right forecasting method applicable to a data set carrying different nature. Hence, in the present study, different methods are applied based on the nature of the data, for forecasting macroeconomic variables.

Generally, before determining the methods of forecasting, the historical data should be plotted on graph and see whether there is any identifiable pattern. If the data shows a clear pattern, i.e. a linear or nonlinear trend, then trend models can be used for forecasting. On the other hand, if there is no clear pattern, trend methods are not suitable. In such cases, ARIMA models developed by Box and Jenkins (1976) are used for forecasting. ARIMA modeling adopt a strategy of ‘let the data speak for themselves’, i.e. selecting a model that fits the data well. This implies that data has a role in model selection. In this study, based on the nature of the data, both trend methods and ARIMA Models are used for forecasting macroeconomic variables.

4.3 Trend models

Trend models are useful for forecasting when there is some kind of specific trend component in the graph of plotted data. Trend component means, data shows either increasing or decreasing trend over time. Here the observed series is a function of time. Thus, time comes as explanatory variable in trend models. The pattern mimicking the trend may be linear or nonlinear. If it is a linear one, i.e. we have a straight line plot, and then linear trend model can be applied. The linear trend model can be specified as

$$Y_t = \beta_0 + \beta_1 Time_t$$

Sometimes line graph shows a curve shape, and then the pattern is nonlinear. In such cases, applicable options are Quadratic trend model and Exponential trend model. Quadratic trend model can be specified as

$$Y_t = \beta_0 + \beta_1 Time_t + \beta_2 Time_t^{\,2}$$

Exponential trend model can be specified as

$$Y_t = \beta_0 e^{\beta_1 Time_t}$$

In time series data, sometimes, it is characterized by seasonality and in order to capture the impact of seasonality, respective multiplicative models are used for forecasting.

4.4 Model selection Criteria

Selecting a model from the above mentioned trend models is based on three criteria, they are adjusted $R^{2,}$ Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC).

4.4.1 Adjusted R^2

R^2 is called coefficient of determination or measure of goodness of fit. It shows the explanatory power of a model, the proportion of variability in the dependent variable (in our case it is Macroeconomic variable) explained by the explanatory variable (in our case it is time). Here Adjusted R^2 used for comparison, since in Quadratic trend model, there are more than two parameters. Adjusted R^2 is used as measure of goodness of fit for the multiple regression models and its R^2 adjusted for the number of parameters in the model. There will not be any significant difference between R^2 and Adjusted R^2, if the number of parameters is two. Usually a model with highest Adjusted R^2 will be selected as best model.

4.4.2 Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC)

Similar to the adjusted R^2,AIC and SIC are other measures which penalizes for adding regressor to the model, because including more variables in a forecasting model will not necessarily improve its out of sample forecasting performance, although it will improve model fit. Thus we have to adjust the mean squared error with the degrees of freedom used. This is to get an accurate estimate of the one step ahead out of sample forecast error variance, need to penalize in sample residuals variance (the MSE) to reflect the degrees of freedom used (Diebold, 2007). Two useful criteria for this purpose are Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC).

$$AIC = \exp\left(\frac{2k}{T}\right)\frac{\sum_{t=1}^{T} e_t^2}{T}$$

$$SIC = T\left(\frac{k}{T}\right)\frac{\sum_{t=1}^{T} e_t^2}{T}$$

Where, k is the number of regressors and T is the number of observations. $2k/T$ in AIC and k/T in SIC equations are penalty factors. AIC and SIC are measures of mean squared error (MSE) and the goal of forecast is to produce low mean squared error. The best linear forecast is the linear function of that minimizes the MSE. Therefore, selection of the model is based on lowest AIC and SIC.

4.5 Autoregressive Integrated Moving Average (ARIMA) Process

Autoregressive Integrated Moving Average or ARIMA (p,d,q) modeling is based on a methodology developed by Box and Jenkins (1976). ARIMA modeling is useful for forecasting when the data is not showing any kind of trend. In ARIMA modeling forecasting is made not only the series itself but also the periods to period changes and by integrating the period to period changes, the series is forecasted. In this modeling the forecast series is estimated by linear combination of recent past values, i.e. regressing the series on its own lagged values and the lag order is represented as order of Autoregressive (AR) process, given as ‘p’ in the general representation of ARIMA model. Along with this, moving average of current and past error terms at different lags are taken into consideration and it is represented by the order of Moving Average (MA) process given as ‘q’ in the general representation of ARIMA (p, d, q) model.

4.5.1 Autoregressive Model or AR (P) Model

The AR (p) model is the generalization of AR (1) model. AR (1) model can be specified as

$$Y_t = \alpha Y_{t-1} + \mu_t$$

The model implies that the value of '*Y*' at time 't' is determined by its own values in previous periods plus a random shock. The lag order of AR term will be different for different data. Thus, to generalize, consider the AR (p) model which is an autoregressive of order (p) and will have p lagged terms as in the following.

$$Y_t = \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + ...\alpha_p Y_{t-p} + \mu_t$$

Using summation symbol

$$Y_t = \sum_{i=1}^{p} \alpha_i Y_{t-i} + \mu_t$$

4.5.2 Moving Average Model or MA (q) Model

MA (q) model is the generalization of MA (1) model

$$Y_t = \mu_t + \phi \mu_{t-1}$$

The generalized MA(q) is of the form

$$Y_t = \mu_t + \phi \mu_{t-1} + \phi \mu_{t-1} + ... + \phi_q \mu_{t-q}$$

The model suggest that value of '*Y*' at time 't' equal to the constant plus a moving average of current and past error terms.

Using summation symbol

$$Y_t = \mu_t + \sum_{j=1}^{q} \phi_j \mu_{t-j}$$

4.5.3 Autoregressive Moving Average or ARMA (p,q) Model

As it is clear from the term ARMA, ARMA (p, q)the model is a combination of AR(p) and MA(q) processes. ARMA (p,q) can be specified in summation form as

$$Y_t = \sum_{i=1}^{p} \alpha_i Y_{t-i} + \mu_t + \sum_{j=1}^{q} \phi_j \mu_{t-j}$$

4.5.4 Integrated Processes and the ARIMA (p, d, q) Model

In ARMA modeling, at first verify the stationarity of the series since ARMA models can only be made on stationary time series. Stationary time series is that series whose mean, variance and covariance are constant over time. However, most financial and economic data, especially high frequency data like weekly and monthly, are non-stationary in level. Their mean, variance, and covariance between two periods are changing over time. Thus, checking the stationarity of a time series before applying ARMA model to data is a prerequisite. If the series is non-stationary in the level, then the series has to convert in to a stationary series by taking the first difference. If the series is non-stationary in level and stationary in first difference then the series is called integrated of order one and denoted as I (1). In general, differencing a time series at 'd' times to make it stationary and then apply the ARMA(p, q) model to it, the original time series follow, ARIMA (p, d, q) process, that it is an autoregressive integrated moving average time series. Thus the general ARIMA model is called ARIMA (p, d, q) with 'p' being the number of the lag of AR term, 'd' being the number of differences required to take in order to make the series stationary, and 'q' being number of lagged terms of MA term.

4.6 Augmented Dickey-Fuller (ADF) Test

To verify whether a series is stationary, Augmented Dickey-Fuller (ADF) test is employed. Augmented Dickey-Fuller (ADF) test is a unit root test that has null hypothesis of the series has a unit root, that means the case of non-stationarity. In fact the ADF test is an improved version of Dickey-Fuller test and it is popularly known as Augmented Dickey-Fuller (ADF) test. Dickey-Fuller test has three different forms, first one without constant and trend, second one with constant and without trend, and third one is with constant and with trend. In conducting Dickey Fuller test as in above three forms it was assumed that the error term u_t was uncorrelated. In case, u_t are correlated, Dickey and Fuller (1979) have developed a test known as the Augmented Dickey Fuller test (ADF). The ADF test which consists of estimating the following regression with null hypothesis $\delta = 0$ (that is $\rho = 1$), i.e. the series has a unit root.

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + u_t \alpha i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t$$

The decision is based on tau (τ) statistics and probability values prepared by MacKinnon (1996). Here we cannot use the usual‘t’ statistics since the estimated coefficients of Y_{t-1} does not follow t distribution even for larger samples but follow tau statistics (τ). Thus, If the computed absolute value of the tau statistic ($|\tau|$) exceeds the MacKinnon critical tau values, we reject the hypothesis that $\delta = 0$, in which case the time series is stationary. On the other hand, if the computed $|\tau|$ does not exceed the critical tau value, we do not reject the null hypothesis, in which case the time series is non-stationary (Gujarati, 2005).

Another criterion of decision making is based on one sided MacKinnon probability values. If the calculated one sided MacKinnon probability value is less than the alpha value (probability value) corresponding to the significance level, then by rejecting the null hypothesis and conclude that the series does not have a unit root, that is the series is stationarity. On the other hand if the one sided Mackinnon probability value is greater than the alpha value (probability value) corresponding to the significance level, then the null hypothesis is not rejected and concluded that the series has unit root, the case of non-stationarity.

4.7 Box and Jenkins Methodology

As pointed out, ARMA model can be estimated only for stationary series. Therefore the first step in Box-Jenkins Approach is to check whether the series is stationary or not. If the results of ADF test suggest that the series is stationary, then go to next stage of fixing a preliminary model. Otherwise, go for making the series stationary by taking the first difference. The next step to find 'p' and 'q' orders of the ARMA model. This is usually done by plotting the Correlogram of the series and observing the Autocorrelation function (ACF) and Partial Autocorrelation function (PACF) to determine which model should be a starting point. The lag length of MA term, i.e. the value of 'q' can be determined by observing the significant spikes in ACF. For a pure MA (q) process, the ACF will tend to show estimated autocorrelations which are significantly different from zero up to lag q and then it will die down immediately after q^{th} lag. The PACF for MA (q) will tend to die down quickly either by an exponential decay or by a damped sine wave. For instance, if the series follows MA(1) process, then there would be a single significant spike at lag 1 in ACF and PACF would show a damped sine wave or exponential decay without any significant spikes.

On the other hand, the pure AR(p) process will have an ACF which will tend to die down quickly either by an exponential decay or by a damped sinewave, while the PACF will tend to show spikes (significant autocorrelations) for lags up to p and then it will die down immediately. For instance, if the series follows AR(1) process, then there would be a single significant spike at lag 1 in PACF and ACF would show a damped sine wave or exponential decay without any significant spikes (Asteriou and Hall, 2005).

After getting a preliminary idea about the possible model, go for estimating different set of models up to the pre determined lag length of AR and MA terms. Then, select a model which gives minimum AIC and SIC values. By and large, the model suggested ACF and PACF will give minimum AIC and SIC values and ultimately giving a common conclusion. However, in some exceptional cases, especially when the series is differenced one, they may suggest different set of models. In such cases, selections of the model is based on AIC and SIC values. Further, see whether the parameters of longest lag are significant. If not, probably there exist too many parameters, and should reduce the insignificant lags. However, the significance of coefficients of MA and AR term should not be taken as a must one, especially for the middle lags, since our basic purpose is to create a forecast series.

By examining the ACF and PACF of residuals of the estimated model, it is to make sure that all coefficients are insignificant and there are no more patterns left. If some ACF and PACF coefficients found significant, means that, there are some more patterns left. In such cases, re estimate the model by adding some more lags to AR and MA terms until all error ACFs and PACFs will be insignificant. Following this procedure finally a model is selected and a forecast series is generated using this model. The residual series is calculated by taking the difference between actual and forecast series and this residual series is taken as the input for further analysis.

4.8 Variables and Data

For the present study, 17 macroeconomic variables are selected on the basis of the selection criteria comprising Characteristics of economy, Availability of published data, Literature support and Objective of the study. All these selected variables have some impact on the future cash flows or discount rate of an organization. As far as possible Berry's criteria is also serve as a basis of selection of economic variables, to limit the number of variables considered in the study. Details of selection of macroeconomic variables and its economic significance corresponding to various systematic risk factors are reported earlier. The selected variables are Money supply (M3), Call money rate (CALM), Reserve Bank's credit to government sector (BCG),Reserve Bank's credit to commercial sector (BCC), Net investment of FIIs (FII), Foreign exchange reserve (FORX), Rupee–US Dollar exchange rate (EXR),Wholesale price index (WPI), Index of industrial production - general (IIPG), Index of industrial production–manufacturing (IIPMF), Index of industrial production–electricity (IIPE), Index of industrial production–mining (IIPMI),Consumer price index (CPI), Export (EXP), Import (IMP),Gold price (GOLD), BSE Turnover (BSET).

In tune with the objective of the study, entire study period is divided in to three, by considering developments in the stock market, as a result of opening of the economy and libarlisation process. The first phase, comprised 6 years starting from April 1994 to March 2000. The selection of the period is related to the land marks of fully automated, nationwide trading system with real time access of information and more transparent trading procedures.

Along with this, policy change on Foreign Institutional investor's entry in to the secondary market (1993) is also happened and related flow of fund increased remarkably in the year 1994. These two major events lead to the selection of the year 1994 as the starting period of the study.

In the year 2000,the second stage of economic libaralisation activities are initiated and its impacts are clearly reflected in the capital market, represented by high volume of activities in the market, supported by the confidence of a stabilized market. These aspects lead to the selection of the period, April 2000 to march 2006 as the second phase. After that the more volatile period in the stock market in the libarilisation era, falling in the third phase covering a period of five years – April 2006 to March 2011.

Data relating to the 17 selected variables are collected on a monthly basis, from official publications and Web sites of Government of India, Reserve Bank of India (RBI) Central Statistical Organization (CSO), and Securities and Exchange Board of India (SEBI).

Tables- Phase 1 (1994-2000)

Table 4.1.1 Model Selection Criteria for BCC

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.977363	21.97497	22.03677
Quadratic Trend	0.987503	21.39377	21.48647
Exponential Trend	**0.988753**	**21.27547**	**21.33727**

Table 4.1.2 Model Selection Criteria for BCG

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.968733	21.84009	21.90189
Quadratic Trend	**0.993906**	**20.21777**	**20.31047**
Exponential Trend	0.991254	20.56608	20.62788

Table 4.1.3 Model Selection Criteria for Money Supply

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.976423	23.60813	23.66993
Quadratic Trend	**0.998219**	**21.03817**	**21.13087**
Exponential Trend	0.997928	21.17638	21.23818

Table 4.1.4 Model Selection Criteria for WPI

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.962446	4.662027	4.723827
Quadratic Trend	**0.974797**	**4.276076**	**4.368776**
Exponential Trend	0.951451	4.918816	4.980615

Table 4.1.5 Model Selection Criteria for CPI

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	**0.976512**	**7.115364**	**7.177164**
Quadratic Trend	0.976198	7.141504	7.234203
Exponential Trend	0.972578	7.283844	7.345644

Table 4.1.6 Model Selection Criteria for GOLD

ARIMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,1,0)	**12.87413**	**12.93689**
(0,1,1)	12.87538	12.93765
(1,1,1)	12.89950	12.99363
(2,1,0)	12.89938	12.99424
(0,1,2)	12.89368	12.98708

Table 4.1.7 Model Selection Criteria for IIPG

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	**0.950359**	**5.559281**	**5.651981**
Quadratic Multiplicative	0.949915	5.580852	5.704452

Table 4.1.8 Model Selection Criteria for IIPE

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.940701	5.465995	5.558694
Quadratic Multiplicative	**0.943995**	**5.421514**	**5.545114**

Table 4.1.9 Model Selection Criteria for IIP Manufacturing

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	**0.940531**	**5.912117**	**6.004816**
Quadratic Multiplicative	0.940248	5.929554	6.053154

Table 4.1.10 Model Selection Criteria for IIP Mining

ARMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,0)	7.397609	7.459881
(0,1)	7.491627	7.553426
(1,1)	7.334047	7.427455
(2,1)	7.261897	7.387402
(2,2)	7.003784	7.160665
(2,3)	7.027792	7.027792
(2,4)	**6.773749**	**6.993382**
(2,5)	6.784912	7.035922
(1,4)	6.775377	6.962193

Table 4.1.11 Model Selection Criteria for Call Money Rate

ARMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,0)	6.011763	6.074035
(0,1)	6.089430	6.151229
(1,1)	**6.004923**	**6.098331**
(1,2)	6.019123	6.143667
(1,3)	6.042566	6.198246

Table 4.1.12 Model Selection Criteria for Exchange Rate

ARIMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,1,0)	1.581984	1.644736
(0,1,1)	1.533533	1.595805
(1,1,1)	1.506552	1.600680
(2,1,1)	1.549992	1.644854
(2,1,2)	**1.504764**	**1.662866**
(3,1,3)	1.622405	1.718012

Table 4.1.13 Model Selection Criteria for Export

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	**0.894506**	**16.18369**	**16.27639**
Quadratic Multiplicative	0.893429	16.20652	16.33012

Table 4.1.14 Model Selection Criteria for Import

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.863764	17.01124	17.11329
Quadratic Multiplicative	**0.882006**	**16.88242**	**17.01849**

Table 4.1.15 Model Selection Criteria for Foreign Exchange Reserve

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.936928	20.70019	20.76199
Quadratic Trend	**0.972590**	**19.87971**	**19.97241**
Exponential Trend	0.969583	19.97093	20.03273

Table 4.1.16 Model Selection Criteria for FII

ARMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,0)	15.63973	15.70249
(0,1)	15.52587	15.58767
(1,1)	**15.24527**	**15.33940**
(1,2)	15.51241	15.63695
(1,3)	15.53541	15.69109

Table 4.1.17 Model Selection Criteria for BSET

Trend Models	**Adjusted R-square**	**Akaike Information Criterion (AIC)**	**Schwarz Information Criterion (SIC)**
Linear Trend	0.628743	21.70949	21.77129
Quadratic Trend	0.858837	20.75539	20.84809
Exponential Trend	**0.902029**	**20.37727**	**20.43907**

Tables- Phase 2 (2000-2006)

Table 4.2.1 Model Selection Criteria for BCC

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.921865	25.47979	25.54159
Quadratic Trend	**0.985763**	**23.79010**	**23.88279**
Exponential Trend	0.974301	24.36782	24.42962

Table 4.2.2 Model Selection Criteria for BCG

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.944720	23.22199	23.28379
Quadratic Trend	**0.985471**	**21.89858**	**21.99128**
Exponential Trend	0.910745	23.70108	23.76288

Table 4.2.3 Model Selection Criteria for Money Supply

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.985770	24.61120	24.67300
Quadratic Trend	0.996023	23.34927	23.44197
Exponential Trend	**0.996471**	**23.21689**	**23.27869**

Table 4.2.4 Model Selection Criteria for WPI

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.975916	4.559710	4.621509
Quadratic Trend	**0.982896**	**4.230312**	**4.323012**
Exponential Trend	0.980931	4.326187	4.387987

Table 4.2.5 Model Selection Criteria for CPI

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.984622	5.839198	5.900997
Quadratic Trend	0.986689	5.707677	5.800377
Exponential Trend	**0.986687**	**5.694946**	**5.756746**

Table 4.2.6 Model Selection Criteria for GOLD

ARIMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,1,0)	12.85020	12.91296
(0,1,1)	**12.74415**	**12.80643**
(1,1,1)	12.76989	12.86402
(2,1,1)	12.76363	12.89011
(3,1,1)	12.74711	12.90646

Table 4.2.7 Model Selection Criteria for IIPG

ARIMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,1,0)	7.042733	7.105485
(0,1,1)	7.065624	7.127896
(1,1,1)	7.053597	7.147725
(2,1,1)	7.011743	7.138224
(1,1,2)	7.012758	7.138262
(2,1,2)	**6.833501**	**6.991603**

Table 4.2.8 Model Selection Criteria for IIPE

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.886410	6.037680	6.130379
Quadratic Multiplicative	**0.891330**	**6.006079**	**6.129678**

Table 4.2.9 Model Selection Criteria for IIP Manufacturing

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.952394	**6.453681**	**6.546381**
Quadratic Multiplicative	0.952660	6.460776	6.584376

Table 4.2.10 Model Selection Criteria for IIP Mining

ARMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,0)	7.443717	7.505989
(0,1)	7.808125	7.869925
(1,1)	7.272842	7.366250
(2,1)	7.157241	7.282745
(1,2)	**6.930929**	**7.065473**
(2,2)	6.931476	7.088357
(3,2)	6.937173	7.125430

Table 4.2.11 Model Selection Criteria for Call Money Rate

ARIMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,1,0)	2.688549	2.751301
(0,1,1)	2.659498	2.721770
(1,1,1)	2.650948	2.745076
(2,1,1)	2.653832	2.780314
(1,1,2)	2.676233	2.801738
(2,1,2)	**2.499915**	**2.658017**

Table 4.2.12 Model Selection Criteria for Exchange Rate

ARIMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,1,0)	**1.038007**	**1.100759**
(0,1,1)	1.040230	1.102502
(1,1,1)	1.064003	1.158131
(2,1,1)	1.091341	1.217823
(1,1,2)	1.086857	1.212362
(2,1,2)	1.054765	1.212867

Table 4.2.13 Model Selection Criteria for Export

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.911138	18.54628	18.63898
Quadratic Multiplicative	**0.927606**	**18.35401**	**18.47761**

Table 4.2.14 Model Selection Criteria for Import

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.930610	19.08905	19.18174
Quadratic Multiplicative	**0.962310**	**18.49137**	**18.61497**

Table 4.2.15 Model Selection Criteria for Foreign Exchange Reserve

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.972238	23.40707	23.46887
Quadratic Trend	**0.979988**	**23.09262**	**23.18532**
Exponential Trend	0.962904	23.69691	23.75871

Table 4.2.16 Model Selection Criteria for FII

ARMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,0)	18.52521	18.58748
(0,1)	**18.47482**	**18.53662**
(1,1)	18.50023	18.59364
(2,1)	18.51589	18.64140
(1,2)	18.51243	18.63697
(2,2)	18.49993	18.55681

Table 4.2.17 Model Selection Criteria for BSET

ARIMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,1,0)	22.07902	22.14177
(0,1,1)	22.11421	22.17648
(1,1,1)	22.02400	22.11813
(2,1,1)	21.97377	22.09927
(1,1,2)	21.95754	22.08209
(2,1,2)	21.96521	22.12209
(3,1,2)	**21.75579**	**21.94551**
(2,1,3)	21.94374	22.13200
(3,1,3)	21.90050	22.12185

Tables-Phase 3 (2006-2011)

Table 4.3.1 Model Selection Criteria for BCC

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	**0.990654**	**25.19790**	**25.26593**
Quadratic Trend	0.990519	25.22750	25.32955
Exponential Trend	0.979225	25.99672	26.06476

Table 4.3.2 Model Selection Criteria for BCG

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.898549	26.33594	26.40398
Quadratic Trend	**0.970706**	**25.10898**	**25.21103**
Exponential Trend	0.951446	25.59904	25.66708

Table 4.3.3 Model Selection Criteria for Money Supply

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.993917	25.68982	25.75786
Quadratic Trend	**0.998010**	**24.58770**	**24.68975**
Exponential Trend	0.994838	25.52557	25.59361

Table 4.3.4 Model Selection Criteria for WPI

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.952148	6.036742	6.104778
Quadratic Trend	**0.958928**	**5.899168**	**6.001222**
Exponential Trend	0.957692	5.913597	5.981633

Table 4.3.5 Model Selection Criteria for CPI

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.961923	8.766110	8.834146
Quadratic Trend	**0.989771**	**7.466969**	**7.569023**
Exponential Trend	0.978814	8.179827	8.247863

Table 4.3.6 Model Selection Criteria for GOLD

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Trend	0.938059	16.65563	16.72367
Quadratic Trend	**0.974192**	**15.79533**	**15.89738**
Exponential Trend	0.890750	16.35523	16.41703

Table 4.3.7 Model Selection Criteria for IIPG

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.892681	7.918870	8.020924
Quadratic Multiplicative	**0.916872**	**7.678384**	**7.814456**

Table 4.3.8 Model Selection Criteria for IIPE

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.909245	6.385650	6.487704
Quadratic Multiplicative	**0.915810**	**6.325494**	**6.461566**

Table 4.3.9 Model Selection Criteria for IIP Manufacturing

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.865918	8.497409	8.599463
Quadratic Multiplicative	**0.881382**	**8.389807**	**8.525879**

Table 4.3.10 Model Selection Criteria for IIP mining

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	**0.916182**	**6.558582**	**6.660636**
Quadratic Multiplicative	0.914763	6.590307	6.726379

Table 4.3.11 Model Selection Criteria for Call Money Rate

ARMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,0)	**3.755564**	**3.824181**
(0,1)	3.979082	4.047118
(1,1)	3.787726	3.890652
(2,1)	3.771726	3.910144
(1,2)	3.811856	3.949090
(2,2)	3.859217	4.032239
(2,3)	3.805619	4.013245

Table 4.3.12 Model Selection Criteria for Exchange Rate

ARIMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,1,0)	2.629013	2.698222
(0,1,1)	**2.594603**	**2.663220**
(1,1,1)	2.644514	2.748327
(2,1,1)	2.692311	2.831934
(1,1,2)	2.671972	2.810390
(2,1,2)	2.631557	2.806086

Table 4.3.13 Model Selection Criteria for Export

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.717385	21.30181	21.40386
Quadratic Multiplicative	**0.738164**	**21.24038**	**21.37645**

Table 4.3.14 Model Selection Criteria for Import

Trend Models	Adjusted R-square	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
Linear Multiplicative	0.709067	22.06310	22.16516
Quadratic Multiplicative	**0.719109**	**22.04292**	**22.17899**

Table 4.3.15 Model Selection Criteria for Foreign Exchange Reserve

ARIMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,1,0)	23.79866	23.86787
(0,1,1)	23.88406	23.92268
(1,1,1)	**23.80285**	**23.90666**
(2,1,1)	23.84427	23.98389
(1,1,2)	23.83544	23.97386
(2,1,2)	23.87759	24.05211

Table 4.3.16 Model Selection Criteria for FII

ARMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,0)	21.07830	21.14692
(0,1)	**21.06222**	**21.13025**
(1,1)	21.08877	21.19170
(2,1)	21.12693	21.26535
(1,2)	21.09970	21.23694
(2,2)	20.99689	21.16991

Table 4.3.17 Model Selection Criteria for Foreign BSET

ARIMA Models	Akaike Information Criterion (AIC)	Schwarz Information Criterion (SIC)
(1,1,0)	22.85415	22.92336
(0,1,1)	22.83904	22.90766
(1,1,1)	22.77820	22.88201
(2,1,1)	22.78871	22.92833
(1,1,2)	22.81022	22.94864
(2,1,2)	22.59617	22.77070
(3,1,2)	**22.54295**	**22.75423**
(2,1,3)	22.82828	23.03772
(3,1,3)	22.60983	22.85632

Table 4.3.18 Forecasting Economic variables –Model selection

Name of Variables	Period -1	Period-2	Period-3
BCC	Exponential Trend	Quadratic Trend	Linear Trend
BCG	Quadratic Trend	Quadratic Trend	Quadratic Trend
Money Supply(M3)	Quadratic Trend	Exponential Trend	Quadratic Trend
WPI	Quadratic Trend	Quadratic Trend	Quadratic Trend
CPI	Linear Trend	Exponential Trend	Quadratic Trend
Gold	ARIMA (1,1,0)	ARIMA(0,1,1)	Quadratic Trend
IIPG	Linear Multiplicative	ARIMA(2,1,2)	Quadratic Multiplicative
IIPE	Quadratic Multiplicative	Quadratic Multiplicative	Quadratic Multiplicative
IIP Manufacturing	Linear Multiplicative	Linear Multiplicative	Quadratic Multiplicative
IIP Mining	ARMA(2,4)	ARMA(1,2)	Linear Multiplicative
Call money rate	ARMA(1,1)	ARIMA(2,1,2)	ARMA(1,0)
Exchange Rate	ARIMA (2,1,2)	ARIMA(1,1,0)	ARIMA(0,1,1)
Export	Linear Multiplicative	Quadratic Multiplicative	Quadratic Multiplicative
Import	Quadratic Multiplicative	Quadratic Multiplicative	Quadratic Multiplicative
Foreign Exchange Reserve	Quadratic Trend	Quadratic Trend	ARIMA(1,1,1)
FII	ARMA(1,1)	ARMA(0,1)	ARMA(0,1)
BSET	Exponential Trend	ARIMA(3,1,2)	ARIMA(3,1,2)

As noted earlier, selection of a forecasting model depends on the nature of the data and the nature of the variable is varying from time to time. Hence different forecasting methods are used to forecast the macroeconomic series, and from that the most appropriate one, based on the criteria of adjusted R^2, AIC and SIC has selected. Instead of a single series forecasting, on the basis of objective of the study and for more reliable forecast, three separate series are forecasted for each macroeconomic variables selected for the study. Comparison of the results of the selection criteria, corresponding to different forecasting models, considered on the basis of nature of the data and the selected models are given in Table 4.1.1 through 4.1.17 for the period one. Table 4.2.1 to 4.2.17 depicts the picture of forecast of macroeconomic series for the second period. 4.3.1 Series of tables shows the comparative result of the selection criteria for different forecasting methods employed to forecast the macroeconomic series selected in the study, for the third period.

Detailed procedure of forecasting, including graph of the original variables plotted, graph of original variables along with best fit and residuals of selected model,(residuals are plotted in a different scale) correlogram of ACF and PACF and results of Unit Root Test for stationarity are given in Appendix 1.

Table 4.4 exhibit the forecasting models selected to estimate the macroeconomic series for the entire study period on a phased manner. It is evident from the table that, for different time periods, the models selected for forecasting the same variable is a different one in some cases. It is the outcome of the changing nature of the data. The plausible explanation is that the study period covers the different stages of economic liberalization process and related policy changes in India. In the liberalized scenario it is too difficult to protect the economic interest of a nation independently. In a dependent world, national and international economic events and its resultant impact, definitely be reflected in the macroeconomic aggregates of an economy and it leads to change in the nature of the data.

Based on the above mentioned estimation process, forecasted series of selected macroeconomic variables are compared with the actual and the series of residuals are taken as unanticipated changes. The series of unanticipated changes in macroeconomic variables are used as independent variable for the canonical correlation analysis, which facilitates the study of linear interrelationship between two sets of variables.

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DIVERSIFICATION AND PORTFOLIO SELECTION

Chapter 5

Contents

The importance of diversification was unraveled by the famous US economist Harry Markowitz (1952), explaining the idea of limiting the risk for the same level of return by combining assets which are not perfectly correlated. The process of combining securities (creating portfolios) with an object of reduction in the total risk without sacrificing the portfolio return is known as diversification. Diversification reduces portfolio risk by holding combinations of instruments which are not perfectly positively correlated. When securities are positively correlated diversifications provides only risk averaging and no reduction in risk. If the securities are perfectly negatively correlated diversification reduces the risk of a portfolio. Modern Portfolio Theory advocates two types of risk i.e. market risk and non market risk (Systematic risk and unsystematic risk). Systematic risk of a security stems from the influence of certain economy wide factors like money supply, inflation, level of government spending, industrial policy, etc, which have a bearing on the fortune of almost every firm. On the other hand diversifiable risk of a security stems from firm specific factors. Systematic or market risk cannot be eliminated through diversification. Risk arising from firm specific factors can be diversified away by creating a well diversified portfolio. In a well diversified portfolio diversifiable risk is more or less eliminated, there exists only systematic risk, representing the risk of a well diversified portfolio.

The fundamental premise behind diversification is that, portfolio risk and volatility can be lowered by investing in a number of differing asset classes which have varying level of risk, volatility and return. When correlation among security returns increases, diversification decreases. And correlation among security returns decreases, diversification increases. While diversifying a portfolio, the risk reduction is due to holding more securities, their returns are imperfectly correlated.

5.1 Portfolio and Diversification

The risk of an equity share portfolio depends on the proportion of the individual shares, their variance and covariance .A change in any of the variables will change in the risk of a portfolio. Risk of a portfolio divided in to two important, but quite different components. They are market risk and non market risk. The market risk of a security or portfolio depends on the extent to which its price is sensitive to the market swings. Non market risk stems from firm specific characteristics. The non market risk of a portfolio depends to a considerable extend on its diversification. As diversification increases the amount of non market risk can be expected to decrease but not proportionately. In a finite economy, the non market risk is diversified away approximately. In a well diversified portfolio diversifiable risk is more or less eliminated and there exists only systematic risk which is the risk of a well diversified portfolio.

Constructing a well diversified portfolio by randomly including shares in it, raise the question of how many shares should be included in the portfolio? The number should depend on the portfolio risk, variance and covariance of securities added in the portfolio. Researchers address the problem in a differing view by giving their justifications.

Evans and Archer (1968) observed that in a randomly created portfolio, the risk declines as the number of shares increased and the risk reduction effect diminishes rapidly as the number of stock increases. They concluded that the economic benefit of diversification is virtually exhausted when portfolio contains ten stocks.

Jacob (1974) has shown that the unsystematic risk of a portfolio can be reduced by few securities by judiciously selecting the securities. His argument is not in tune with random selection of securities

Elton and Gruber (1977) investigated the relationship between risk and number of stocks in a portfolio and give an analytical solution for the relationship between the two. Their analysis reveals that 51 percentage of portfolio standard deviation is eliminated as diversification increases from 1 to 10 securities. Adding 10 more securities eliminates an additional 5 percentage of the standard deviation. Increasing the number of securities to 30 eliminates only an additional 2 percentage of the standard deviation.

GUP (1983) assent that proper diversification does not require investing in a large number of different industries or securities. When the number of securities is increased to nine almost all of the diversifiable risk is eliminated.

Stevenson and Jennings (1984) states that there is no need to hold a market portfolio, the same result can be achieved from a practical stand point with a smaller portfolio combining eight to sixteen shares.

Reilly (1985) states that adequate diversification does not require 200 stocks in a portfolio, and observed that most of the benefits of diversification can be achieved by a portfolio consisting 12 to 18 stocks.

Francis (1986) remarked that the maximum benefits from a naive diversification most likely have been attained by including 10 to 15 shares. And comment that further spreading of portfolio assets is superfluous diversification and should be avoided.

Meir Statman (1987) Examine the diversification by following the principle of marginal cost to marginal benefit comparison. Diversification should be increased as long as the marginal benefits exceed the marginal costs. The benefits of diversification are in risk reduction. The costs are transaction costs. He argued for limited diversification, based on faster increase of marginal cost than marginal benefits, as the diversifications increases. He observed that to create a well diversified portfolio, it should contain 30 to 40 shares.

From the above view points, it is evident that there is no unanimity about the number of shares required to construct a well diversified portfolio. Generally it is true that when shares are randomly selected and combined in equal proportions into a portfolio, the risk of a portfolio declines as the number of shares in it increases.

5.2 Measure of Diversification

Extend of the diversification is measured by using Normalized Portfolio Variance technique developed by Elton and Gruber (1977). In this measure, the portfolio variance is divided by the average variance of the securities in the portfolio.

$$NV = \frac{{\sigma_p}^2}{\overline{\sigma^2}}$$

NV = Normalized portfolio variance

σ_p^2 = Variance of portfolio

$\overline{\sigma^2}$ = Average variance of the securities in the portfolio.

This measure indicates that portfolio variance can be reduced by increasing the number of imperfectly correlated stocks in the portfolio (randomly) or by a proper selection of stocks, by including the securities possessing lower correlations. Extend of diversification reflected in the relationship of variance of portfolio with the average variance of the securities in the portfolio.

Portfolio risk is also reduced by proper selection of a limited number of securities and by making investment using proper weights. For reflecting the characteristics of the market, portfolios are created randomly, which ensure the cross section of the market.

For the present study the portfolios are created through randomly including securities and the extend of diversification is measured by using normalized portfolio variance, by discarding Sharp (1972), Blume and Friend (1975), diversification measure based on relative market value factor and relative non market risk.

As earlier mentioned, for the present study portfolios are constructed by randomly selecting the securities from the shares listed in Bombay stock exchange. A total of 145 securities comprising large, medium and small sized companies are considered in the study and the selection criterions are of market capitalization, survival in the entire study period, market classification by BSE and availability of continuous and reliable data.

In tune with the objective of the study, separate portfolios are constructed based on size and period classification. A total of six well diversified portfolio are constructed, for period one and two, one portfolio each for large sized companies, and for the third period four portfolios-one for large sized companies, one for medium sized companies, one for small sized companies and one portfolio for combined size, representing the cross section of the market.

The securities are selected from the respective groups (number of companies in the groups, which fulfill the selection criterion, restricted on the basis of practicability and requirement of the study) for constructing a portfolio on a random basis, portfolio variance of all the equally weighted portfolios of the respective group, which is equal to N*(N-1) portfolios are calculated. A MATLAB program capable to construct N*(N-1) combinations of security return and reporting portfolio variance of randomly constructed equally weighted portfolio, average variance and normalized portfolio variance, has wrote for this purpose.

Based on the arguments of Elton and Gruber (1977) and observations of Meir Statman (1987), a selection region has been set for identifying the well diversified portfolio. The selection region ranges from the combinations of 20 to 35 shares, which is reasonably large and generally acceptable. The selection criterion of the well diversified portfolio is that, the portfolio that posses the lowest normalized portfolio variance with in the selection region.

Diversification measures of the portfolios falling in the selection region, reported in respective tables for different periods and size, is serve as a basis for selection of the well diversified portfolios for the present study.

Table 5.1 Portfolio Selection- Large Cap Companies

Phase -1

Number of Companies in the portfolio	Portfolio Variance	Average Variance of the companies	Normalised Portfolio Variance
20	0.0034451	0.024659	0.13971
21	0.0041886	0.024478	0.17112
22	0.0043257	0.027624	0.15659
23	0.0043283	0.02492	0.17369
24	**0.0035839**	**0.026751**	**0.13397**
25	0.004453	0.025488	0.17471
26	0.0034822	0.021782	0.15986
27	0.0043928	0.025318	0.17351
28	0.0043264	0.02741	0.15784
29	0.0052748	0.024236	0.21764
30	0.003915	0.023111	0.1694
31	0.004835	0.025454	0.18995
32	0.0048593	0.025701	0.18907
33	0.0043354	0.025417	0.17057
34	0.0041597	0.024643	0.1688
35	0.0048296	0.024915	0.19384

Table 5.1 shows the result of diversification measures of large sized companies for the first period. In the selection region, randomly constructed equally weighted portfolio consisting of 24 securities gives the lowest

normalized portfolio variance. In the case of portfolio variance, Portfolio consisting of 20 securities gives the lowest value. In such a case the average variance of the securities of the portfolio is also taken in to consideration, for a decision. It is based on the concept of higher the risk, higher will be the return. Table shows that average variance of the portfolio consisting 20 securities is much smaller than the average variance of the portfolio containing 24 securities. This relationship is reflected in the normalized portfolio variance.

In comparison with other portfolios in the selection region, based on the criteria of normalized portfolio variance, portfolio consisting 24 securities possessing the lowest value. It leads to the selection of the particular portfolio, as the well diversified portfolio for the period one, for large sized company segment.

Name of the securities included in the selected well diversified portfolio is listed in chapter Appendix 1.

In period 2, for large sized company securities, table 4.2 shows that 26 securities are sufficient to create a well diversified portfolio on random basis. This portfolio posses the lowest portfolio variance and normalized portfolio variance. The selected portfolio, which possessing a higher average variance gives the lowest portfolio variance and is highlighting the benefit of diversification in risk reduction.

Table 5.2 Portfolio Selection -Large Cap Companies Phase-2

Number of Companies in the portfolio	Portfolio Variance	Average Variance of the companies	Normalised Portfolio Variance
20	0.0024418	0.025617	0.09532
21	0.0037356	0.028106	0.13291
22	0.0035121	0.026068	0.13473
23	0.003692	0.026222	0.1408
24	0.0037209	0.028919	0.12867
25	0.003	0.025285	0.11865
26	**0.0022042**	**0.028913**	**0.076235**
27	0.0037922	0.02619	0.1448
28	0.0049451	0.02194	0.22539
29	0.0042031	0.024266	0.17321
30	0.0033578	0.029115	0.11533
31	0.0041318	0.026904	0.15358
32	0.0034417	0.026286	0.13094
33	0.0031768	0.022833	0.13913
34	0.0035858	0.025266	0.14192
35	0.0041552	0.026562	0.15643

Names of randomly included securities in the well diversified portfolio for the second period, given in chapter Appendix 2.

For the third period, four well diversified portfolios are constructed on the basis of size and market cross section, ie. one portfolio each for large sized companies, medium sized companies, small sized companies and a combination of all these representing the market.

Table 5.3 Portfolio Selection- Large Cap Companies

Phase -3

Number of Companies in the portfolio	Portfolio Variance	Average Variance of the companies	Normalized Portfolio Variance
20	0.006436	0.024507	0.26261
21	**0.005564**	**0.022785**	**0.2442**
22	0.005696	0.022668	0.25125
23	0.006581	0.023848	0.27593
24	0.00662	0.024255	0.27292
25	0.006365	0.022645	0.28108
26	0.006365	0.024858	0.25603
27	0.007388	0.024482	0.30178
28	0.005306	0.017399	0.30493
29	0.006973	0.023015	0.30297
30	0.006042	0.023058	0.26202
31	0.007573	0.023628	0.32052
32	0.007106	0.02351	0.30225
33	0.007779	0.023293	0.33397
34	0.007418	0.024158	0.30708
35	0.007566	0.02459	0.3077

Table 5.3 depicts the result of diversification process and construction of the well diversified portfolio belonging to large sized companies. Based on the selection criteria of normalized portfolio variance, randomly selected securities of 21 companies form a well diversified portfolio in tune with the

risk-return relationship. Name of the securities included in the selected portfolio listed in chapter Appendix 3.

In the segment of small sized companies the portfolio consisting of 22 securities fulfill the selection criteria. Table 5.4 shows the result of diversification process and selection of the well diversified portfolio.

Table 5.4 Portfolio Selections -Small Cap Companies

Phase -3

Number of Companies in the portfolio	Portfolio Variance	Average Variance of the companies	Normalized Portfolio Variance
20	0.010566	0.038544	0.27413
21	0.013336	0.042497	0.31381
22	**0.008912**	**0.035863**	**0.2485**
23	0.013091	0.043301	0.30231
24	0.010089	0.039588	0.25485
25	0.014038	0.043027	0.32627
26	0.00959	0.036881	0.26003
27	0.013283	0.039451	0.33669
28	0.009537	0.032891	0.28997
29	0.012435	0.038437	0.32351
30	0.009836	0.033115	0.29702
31	0.012172	0.039686	0.30672
32	0.013489	0.040287	0.33483
33	0.012464	0.037841	0.32938
34	0.011456	0.038635	0.29652
35	0.012513	0.038537	0.32469

Name of securities included in the equally weighted portfolio constructed on random basis for small sized companies are listed in chapter Appendix 4.

For the third period, in the case of medium sized company segment, based on the criteria of normalized portfolio variance, the well diversified portfolio consist shares of 26 companies belonging to different industry sectors. The results of diversification process and portfolio selection are given in table 5.5.

Table 5.5 Portfolio Selections -Mid Cap Companies

Phase -3

Number of Companies in the portfolio	Portfolio Variance	Average Variance of the companies	Normalized Portfolio Variance
20	0.007797	0.02463	0.31657
21	0.010338	0.029525	0.35014
22	0.009119	0.028456	0.32047
23	0.01025	0.028924	0.35437
24	0.009291	0.026819	0.34644
25	0.00948	0.028559	0.33196
26	**0.007867**	**0.025313**	**0.31079**
27	0.00927	0.025088	0.36952
28	0.008421	0.025378	0.3318
29	0.010671	0.029197	0.36547
30	0.009492	0.02725	0.34834
31	0.0101	0.026976	0.37443
32	0.010401	0.02755	0.37754
33	0.010571	0.027375	0.38617
34	0.010114	0.027631	0.36604
35	0.010265	0.027378	0.37493

Chapter Appendix 5 exhibit the names of securities included in the equally weighted and randomly selected portfolio falling under medium sized companies.

As a cross section of the market, a well diversified portfolio is constructed for the third period. Table 5.6 shows that, out of the portfolios given in the selection region of diversification results.

Table 5.6 Portfolio Selections – Market Portfolio

Phase -3

Number of Companies in the portfolio	Portfolio Variance	Average Variance of the companies	Normalised Portfolio Variance
20	0.007474	0.030016	0.24899
21	0.007182	0.026363	0.27244
22	**0.005421**	**0.032947**	**0.16454**
23	0.007145	0.027772	0.25729
24	0.007754	0.029689	0.26117
25	0.008836	0.029891	0.2956
26	0.008842	0.030481	0.29009
27	0.007131	0.027177	0.26239
28	0.007236	0.024629	0.2938
29	0.008297	0.028569	0.29041
30	0.00963	0.034343	0.28041
31	0.011125	0.035345	0.31477
32	0.009904	0.03564	0.2779
33	0.009465	0.0309	0.30629
34	0.006936	0.025	0.27744
35	0.007864	0.025875	0.3039

Portfolio consisting 22 securities gives the lowest value of normalized portfolio variance. On this basis, the particular portfolio is selected as the well diversified portfolio for this segment. Chapter Appendix 6 contains the list of security names included in the equally weighted well diversified portfolio for the third period.

Securities, for constructing the various portfolio combinations, belonging to different segments are selected on the basis of certain criteria and are reported earlier. Name of the securities selected for the study are given in Appendix 4.

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Appendix -1

Name of Companies Large Companies portfolio

Period -1

Bajaj Holding and investments Ltd
Bharth Forge
Aditya Birla Nuvo Ltd
Bombay Dyeing and Manufacturing Company Ltd
Caprihans India Ltd
Ceat Tyres India Ltd
Classic Diamond India Ltd
Colgate Palmolive India Ltd
Garware Plastics and Polyester Ltd
Glaxo Smithkline Pharmaceuticals
Sesa Goa
HDFC Ltd
Hindustan Motors Ltd
Indian Organics Ltd
Indian Tobacco Company Ltd
Mahindra and Mahindra Ltd
Mukund Iron Ltd
Nestle India Ltd
Pfizer Ltd
Raymond Woolen Mills Ltd
Siemens Ltd
SKF India Ltd
Tata chemicals Ltd
Wipro

Appendix -2

Name of Companies Large Companies Portfolio

Period -2

Aravind Mills
Associate Cement Companies Ltd
Bajaj Holding and Investments Ltd
Bombay Dyeing and Manufacturing Company Ltd
Cipla Ltd
Classic Diamond India Ltd
Colgate Palmolive Ltd
Crompton Greaves
Garware Plastics and Polyester Ltd
Sesa Goa
HCL Technologies
HDFC Ltd
Hindustan motors Ltd
Hindustan Petroleum
Indian Organics Ltd
Larsen and Toubro Ltd
Mahindra and Mahindra Ltd
Mukund Iron Ltd
Nalwa Sons
Nestle India Ltd
NIIT Ltd
Philips India Ltd
Pfizer Ltd
Reliance industries Ltd
Siemens Ltd
SKF India Ltd

Appendix -3

Name of Companies Large Companies Portfolio

Period -3

Ambuja Cements
Bharti Airtel
Castrol India Ltd
Cipla Ltd
Colgate Palmolive Ltd
Glaxo Smithkline Pharmaceuticals
Sesa Goa
HCL Technologies
Hindustan motors Ltd
Larsen and Toubro Ltd
Ashok Leyland
Mahindra and Mahindra Ltd
Maruti Suzuki
Mukund Iron Ltd
Nalwa Sons
NIIT Ltd
Pfizer Ltd
Raymond Woolen Mills Ltd
Ranbaxy Laboratories
Tata Chemicals
Tata consultancy services

Appendix -4

Name of Companies - small cap portfolio

Period -3

Ago Tech Foods
Apar Industries
Bharati Shipyard
Bombay Burma Trading Corporation
Chemplast Sanmar
ESAB India Ltd
Fag Bearings India ltd
Federal Mogul Goetze
Good Year India Ltd
Gulf Oil Corporation
HBL Power systems
INEOS ABS India Ltd
Jindal Drilling Industries
Kirlosker Pneumatic Company
KSB Pumbs
Natco Pharma
Philips Carbon Black
Reliance Industrial Infrastructure
SREI Infrastructure Finance
Supreme Petrochemicals
Walchandnagar Industries

Appendix -5

Name of Companies -Mid cap Portfolio

Period-3

Alok Industries

Appolo Hospitals

Appolo Tyres

Amtek Auto Ltd

Atlas Cop co

Balarampur Chini Mills

Ballarpur Industries

Bank of Maharashtra.

BASF

Berger Paints.

Britannia Industries

CMC Ltd

Coramandel International

Eid Parry

EIH Ltd

Essar Shipping and Ports

Federal Bank Ltd

Godrej Industries

Goa Carbon Black

GTL Ltd

India Cements

Jubilant Life Sciences

Kirlosker Brothers

Madras Cements

Maharastra Seamless

3 M India Ltd

Appendix -6

Name of Companies- Market Portfolio

Period -3

Appolo Hospitals

Atlas Cop co

Coromandel International

Federal Mogul Goetze

Glaxo Smithkline Pharmaceuticals

Sesa Goa

HDFC Ltd

Hero Honda Ltd

Hindustan Petroleum

INEOS ABS India Ltd

Jubilant Life Sciences

JK Lakshmi Cements

Jyoti Structures

Maharashtra Seamless

Natco Pharma

NIIT Ltd

Philips Carbon Black

Raymond Woolen Mills Ltd

Reliance Industrial Infrastructure

Reliance industries Ltd

SML Isuzu

Walchandnagar Industries

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Chapter 6

ANALYSIS

Contents

Arbitrage pricing theory tries to identify the underlying source of uncertainty that makes the securities risky. The theory suggests that the return can be explained in terms of returns on a small number of systematic risk factors proxied by macroeconomic variables. The study is intended to identify the number of factors, macroeconomic variable responsible for loading and the direction of relationship, behind the return generating process. Canonical correlation analysis is the most powerful tool for identifying the factor structure, magnitude and direction of relationship. As mentioned earlier, individual share returns of well diversified portfolio are taken as dependent variable and residuals of selected macroeconomic variables are taken as independent variable for the canonical correlation analysis. In tune with the assumptions of CCA, multicollinearity of independent variables in the set should be minimized.

Multicollinearity among the independent variables is tested with the help of a linear regression analysis. Among the seventeen macroeconomic variables considered for the study, by taking one variable as dependent variable, linear regression analyses have been conducted. On a repeated process, by changing the dependent variable for linear regression analysis, the result of the test indicates that, some of the variables included in the list of variables are experiencing multicollinearity problem. In regression analysis the extent of multicollinearity is measured with the help of Variance Inflation Factor (VIF). Variance inflation factor value of 1 indicates that there is no multicollinearity among the set of variables. The acceptable standard for retaining a variable in the study, based on VIF value, is less than 10. For making a reliable analysis and interpretation of the result of CCA, effect of multicollinearity should be minimized.

The test result indicates that for the first phase of the study, IIPMF and IIPMI are experiencing the multicollinearity problems. These variables are excluded from the final set of variables used for CCA. In addition, exploring the relationship by using two variables of same nature for a single element of risk, makes the analysis and interpretation become complex. Considering the tolerance value of WPI and CPI (proxy for inflation risk), with higher tolerance value compared to CPI, WPI is retained in the final list of macroeconomic variables. As a result, 14 macroeconomic variables are existed in the final list, for the first phase of the study covering a period of six years from 1994.

For the second phase of the study (2000-2006), on checking the multicollinearity, the same set of variables fulfill the VIF criterion and tolerance, and used for CCA. For the third phase (2006-2011), based on the result of multicollinearity testing, the same set of variables is retained, as in second phase, except WPI. Instead of WPI, CPI gets selected in the list of variables on the basis of value of tolerance and VIF, as a proxy for inflation.

The excluded variables are either multiple proxy variables of a single risk element or subsector variables, and there by the exclusion of these variables will not affect the interpretability of the relationship. Result of the multicollinearity tests for the final set of independent variables used for CCA, for the three phases, based on dependent variable, as a model are given in chapter appendix 1 (Table 6.A, 6.B,6.C,6.D,6.E,6.F).

6.1 Canonical Correlation Analysis

Canonical correlation analysis (CCA) is a multivariate statistical model that facilitates the study of linear interrelationship between two sets of variables. Canonical correlation is the maximized correlation of two canonical variates formed from the linear combinations of two sets of variables. It represents a relationship between the set of variables rather than individual variables and analyse the many to many relationships between the variables included in the dependent and independent sets of variables. It is used to depict the different dimensions of relationship between the two sets, represented as functions and these dimensions are independent (Orthogonal) to one another. For every canonical function there are two variates. They are synthetic variables created from the corresponding set of original dependent and independent variables. This technique gives an opportunity to assess the strength and direction of the relationship between original variables and latent variable of its on set. It also permits to assess the strength and direction of the relationship of one canonical variate with the other variate and its original variables. As already stated, the functions in the canonical correlation analysis are orthogonal or uncorrelated; a single function is comparable to a set of variables, which is very useful for explaining the many to many relationships between two sets of variables.

Like, other multivariate analysis CCA based on certain assumptions. These assumptions are related to linearity, normality and multicollinearity. The canonical correlation coefficient between the pairs of variates is based on a linear relationship. CCA can accommodate any metric variable without strict assumptions of normality. Normality is desirable to enhance the reliability of interpretation of the results. The multi co linearity of the variables among independent set will confound the ability of the technique to isolate the impact of any single variables, making interpretation less reliable and complex. These assumptions are not strictly required; interpretability of canonical solutions is enhanced if they are (Hair et. al 1998).

In CCA for testing the significance of the overall model and multivariate normality Wilk's Lambda is used. 1-value of Wilk's λ indicates the overall prediction capacity of the model like R^2 in multiple regressions (Sherry and Henson, 2005). P value indicates the significance of the model and a value of .05 or more indicate that the model is statistically significant by fulfilling the assumptions of multivariate normality. Selection of the functions from the exhaustive list of canonical functions, Eigen value is taken as a measure same as in factor analysis.

In canonical correlation analysis the canonical correlation coefficient (r_c) is the Pearson relationship between two synthetic variables in a function and is ranging from 0 to 1, because of scaling created by standard weights in the linear equation. It measures the strength of the overall relationship between two variates, one for independent variables and other for dependent variables. The squared canonical correlation (rc^2) represents the proportion of variance shared by two canonical variables. Standardised canonical function coefficient is the correlation loaded to construct the canonical correlation of a function and is used to assess the relative importance of individual variables contribution to a particular function's canonical correlation.

Structure correlations or factor loadings (r_s) is the correlation of canonical variable with an original variable of its on set. It is a bivariate correlation between an observed variable and a synthetic variable. It is used to interpret the structure of synthetic variable, i.e. what observed variables can be useful in creating a synthetic variable. Square of the canonical structure coefficients indicates the proportion of variance on an observed variable shares with their own synthetic variable.

Canonical cross loadings are the loadings generated from a procedure used to correlate each of the variables in a set (independent or dependent) with other canonical variate. It is equal to the product of canonical correlation coefficient (r_c) of the function and canonical structure correlations (r_S) of the corresponding variables. It provides a more direct measure of the dependent-independent variable relationship by eliminating an intermediate step involved in conventional canonical loadings.

Researchers, while interpreting the nature and magnitude of canonical relationship, different methods are used. One stream of researchers is relying upon standardized canonical function coefficient. Another group of researchers are using canonical loadings for interpreting the relationship. Alpert and Peterson (1972) argued that canonical weights appear more suitable for prediction, while structure correlations may better explain underlying constructs.

Hair et.al (1998) assert that, compared to canonical weights and canonical loadings, canonical cross loading method is more appropriate to interpret the relationship between two variates. He argued that canonical weights are useful for interpretation but valid only when collinearity is minimal. The characteristics of transformation of a canonical model to a single latent construct and also facilitated to directly measure the relationship between dependent and independent variables by eliminating an intermediate step involved in conventional loading, the cross loading approach is more preferable and standardized one.

The study focused on cross loading approach to analyse the relationship between dependent and independent variables. Along with this, Eigen value weighted canonical cross loading is used to assess the overall interpretability of the priced variables and overall effect on the opposite set of variables.

6.2 Factor Model Test Results and Interpretation

A canonical correlation analysis was conducted using fourteen macro economic variables as predictors of 22 share return variables in a well diversified market portfolio, to evaluate the multivariate shared relationship between the two variable sets.

Table 6.1 Multivariate Tests of Significance.

Test name	value	Approx.F	Hypoth.DF	Error DF	Sig. of F
Pillais	5.14659	0.97766	308	518	0.584
Hotellings	14.77375	1.06212	308	310	0.298
Wilks	**0.00039**	**0.99707**	**308**	**327.11**	**0.51**
Roys	0.85535				

Table 6.2 Eigen values and Canonical Correlations

Root No	Eigen value	%	Cum.%	Canon Cor.(R_c)	Sq.Can Cor.(R_c^2)
1	**5.91308**	**40.02423**	**40.02423**	**0.92485**	**0.85535**
2	**2.20127**	**14.89988**	**54.92411**	**0.82923**	**0.68762**
3	**1.85355**	**12.54625**	**67.47036**	**0.80595**	**0.64956**
4	**1.20237**	**8.13857**	**75.60894**	**0.73888**	**0.54594**
5	0.82291	5.57007	81.17901	0.67188	0.45143
6	0.69012	4.67126	85.85027	0.639	0.40833
7	0.59192	4.00657	89.85684	0.60978	0.37183
8	0.35175	2.38093	92.23777	0.51012	0.26022
9	0.33616	2.2754	94.51318	0.50159	0.25159
10	0.315	2.13213	96.64531	0.48943	0.23954
11	0.22995	1.5565	98.2018	0.43239	0.18696
12	0.14539	0.9841	99.1859	0.35628	0.12693
13	0.09601	0.64988	99.83578	0.29597	0.0876
14	0.02426	0.16422	100	0.1539	0.02369

The analysis yielded four highly loaded functions based on Eigen values, with squared canonical correlations ($\mathbf{r_c}^2$) of 0.8553, 0.6876, 0.6495 and 0.5459 for each successive function. By observing the Wilk's Lambda (Table 6.1) as 0.00039, which represents the unexplained variance and 1-λ,ie, 0.9996 yields the full model effect size in an R^2 metric facilitates to explain model frame work. Collectively the full model explains 99.96 percentage of variance shared between the variable sets. Wilk's P value of 0.51 is higher than the benchmark of 0.05 indicates that the model is tenable to the assumption of multivariate normality.

In CCA it is not possible to test the significance of each function's canonical correlation; only a hierarchical testing is possible (using SPSS). The APT should be concerned only with the joint significance of risk premium for a set of functions. It is not appropriate to check for the statistical significance of individual factors, the fundamental question is whether a multifactor structure determines the returns on assets or not. The dependent relationship between statistical significance test and sample size has revealed that even a no meaningful effect can be statistically significant at sufficiently large sample size (Wilkinson et.al 1999, Sherry and Henson 2005). This leads to a conclusion that for practical situations, effect size (eigen value of the function) is a good basis for determining the significance of a function in explaining the relationship.

From the analysis it is evident that there exists a factor structure and the model significantly explains the shared variance between two set of variables as hypothesized in APT multifactor model. The CCA functions, that explain relationship between variates of dependent and independent variables, are considered as factors in APT, and it could explain the relationship between share returns and systematic risk factors proxied by macroeconomic variables. As reported, results of CCA conducted for identifying the factor structure and over all explaining capacity of relationship between risk factors of share returns and macroeconomic variables, it is obvious that the model explains 99.96 percentage of shared variance between the two set of variables. It is identified that among the priced functions, the highly priced four dimensions of relationship explains more than 75 percentage of the variance between two set of variables. Considering an additional function, the fifth function's eigen value 0. 82291 indicating that, an additional function will not contribute much explanatory power, as its marginal contribution is less than one. Table 6.2 shows that a four factor model explains 75.6 percentage of the shared variance between two sets of variables, a six factor model explains only 85.8 percentage; the additional two functions explains only 10.2 percentage of the variance in share returns. And an eight factor model explains 92.2 percentage of the shared variance. Considering the 12 factor model, the incremental explanation is only 23.5 percentages for 8 additional factors. Thereby, the average contribution per factor reduced by more than 100 percentage. Though, the variance explained in the model increases with additional factors, their incremental explanation power is not substantial and increases complexity in analysis and interpretation of the results leading to a less reliable conclusion. The analysis and interpretation lead to the conclusion that in Indian stock market, a four factor model substantially explains the return generating process in tune with the multifactor frame work of APT.

Table 6.2 shows that**,** the highly loaded four functions (Eigen value >1) explains 75.6 percentage of variance which connects a substantial portion of the total shared variance between the dependent and independent variable sets.

From among the functions selected for interpretation, on the basis of its contribution to maximize the loading of the relationship between two sets of variables, function one alone accounts for 40 percentage of the shared variance in the full model and also explains 85.53 percentage of variance within the function. The second function which is developed by using residual variance, this is not loaded in the first function, in an uncorrelated nature, explains 14.89 percentage of the residual variance and 68.76 percentage of variance respectively within the function. The third and fourth functions accounts for 12.5 percentages and 8.1 percentage of the residual variance on a successive manner and there by explains 64.95 percentages and 54.59 percentages of variances respectively. The selected functions for interpretation collectively accounts for 75 percentage of the total shared variance between the two sets of variables, which is substantial in nature and it could explain four functions out of fourteen functions available, based on the lowest number of variables included in the predictor and criterion sets of variables.

As the full model substantially explains the relationship between the sets of share return variables and the macroeconomic variables, it is proxy of systematic risk factors, identified on the basis of theoretical relationship, with an impact on future cash flow and discounting rate, the relationship should be meaning full and interpretable. The strength of relationship (R_c) measured and reported in Table 6. 2 show that, the selected dimensions of relationship possess high canonical correlations (0.92485, 0.82923, 0.80595, and 0.73888) between the variates of share returns and macroeconomic variables. It indicates that there exist a strong relationship between the two set of variables and the priced macroeconomic variables in the selected functions jointly determine the variations in share returns. In

CCA, the variates are formed by using the structure correlations of individual variables, and as the functions are uncorrelated, the variates of share returns collectively represent the variance in share returns comparable to variates of macroeconomic variables. Identification of effect of individual macroeconomic variables in the relationship existed and its direction is unraveled in the analysis of canonical cross loadings and Eigen value weighted canonical cross loadings. The canonical cross loadings are based on Structure Correlations of Canonical variables. Standardized canonical coefficients for covariates (Table 6.3) and Structure Correlations of Canonical variables-Independent Variate (Table 6.4) given in chapter appendix 2.

As stated earlier, canonical cross loading method is used for analyzing the relative importance of each original independent variable in the canonical correlation relationships. This method is particularly useful to explain the relationships between independent macroeconomic variables with variate of share return variables. Canonical cross loading are the product of canonical correlation of the respective functions and structure correlations of macroeconomic variables to its variate. For interpreting these functions, the power of the function should be taken into consideration i.e. based on Eigen values of the function, which could serve as a basis of relative importance of the function and its power.

Table 6.5 Canonical cross loadings on Variates of Share returns

Variables	Functions			
	1	**2**	**3**	**4**
BCC	0.225793	0.21788	-0.0946	0.265613
BCG	**-0.55484**	**-0.35415**	0.116194	-0.20524
M3	**-0.42472**	**-0.36194**	-0.09393	-0.08421
CPI	0.233488	-0.06861	-0.04681	**-0.34915**
GOLD	0.041341	-0.1708	-0.09902	-0.27268
IIPG	-0.11282	0.104483	-0.12511	0.003547
IIPE	-0.07687	0.004279	0.24874	0.191606
CALM	0.297829	0.211197	-0.01292	-0.15718
EXR	0.093299	-0.26088	**0.316497**	**-0.39752**
EXP	0.190741	-0.00718	-0.18351	0.153133
IMP	0.235948	0.134252	-0.07218	-0.1711
FORX	0.056721	0.087882	**-0.37571**	0.22677
FII	**-0.59699**	-0.02089	0.28961	0.015834
BSET	**-0.59472**	**0.462205**	-0.17345	-0.06216

The first function being the major dimension factor, explains more than half of the explained variance between the predictor and criterion set of variables. Four variables are highly loaded into the opposite variate (generally, loading of 0.3 or more interpreted in CCA). The prominent variables are FII with a loading of -0.59699, BSET (-0.59472) BCG (-0.55484) and M3 (-0.42472). In its variate all these variables loaded negatively. In the opposite variate also the cross loading of these variables are negative, indicating an inverse relationship with a variation in share return.

The second dimension of relationship accounts for 14.89 percentage of shared variance between the dependent and independent sets of variables. BSET, BCG and M3 loaded in the opposite variate considerably. Among these priced variables, BCG and M3 loaded negatively indicating an inverse relationship. BSET, the third variable priced in this function, loaded in the variate of share return positively and the magnitude of this loading is relatively small considering the power of the function, compared to the first dimension of relationship, where BSET negatively loaded in the opposite variate. As the functions are uncorrelated and successive functions are developed on the basis of residual variance, a loading of the same variable in successive functions with opposite sign is justifiable. By observing the Table 6.5, for the third independent function EXR and FORX are the priced factors. EXR loaded in the opposite variates with a direct relationship, where as FORX loaded with a negative relationship. In the last priced function selected for interpretation, CPI and EXR loaded in the opposite variate negatively, indicating an inverse relationship. EXR loaded in the fourth function with a negative sign and in comparison with the third function the direction of the relationship is an opposite one. Relative importance of the priced variables in different dimensions of relationships between the dependent and independent sets of variables is not disclosed by the canonical cross loadings. To determine the relative importance of the priced macroeconomic variables and its magnitude of effect on the share return, power of the function should be considered. As the power (represented by the Eigen values of the functions) of the successive functions are reducing, the cross loadings will not give an interpretable solution. For this, eigen value weighted cross loading makes the cross loadings comparable and serve the purpose of explaining the relative importance of macroeconomic variables in explaining the return generating process in the market.

Table 6.6 Eigen value weighted canonical cross loadings of priced variables - Market portfolio -2006

variables	Dimensions		Effect size*
	1	2	
BCG	-3.28079	-0.77957	-4.0603641
FII	-3.53005		-3.5300536
M3	-2.5114	-0.79673	-3.3081294
BSET	-3.51666	1.017437	-2.4992184
FORX	-0.6964		-0.6963967
CPI	-0.41981		-0.4198079
EXR	0.586642	-0.47796	0.1086792

*Magnitude only
Sign of the effect size represents direction of relationship

Magnitude and direction of relationship of cross loadings, weighted by eigen value depicted in Table 6.6. The overall effect of highly priced predictor variable in selected four dimensions of relationship on the criterion variable through canonical variables measures the magnitude and indicates the direction of relationship existed. This measure based on magnitude, identified BCG as prime variable explains the shared variance between in share return and selected macroeconomic variables in the Indian stock market for the period covering 5 years from 2006. As the direction of the overall effect size is a negative one, indicates an inverse relationship with the variations in share returns.

Analyzing the relative importance of priced macroeconomic variables' overall effect on the variates of market portfolio, BCG was followed by FII, M3, BSET, FORX, CPI and EXR in the order of importance. The overall effect of these variables, except EXR pointing towards an inverse relationship with share returns variables. In the case of BSET and EXR direction of the relationship on different functions are possessing opposite signs.

As pointed out earlier, the return generating process in the Indian stock market follows the multifactor APT model; four dimensions can substantially explain the process. BCG explains substantial risk on the basis of effect size, loaded in two dimensions indicating an inverse relationship with the variations in share returns. As BCG included in the study as a proxy for investment and credit environment, it is evident that a change in investment and credit environment affects share prices and returns. The result of the study indicates that in Indian stock market, for a positive change (increase in government spending and investment) reduce the downward variation in return, indicating a decrease in risk. This relationship highlighted the importance of public sector investments, even in the liberalized economic environment, for stabilizing the stock market which in turn it helps to build confidence among investors. As a result of this confidence building, more fund will be flowed in to the market, this could meet the fund requirement of the corporate sector and leads to economic development. Importance of BCG evidenced in the study, support the empirical findings of Bhattacharya (1984) and Krishnamurthy (1985) with respect to growth in output and development, even in liberalized scenario.

Considering the magnitude of effect size, the second important variable that explains a substantial variation in share return is the FII. As the direction of the relationship is an inverse one, an increase in FII increases the share prices and return; which in turn reduces the risk. In the globalised scenario, the fund is flowed from less profitable area to a destination that offer high returns, by considering the investment climate and credibility of the destination. The existence of this relationship indicates that FII has an important role in determining the market prices of the shares and resultant returns in Indian stock market, in the liberalized scenario, for the period of 2006 -11.

On the basis of magnitude of effect size, it is identified that, M3 is the third prominent variable explaining the return generating process on a substantial nature. The result indicates that a negative relationship existed in the market. It can be interpreted as an increase in money supply reduces the downward variation in share return. This relationship fails to endorse the empirical relationship hypothesized by the Keynesian economists, where an increase in money supply alters the expectation about future monetary policy, and expect a tightened monetary policy in future. It results a decrease in money supply that increases demand for money, leads to increase in interest and discount rates. An increase in discount rate reduces the profitability of the firms and leads to a decline in the market price of the shares and return. Where as the result of the study endorses the relationship put forwarded by the real activity theorist (Sellin,2001).They hypothesized a positive relationship between money supply and share prices, and interpreted as an increase in money supply increases the market price of the share, which in turn shows a decrease in the downward variation in return.

Considering the effect size, BSET is identified as the fourth important variable that explains the return generating process. It shows two dimensions of relationship in the market with opposite signs, indicating an inverse and direct relationship. The overall effect of this variable shows an inverse relationship, indicates that an increase in market turnover increases the share prices and thereby reduces the downward variation in returns. Against this overall relationship, the other dimension of relationship is also existed in the Indian stock market, i.e. an increase in market activity increases the downward variation in return and the resultant increase in risk. The plausible explanation for this bi-directional relationship is that the market is experienced with the existence of bearish and bullish trends, coupled with speculation. The result of the study substantiates the importance of liquidity risk in the return generating process. Even though the effect size of this variable is high, Considering the nature of this variable, as an outcome of the stock market and related to other priced variables effect, declines the importance of this variable, in interpreting the relationship between variations in share returns and identified systematic risk factors.

Relative importance of FORX is lower one and shows a negative relationship. Result indicates that the credibility of the economy has an impact on the variation in share return. As foreign exchange reserve increases, it stabilizes the domestic currency and allows business firms to reap the benefit of long range planning. A sound domestic currency coupled with adequate reserves, enhances the credibility of the economy and it give an opportunity to minimize the exchange rate risk, results a reduction in the downward variation in share return.

From the above discussion the return generating process is explained by a limited number of risk factors identified from the set of fourteen macroeconomic variables. The magnitude and direction of these variable's loadings are different, canonical cross loadings weighted by respective function's eigen value in the selected functions determines risk premium of APT risk factors. As the functions contains the effect of more than one variable and the substantial amount of relationship is explained by four functions, the canonical cross loadings represented as determinant of risk premium of APT risk factors, jointly explains the relationship. This means that the effect of any one of the risk factors does not explain a substantial amount of shared variance between the two set of variables and fails to give a clear picture about the return generating process. Collectively these risk factors explain substantial amount of shared variance between the two set of variables.

The above analysis and interpretation of the results lead to the conclusion that the factor structure behind the return generating process in the Indian stock market is a multifactor one and endorsed the arguments of more than one factor determines the return generating process hypothesized by Arbitrage pricing theory. A four factor model explains more than 75 percentage of the underlying relationship between share returns and macroeconomic variables. BCG, FII, M3 and BSET, based on their magnitude of relationship, identified as the major systematic risk factors responsible for variations in share returns for the period of 2006 - 11.

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Appendix -1

Table 6.A Independent Variables-First phase

Model 1	Collinearity Statistics	VIF
	Tolerance	
BCC	.464	2.155
BCG	.605	1.652
WPI	.673	1.487
GOLD	.910	1.099
IIPG	.482	2.074
IIPE	.705	1.419
CALM	.757	1.321
EXR	.775	1.290
EXP	.458	2.184
IMP	.517	1.933
FORX	.615	1.627
FII	.766	1.306
BSET	.767	1.304
Dependent Variable: M3		

Table 6.B Independent Variables -First phase

Model 2	Collinearity Statistics	VIF
	Tolerance	
BCG	.505	1.979
WPI	.678	1.474
GOLD	.896	1.116
IIPG	.589	1.698
IIPE	.707	1.415
CALM	.752	1.331
EXR	.758	1.320
EXP	.456	2.194
IMP	.532	1.881
FORX	.519	1.925
FII	.771	1.297
BSET	.767	1.303
M3	.533	1.875
Dependent Variable: BCC		

Table 6.C Independent Variables -Second phase

Model 1	Collinearity Statistics	VIF
	Tolerance	
BCC	.408	2.449
BCG	.587	1.704
WPI	.710	1.408
GOLD	.704	1.420
IIPG	.662	1.511
IIPE	.735	1.361
CALM	.841	1.189
EXR	.800	1.250
EXP	.530	1.886
IMP	.555	1.802
FORX	.358	2.795
FII	.704	1.420
BSET	.785	1.274
Dependent Variable: M3		

Table 6.D Independent Variables -Second phase

Model 2	Collinearity Statistics	VIF
	Tolerance	
BCG	.600	1.667
M3	.736	1.358
WPI	.701	1.427
GOLD	.708	1.412
IIPG	.661	1.513
IIPE	.740	1.352
CALM	.815	1.227
EXR	.765	1.308
EXP	.536	1.866
IMP	.559	1.788
FORX	.522	1.917
FII	.702	1.425
BSET	.781	1.281
Dependent Variable: BCC		

Table 6.E Independent Variables -Third phase

Model 1	Collinearity Statistics Tolerance	VIF
GOLD	.642	1.558
IIPG	.515	1.942
CALM	.637	1.569
EXR	.577	1.734
EXP	.254	3.938
FORX	.856	1.168
FII	.644	1.552
BSET	.711	1.407
BCC	.301	3.322
IMP	.410	2.439
BCG	.259	3.855
CPI	.594	1.684
IIPE	.697	1.434
Dependent Variable: M3		

Table 6.F Independent Variables -Third phase

Model 2	Collinearity Statistics Tolerance	VIF
BCG	.337	2.966
M3	.481	2.081
CPI	.427	2.340
GOLD	.619	1.614
IIPG	.565	1.769
IIPE	.663	1.508
CALM	.730	1.370
EXR	.573	1.744
EXP	.329	3.043
IMP	.428	2.336
FORX	.836	1.196
FII	.625	1.599
BSET	.704	1.421
Dependent Variable: BCC		

Appendix -2

Table 6.3 Standardized canonical coefficients for covariates (Independent Variables)- Market portfolio 2006

Variables	Functions			
	1	2	3	4
BCC	-0.40597	0.36195	0.32632	0.09331
BCG	-0.80964	-0.46344	0.16315	0.23332
M3	-0.13544	-0.47529	-0.64461	-0.38247
CPI	0.29266	-0.28992	-0.658	-0.49894
GOLD	-0.13458	0.31607	0.06872	-0.35008
IIPG	0.056	0.0183	-0.2464	-0.10347
IIPE	0.19774	0.16007	0.41263	0.31132
CALM	-0.01271	0.20968	0.21671	-0.2251
EXR	0.32893	-0.05221	0.50198	-0.29418
EXP	0.16289	-0.91404	-0.47681	0.51131
IMP	-0.11051	0.41996	0.38389	-0.44838
FORX	0.11188	-0.04166	-0.26948	0.31868
FII	-0.3551	0.04644	0.73422	0.03901
BSET	-0.36704	0.71288	-0.40419	-0.33148

Table 6.4 Structure Correlations of Canonical variables (Independent Variate) -Market portfolio 2006

Variables	Functions			
	1	2	3	4
BCC	0.24414	0.26275	-0.11738	0.35948
BCG	-0.59992	-0.42708	0.14417	-0.27777
M3	-0.45923	-0.43648	-0.11654	-0.11397
CPI	0.25246	-0.08274	-0.05808	-0.47254
GOLD	0.0447	-0.20598	-0.12286	-0.36904
IIPG	-0.12199	0.126	-0.15523	0.0048
IIPE	-0.08312	0.00516	0.30863	0.25932
CALM	0.32203	0.25469	-0.01603	-0.21273
EXR	0.10088	-0.31461	0.3927	-0.538
EXP	0.20624	-0.00866	-0.2277	0.20725
IMP	0.25512	0.1619	-0.08956	-0.23157
FORX	0.06133	0.10598	-0.46617	0.30691
FII	-0.6455	-0.02519	0.35934	0.02143
BSET	-0.64305	0.55739	-0.21521	-0.08413

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Chapter 7

COMPARATIVE ANALYSIS

Contents

7.1 Comparative analysis- size of capitalization

As mentioned in chapter 6, the Arbitrage pricing theory based on factor structure and factor loadings, substantially explains the relationship between variations in share returns and unanticipated changes in priced macroeconomic variables. Considering the 'market portfolio', as a cross section of the market, the result of the study indicates that, in the highly priced four functions, BCG, FII, M3, BSET are identified as the major explanatory variables in the variations of the share returns in the order of importance. And all these variables unanticipated changes are inversely related to variations in returns.

In this context, apart from the general relationship, an enquiry into the relationship and magnitude of the share returns, based on size of capitalization, and unanticipated changes in macroeconomic variables are highly warranted. It gives additional information to the investors in their decision making process of investment.

7.1.1 Large cap portfolio 2006

In the third phase of the study, period covering 5 years from 2006, for the large cap portfolio a canonical correlation analysis was performed.

Table 7.1 Multivariate Tests of Significance

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	5.13956	1.04963	294	532	0.315
Hotellings	15.56057	1.22488	294	324	0.037
Wilks	**0.00033**	**1.11488**	**294**	**333.47**	**0.168**
Roys	0.86219				

Wilk's Lambda value in the Table 7.1 indicates the unexplained variance, leads to a conclusion that the model facilitate to explain 99.96percentage (1-λ) of the shared variance between dependent and independent sets of variables. Wilk's P value of the model 0.168 fulfills the normality assumption required for the multivariate analysis.

Table 7.2 Eigen values and Canonical Correlations

Root No.	Eigen value	%	Cum.%	Canon Cor.	Sq. Cor
1	**6.25638**	**40.20662**	**40.20662**	**0.92854**	**0.86219**
2	**2.5225**	**16.21083**	**56.41745**	**0.84623**	**0.71611**
3	**1.7451**	**11.21487**	**67.63233**	**0.79732**	**0.63571**
4	**1.34155**	**8.62145**	**76.25377**	**0.75692**	**0.57293**
5	**1.04986**	**6.74691**	**83.00068**	**0.71565**	**0.51216**
6	0.75836	4.87361	87.87429	0.65673	0.43129
7	0.5043	3.24091	91.1152	0.579	0.33524
8	0.40758	2.61933	93.73454	0.53811	0.28956
9	0.36947	2.37441	96.10895	0.51941	0.26979
10	0.25029	1.6085	97.71745	0.44742	0.20019
11	0.18297	1.17589	98.89334	0.39329	0.15467
12	0.10657	0.68489	99.57822	0.31034	0.09631
13	0.04167	0.26781	99.84603	0.20001	0.04001
14	0.02396	0.15397	100	0.15296	0.0234

Eigen values and canonical correlation of all the functions are listed in Table 7.2, by observing Eigen values, there are five priced dimensions of relationship between the share returns of 21 companies included in the portfolio and 14 macroeconomic variables selected for the study period. As in the case of market portfolio, the same set of macroeconomic variables are used for the analysis.

The selected functions possess squared canonical correlations (r_c^2) of 0.8621, 0.7161, 0.6357, 0.5729 and 0.5126 respectively. The first dimension of relationship between the set of variables alone accounts for 40.2 percentage of the shared variance. The successive functions are accounts for 16.21 percentages, 11.21 percentages, 8.6 percentages and 6.7 percentage of shared variance between the criterion and predictor set of variables. Collectively, 5 functions selected for interpretation account for 83 percentage of shared variance in the model and is substantial one. Standardized canonical coefficients for covariates (Table 7.3) and Structure Correlations of Canonical variables-Independent Variate (Table 7.4) are given in chapter appendix 2.

Being the major dimension of relationships, function number one accounts for about half of the total shared variance explained by the five functions selected for interpretation. Table 7.5 shows that in function number one, five variables are highly loaded in the opposite variate of share returns. From among the highly loaded variables BSET, FII and BCG loaded in the opposite variate with a direct relationship. The other two variables, EXP and IMP negatively loaded in the opposite variate indicating an inverse relationship.

Table 7.5 Canonical cross loadings Large cap portfolio 2006

variables	functions				
	1	2	3	4	5
BCC	-0.27138	0.167384	0.128392	-0.27455*	**0.355098**
BCG	**0.433396**	-0.02844	-0.14156	0.148939	**-0.37832**
M3	0.225199	0.043192	**-0.41863**	0.228052	0.048435
CPI	-0.2462	-0.14319	0.054266	0.230164	-0.1588
GOLD	-0.02891	0.186365	**-0.41856**	-0.0821	0.205034
IIPG	-0.08298	0.22602	0.100167	0.243138	-0.12555
IIPE	0.024161	-0.05561	-0.07402	0.150786	-0.07886
CALM	-0.13606	0.254377	-0.21848	0.048731	0.297159
EXR	0.163386	**-0.38718**	**-0.38935**	0.045491	0.014778
EXP	**-0.31806**	0.251863	0.092657	-0.2178	0.168879
IMP	**-0.42917**	0.242411	0.212645	0.165758	0.087431
FORX	-0.04472	**0.349044**	-0.09549	0.20396	-0.1503
FII	**0.568192**	-0.04026	-0.11111	0.080544	**-0.33907**
BSET	**0.691809**	0.130396	**0.362215**	0.265876*	0.079573

*Loadings less than 0.3

Exchange rate (EXR) and FORX are the priced variables in the second dimension of the relationship between the dependent and independent sets of variables. Among these variables, EXR negatively loaded in the opposite variate indicating an inverse relationship. FORX loaded directly in the variate of share returns. In the third priced function, M3, Gold and EXR are loaded negatively in the opposite variates. BSET loaded directly in the opposite canonical variate.

Fourth and Fifth functions explains a relatively lesser amount of shared variance. In function number four, the cross loaded variables are below the bench mark of interpretation. BCC* and BSET* are the prominent variables in the function. In the Fifth dimension of relationship, BCG and FII are loaded negatively on the variate of share returns where as BCC positively loaded in the opposite variate.

Table 7.6 Eigen value weighted canonical cross loadings of priced variables Large cap portfolio2006

Variables	Dimensions			Effect size *
	1	2	3	
BSET	4.328218	0.632101	0.356686	5.317004
FII	3.554826	-0.35597		3.198853
IMP	-2.68506			-2.68506
BCG	2.71149	-0.39718		2.314306
EXP	-1.98992			-1.98992
EXR	-0.97667	-0.67945		-1.65612
FORX	0.880465			0.880465
M3	-0.73056			-0.73056
GOLD	-0.73043			-0.73043
BCC	-0.36832	0.372804		0.004481

*Magnitude only
Sign of the effect size represents direction of relationship

For analyzing the relative importance of priced variables in selected dimensions, Eigen value weighted cross loadings are constructed and listed in Table 7.6. Overall direction and magnitude of relationship of priced predictor variables on the criterion set of variables are summarized in the Table 7.6. By observing the values of BSET, FII, BCG and IMP are identified as highly priced macroeconomic variables responsible for changes in share returns. EXR and EXP are relatively moderate effect on the variation in share returns. Though M3, Gold and FORX are priced variables, the role in explaining the variation in share returns are moderately low in this period for large sized company's portfolio.

Foreign institutional investment net flow (FII) and BCG are loaded in the variate of share returns in two dimensions exhibiting opposite signs of relationship. BSET positively loaded in 3 dimensions leads in the forefront in explaining the variance of share returns. EXR, EXP and IMP explain a negative relationship with share returns. BCG and FII loaded directly on share return variation.

7.1.2 Mid Cap Portfolio 2006

Analyzing the result of canonical correlation analysis of the midcap portfolio for the third phase of the study, six functions are identified as priced functions on the basis of Eigen value criterion. As a whole, the model explains 99.97 percentage (1-λ) of shared variance between dependent share return variates and independent macroeconomic variates. The model also achieved the basic requirement of normality with a Wilk's P value of 0.287 (Table 7.7).

Table 7.7 Multivariate Tests of Significance

Test name	Value	Approx.F	Hypoth.DF	Error DF	Sig. of F
Pillais	6.43455	1.0795	364	462	0.219
Hotellings	20.18006	1.00583	364	254	0.483
Wilks	**0.00003**	**1.0647**	**364**	**294.93**	**0.287**
Roys	0.82625				

Table 7.8 Eigen values and Canonical Correlations Mid cap portfolio2006

Root No	Eigenvalue	%	Cum.%	Canon Cor	Sq.Can Cor
1	**4.75539**	**23.56478**	**23.56478**	**0.90898**	**0.82625**
2	**3.82969**	**18.9776**	**42.54239**	**0.89048**	**0.79295**
3	**3.29042**	**16.30528**	**58.84767**	**0.87574**	**0.76692**
4	**2.10212**	**10.4168**	**69.26446**	**0.82319**	**0.67764**
5	**1.47231**	**7.29588**	**76.56035**	**0.7717**	**0.59552**
6	**1.26677**	**6.27733**	**82.83767**	**0.74756**	**0.55884**
7	0.8736	4.32901	87.16668	0.68284	0.46627
8	0.74621	3.69777	90.86445	0.65371	0.42733
9	0.66058	3.27344	94.13789	0.63072	0.3978
10	0.40655	2.01459	96.15248	0.53762	0.28904
11	0.32445	1.60776	97.76024	0.49494	0.24497
12	0.19017	0.94235	98.70259	0.39973	0.15978
13	0.14497	0.71839	99.42098	0.35583	0.12662
14	0.11685	0.57902	100	0.32345	0.10462

Among the canonical functions, six functions collectively explain 82.83 percentage of total shared variance explained by the model and is substantial for explaining the canonical relationships in the two sets of variables. Table 7.8 shows the function wise contributions of explaining capacity in percentage, canonical correlation coefficient that explains the shared variance between variates of a function. Along with this, the measure of squared canonical correlation explains the variance within a variate of a function. Standardized canonical coefficients for covariates (Table 7.9) and Structure Correlations of Canonical variables-Independent Variate (Table 7.10) are given in chapter appendix 2

Table7.11 Canonical cross loadings on Share returns Mid cap portfolio2006

variables	Functions					
	1	2	3	4	5	6
BCC	0.18225	0.117428	**-0.39652**	-0.12708	**0.378503**	-0.02524
BCG	0.004845	0.045673	**0.636917**	0.001037	**-0.39549**	0.049182
M3	-0.27418	**0.47866**	0.124329	0.066308	-0.02523	0.044831
CPI	-0.10348	**-0.30474**	0.066127	-0.1196	-0.14919	-0.00372
GOLD	**-0.44421**	0.143866	0.003582	-0.24773	-0.17009	-0.12279
IIPG	-0.16911	0.099707	-0.01535	-0.14334	-0.06834	-0.16361
IIPE	-0.14329	-0.11204	0.178231	0.034533	0.062153	**-0.3708**
CALM	-0.12444	-0.21226	-0.08616	-0.29819*	0.**324863**	0.047007
EXR	0.168361	-0.16087	0.100754	0.236807	-0.2528	-0.06896
EXP	-0.15758	0.032405	-0.42645	-0.05779	0.080905	0.230271
IMP	**-0.40467**	-0.25817	-0.22168	0.290973*	0.228006	**0.330975**
FORX	-0.04077	0.249103	**-0.36458**	-0.23511	0.055184	0.144802
FII	0.047649	**0.483611**	**0.380369**	0.202752	-0.15385	-0.05243
BSET	0.145837	**0.441304**	0.1461	0.209123	0.107112	0.129066

*Loadings less than 0.3

Observing the canonical cross loading of macroeconomic variables on share return variables, given in Table 7.11, Gold and IMP are highly loaded in the most powerful dimension of relationship. Both these variables are loaded negatively on the opposite variate, indicating an inverse relationship for the period. In the second dimension of relationship, M3, FII and BSET are loaded in the opposite variate showing a direct relationship. CPI negatively loaded and shows an inverse relationship with the opposite variate.In the third function, BCG and FII loaded with a positive sign in the opposite variate indicating a direct relationship. EXR, BCC, FORX are negatively loaded in the opposite variate and shows an inverse relationship.

As the fourth dimension of relationship explains only 10.41 percentage of the shared variance of the function and the cross loaded variables are below the bench mark of interpretation (0.3). Prominent variables in the functions are CALM and IMP. Fifth and Sixth dimensions of relationship between dependent and independent variable sets explains relatively small amount of shared variance between the variates. The priced variables, BCG and IIPE show an inverse relationship with their respective opposite variates. BCC, CALM and IMP cross loaded with a positive relationship on the respective functions.

Table 7.12. Eigen value weighted canonical cross loadings of priced variables Mid cap portfolio 2006

variables	Dimensions			Effect size*
	1	2	3	
FII	1.852079	1.251573		3.103653
GOLD	-2.11239			-2.112389
M3	1.833118			1.833118
BSET	1.690058			1.690058
BCG	2.095724	-0.58228		1.513443
EXP	-1.4032			-1.403201
FORX	-1.19962			-1.199619
CPI	-1.16706			-1.16706
IMP	-1.92436	0.61166	0.419269	-0.893429
BCC	-1.30471	0.557274		-0.747435
CALM	-0.62684	0.478298		-0.148538

*Magnitude only
Sign of the effect size represents direction of relationship

Overall effect and direction of priced macroeconomic variables, on share return variables depicted in Table 7.12. By observing the values, it is evident that FII, Gold, M3 and BCG are highly cross loaded in the variates of share returns. The sign of the effect size indicating its relationship with share return variables. FORX, EXP and CPI moderately explains the variation in share returns included in the mid cap portfolio. Though IMP and BCC are priced substantially in a dimension, other priced dimension with an opposite sign reduced the overall effect in explaining the variation of share returns of mid cap portfolio. As the net effect value is small, call money rate changes are not significantly explains the variation of midcap portfolio's share returns.

7.1.3 Small Cap Portfolio 2006

For a period of 5 years beginning from 2006 for the small cap portfolio, covering 21 companies and considering the same set of macroeconomic variables used in the case of market portfolio, a CCA was performed. From the analysis, the unexplained variation represented by Wilk's Lambda (Table 7.13) as 0.00039 and 1-λ, i.e., 0.9996 yields the variance explained by the full model. This shows that collectively, the full model explains 99.96 percentage of the shared variance between the variable sets. As the p value is 0.229, the model achieved Multivariate normality.

Table 7.13 Multivariate Tests of Significance

Test Name	Value	Approx.F	Hypoth.DF	Error DF	Sig. of F
Pillais	4.98583	1.00087	294	532	0.493
Hotellings	15.46602	1.21744	294	324	0.042
Wilks	**0.00039**	**1.0874**	**294**	**333.47**	**0.229**
Roys	0.85661				

Table 7.14 Eigen values and Canonical Correlations Small Cap Portfolio 2006

Root No.	Eigen value	Pct.	Cum. Pct.	Canon Cor.	Sq. Cor
1	**5.97396**	**38.62633**	**38.62633**	**0.92553**	**0.85661**
2	**2.81992**	**18.23304**	**56.85937**	**0.85919**	**0.73821**
3	**1.95094**	**12.61437**	**69.47373**	**0.8131**	**0.66112**
4	**1.61067**	**10.41427**	**79.88801**	**0.78547**	**0.61696**
5	0.77734	5.02609	84.9141	0.66133	0.43736
6	0.61059	3.94794	88.86204	0.61572	0.37911
7	0.52627	3.40277	92.26481	0.5872	0.34481
8	0.38049	2.4602	94.72501	0.525	0.27562
9	0.30851	1.99478	96.71979	0.48557	0.23577
10	0.2303	1.48904	98.20883	0.43265	0.18719
11	0.13756	0.88943	99.09826	0.34774	0.12093
12	0.07436	0.4808	99.57906	0.26308	0.06921
13	0.04089	0.26437	99.84343	0.19819	0.03928
14	0.02422	0.15657	100	0.15376	0.02364

The selected functions for interpretation based on Eigen value greater than one accounts for four dimensions (Table 7.14) which explains 79.88 percentage of shared variance between criterion and predictor variable sets. These functions possess squared canonical correlation of 0.8566, 0.73821, 0.6611, and 0.6169 respectively.

From among the selected four functions, function one alone accounts for 38.62 percentage of the shared variance in the full model, and also explains 85.66 percentage of variance within the function. Other selected functions independent to one another, based on residual variance accounts for 18.23, 12.61, 10.41 percentages respectively, explains the shared variance between the set of variables. . Standardized canonical coefficients for covariates (Table7.15) and Structure Correlations of Canonical variables-Independent Variate (Table 7.16) are given in chapter appendix 2.

Table 7.17 Canonical cross loadings Small Cap Portfolio

Variables	Functions			
	1	**2**	**3**	**4**
BCC	0.051894	0.203293	0.279763	0.266636
BCG	-0.24552	-0.03946	**-0.33527**	**-0.48397**
M3	**-0.34028**	**-0.49091**	-0.23965	-0.11053
CPI	**0.308294**	-0.12896	0.062438	-0.22555
GOLD	0.146289	**-0.34408**	-0.14738	0.11603
IIPG	-0.15181	0.081417	-0.28537	-0.0715
IIPE	-0.22786	-0.08062	-0.15911	-0.19731
CALM	**0.320622**	-0.05333	-0.04147	0.081948
EXR	**0.5533**	-0.13978	-0.16399	**-0.37858**
EXP	-0.04539	-0.14938	**0.363968**	0.259865
IMP	0.117015	-0.15918	**0.325582**	0.237204
FORX	-0.13851	-0.00794	0.096287	**0.331955**
FII	**-0.50509**	-0.00743	0.077212	-0.51762
BSET	**-0.40088**	0.202545	**-0.30257**	-0.00983

Table 7.17 shows that, in the function number one, being the major dimension based on its contribution in explaining the shared variance between the variable sets, six variables are highly loaded on the opposite variate of share returns. Following the order of importance, the variables are EXR, FII, BSET, M3, CALM and CPI. Among the priced variables, FII, BSET and M3 are loaded negatively, showing an inverse relationship with opposite variate

representing dependent share returns. Priced variables EXR, CALM and CPI show a positive loading in the opposite variate, indicating a direct relationship.

In the second dimension of relationship the priced variables are M3 and Gold, both are negatively loaded in the opposite variate showing an inverse relationship. Considering the third function, variables loaded are EXP, IMP, BCG and BSET. Both EXP and IMP loaded in the opposite variate with a positive relationship. BCG and BSET negatively loaded in the opposite variate indicating an inverse relationship. In the last function selected for interpretation, BCG, EXR and FII are priced variables and negatively loaded in the variate of dependent variables. FORX is also priced in this dimension of relationship between criterion and predictor variables and shows a direct relationship.

Table 7.18 Eigen value weighted Canonical cross loadings of priced variables-Small Cap Portfolio2006

Variable	Dimensions		
	1	2	Effect size *
FII	-3.01738	-0.83372	-3.85111
M3	-2.03282	-1.38432	-3.41714
BSET	-2.39487	-0.5903	-2.98516
EXR	3.305394	-0.60977	2.695625
CALM	1.915384		1.915384
CPI	1.841736		1.841736
BCG	-0.65408	-0.77951	-1.43359
GOLD	-0.97028		-0.97028
EXP	0.71008		0.71008
IMP	0.63519		0.63519
FORX	0.53467		0.53467

*Magnitude only.
Sign of the effect size represents direction of relationship.

Magnitude and direction of relationship of priced predictor variable on the criterion variable set is listed in Table 7.18. By observing the Table, FII and M3 are identified as prominent variables explaining the relationship of criterion and predictor variables. In the order of importance, BSET, CALM, EXR, CPI and BCG are significantly explained the relationship. In this period, EXR loaded in two functions with a sign of opposite directions on the variates of share returns. Though, Gold is a priced variable in the market on small cap portfolio, the magnitude of the effect is only a moderate one. Variables like EXP, IMP and FORX are loaded on the opposite variate, as their effect size are relatively small, influence of these variables are also lower in this period in the market of small cap segment.

From the above analysis, on size wise portfolios, the hypothesized factor structure of APT is evident. And the models are substantially explains the shared variances between share returns and unanticipated changes in macroeconomic variables.

7.1.4 Comparative Analysis (size) - Interpretation

Table 7.19 Factor structure of Size Portfolios-2006

Functions	Portfolios					
	Large		Mid		small	
	Eigen value	Cum %	Eigen value	Cum %	Eigen value	Cum %
1	6.25638	40.2066	4.75539	23.5648	5.97396	38.6263
2	2.5225	56.4175	3.82969	42.5424	2.81992	56.8594
3	1.7451	67.6323	3.29042	58.8477	1.95094	69.4737
4	1.34155	76.2538	2.10212	69.2645	1.61067	79.888
5	1.04986	83.0007	1.47231	76.5604		
6			1.26677	82.8377		

Capitalization size wise analysis shows that (Table 7.19) five functions are identified as priced functions in large cap portfolio, where as in mid cap portfolio six functions are explaining the substantial relationship. Numbers of priced functions are four in small cap portfolio. In all these size wise portfolios, in and around 80 percentage of shared variance between the two set of variables are explained by the selected functions and it is substantial in nature. Variation in the factor structure indicates that, based on size of capitalization, the number of variables required to explain the relationship is varying and may leads to a change in magnitude or in some cases, direction of relationship.

Table 7.20 Eigen value weighted Canonical cross loadings of priced variables-Portfolios 2006

variables	Portfolio					
	large		mid		small	
	Effect size *	Rank	Effect size *	Rank	Effect size *	Rank
BSET	5.317004	1	1.690058	4	-2.98516	3
FII	3.198853	2	3.103653	1	-3.85111	1
IMP	-2.68506	3	-0.89343	9	0.63519	10
BCG	2.314306	4	1.513443	5	-1.43359	7
EXP	-1.98992	5	-1.4032	6	0.71008	9
EXR	-1.65612	6	nil	-	2.695625	4
FORX	0.880465	7	-1.19962	7	0.53467	11
M3	-0.73056	8	1.833118	3	-3.41714	2
GOLD	-0.73043	9	-2.11239	2	-0.97028	8
BCC	0.004481	10	-0.74744	10	nil	-
CPI	nil	-	-1.16706	8	1.841736	6
CALM	nil	-	-0.14854	11	1.915384	5

*Magnitude only.
Sign of the effect size represents direction of relationship.

Table 7.20 shows that, on the basis of magnitude of effect size, BSET is identified as the prominent variable in explaining the variations in share returns of large cap portfolio. But it is identified, as the third and fourth variables in case of small and medium cap portfolios. Considering the direction of relationship, BSET shows an overall direct relationship in large and mid cap companies. It indicates that an increase in market turnover increases the volatility in price and downward variation in return. The effect size indicates that more than three times volatile is the large cap companies compared to mid cap companies and it may be the result of high speculation existed in the market and major market players attraction to large capitalization company's shares. As the BSET priced as third important variable in small cap portfolio and the direction of relationship is an inverse one. i.e. increase in market activity decreases the downward variation in return and may be the result of excess volatility in large and mid cap shares, some of the investors divert their investment to small cap sector as a safe bet, where speculation is relatively low, and returns are promising. As indicated earlier, though, a highly priced variable, BSET's importance is reducing by its nature.

An unanticipated change in FII is a highly priced variable in all these size wise portfolios. FII ranked first in mid and small cap portfolios and second in large cap portfolio, literally first, considering the nature of BSET. Table 7.20 shows that positive variations in FII increases the downward variations in large and mid cap shares, indicating more volatility in prices coupled with profit booking, as evidenced by the relationship with BSET. Effect size of FII is more or less same in all these portfolios, but in small portfolio the direction of relationship is an inverse one. This inverse relationship indicates that increase in FII decreases the downward variation in return and it is validated by its relationship with BSET.

In large cap portfolio, IMP is the third highly priced variable on the basis of effect size, where as the order of importance is nine and ten respectively in mid and small cap portfolios. Unanticipated changes in IMP shows an inverse relationship with downward variation in returns of large and mid cap portfolios. But in small cap portfolio the relationship is a direct one. The relationship existed in between large cap shares and IMP may indicate that, with their ample resources and through exchange rate risk hedging, facilitates to reduce the downward variation in share returns (EXR also shows an inverse relationship).

Instead of IMP, M3 and BSET are ranked as third important priced variables in case of mid and small cap portfolios. M3 positively loaded in the mid cap shares and shows a negative relationship in large and small portfolios. As the second important variable explaining the return variations of small portfolio, the inverse relationship indicates that as M3 increases, the downward variation in share returns reduces; it indicates that as money supply increases in the market, profitability of small cap companies increases and reduces the systematic risk element attached. An opposite relationship is exhibited in the case of mid cap portfolio, M3, as the third important variable explaining the variations in share returns.

BCG ranked as fourth important variable on the basis of magnitude of effect in large cap portfolio, but it is ranked fifth and seventh in mid and small cap portfolios respectively.BCG shows a positive relationship in case of large and mid cap portfolios, but a negative relationship with small cap portfolio. (The positive relationship may be the result of government spending and investment to tackle the growth problem by pumping money in to the market- how the market is assessed the action is important. As it indicates that the economic situation is worse, this information spread in the investment arena and the resultant activity of FII and speculators increases the risk). In case of small portfolio, the relationship is a negative one and indicates that as BCG increases, the downward variation in returns decreases. (This may be the result of supportive hand given to small cap sector as a policy matter).

As mentioned, in large cap portfolio, BCG is the fourth ranked variable on the basis of effect size, in mid cap portfolio, BSET is the fourth important variable explaining the return generating process. In small cap sector EXR is the fourth important priced variable with a direct relationship. This relationship indicates that as exchange rate increases, the profitability of the small firms reduces and resultantly increases the systematic risk attached with these firms. (Capacity to hedge exchange rate risk and resources are very low and is indicated by its relationship with IMP and EXP).

Exchange rate is the sixth important priced variable in large cap portfolio and shows a negative relationship. It indicates that as EXR increases, reduces the downward variation in return and is beneficial to large firms (they have their own mechanism for exchange rate risk hedging along with relatively high resources). This variable is not priced in mid cap portfolio.

In contrast with large and small portfolio, FORX has highly priced variable and shows an inverse relationship in case of mid cap shares. It indicates that, as FORX increases, the downward variation in return decreases. Effect size of FORX is relatively small in large and small portfolios and shows a direct relationship.

Gold is priced in all the portfolios with an inverse relationship, but effect size is considerable and important only in mid cap portfolio. As GOLD price increases, downward variation in return of mid cap portfolio decreases, indicating a switch over of investments into mid cap shares.

Inflation is priced as sixth and eighth variable in the order of importance respectively in small and mid cap portfolios. Compared to mid cap portfolio, effect of inflation is much higher in small portfolio and shows a direct relationship. As CPI increases, downward variation in return also increases in small portfolio. A reverse relationship is experiencing in the case of mid cap portfolio. This variable is not priced in large cap portfolio.

Call money interest rate is the fifth priced variable in small cap portfolio, which shows a direct relationship. As CALM increases the systematic risk element is also increased in small cap portfolio. This variable is not priced in large cap and priced with a meager effect size in mid cap portfolio.

In large portfolio, BSET, FII, IMP, BCG, EXP and EXR are important priced variables in their order of importance, which determines variation in return of the shares included in the portfolio. In the case of mid cap portfolio and small cap portfolio, number of priced variables are increased. In mid cap segment important priced variables are FII, GOLD, M3, BSET, BCG and EXP, where as in small cap portfolio the important priced variables, in the order of importance, are FII, M3, BSET, EXR, CALM and CPI.

The analysis reveals that some of the variables are commonly priced in all portfolios. But their magnitude and direction of relationship are different one among portfolios. In addition, certain variables are priced in certain categories of portfolios. There may be difference in magnitude of relationship or direction of relationship of priced variables among these three categories of portfolios. Along with this, variables priced may be different among the portfolios. It leads to the conclusion that, size of capitalization has an important determinant in explaining the relationship between share returns and macroeconomic variables in portfolio context. And there is no evidence to reject the hypothesis that influence of economy wide factors tends to vary on size of capitalization.

7.2 Comparative analysis- Time period

In India, since the opening of the economy in 1991, remarkable developments have occurred in the economy and in the stock market. Policy measures related to liberalizing the economy have been introduced in India on a phased mode. In this ground, a time period based analysis of relationship between variations in share returns and unanticipated changes in macroeconomic variables on portfolio context within the frame work of APT is useful and hence it is part of this study.

7.2.1 Large Cap Portfolio 2000

Second phase of the study, covering a period of six years from 2000, and a well diversified portfolio consisting of 26 company's shares were used as dependent variable set in the canonical correlation analysis. Fourteen macroeconomic variables were used as independent variable in the analysis.

Table 7.21 Multivariate Tests of Significance

Test name		Value	Approx.F	Hypoth.DF	Error DF	Sig. of F
Pillais		5.25007	1.03848	364	630	0.339
Hotellings		13.5569	1.12265	364	422	0.126
Wilks		**0.00039**	**1.07787**	**364**	**443.28**	**0.226**
Roys		0.80536				

Table 7.21 shows the overall predictability of the model. Wilk's Lambda value 0.00039, which represents unexplained variance in the model. It leads to an inference that the full model explains 99.96 percentage (1-lambda) of the shared variance between criterion and predictor set variables.

Table 7.22 Eigen values and Canonical Correlations

Root No	Eigenvalue	%	Cum.%	Canon Cor	Sq.Can Cor
1	**4.13772**	**30.5211**	**30.5211**	**0.89742**	**0.80536**
2	**2.12131**	**15.64743**	**46.16853**	**0.82439**	**0.67962**
3	**1.81118**	**13.35986**	**59.52838**	**0.80267**	**0.64428**
4	**1.68482**	**12.42777**	**71.95615**	**0.79217**	**0.62754**
5	0.8569	6.32078	78.27694	0.67931	0.46147
6	0.76614	5.65128	83.92822	0.65863	0.43379
7	0.59605	4.39663	88.32485	0.61111	0.37345
8	0.48233	3.55784	91.8827	0.57043	0.32539
9	0.32121	2.36932	94.25201	0.49307	0.24312
10	0.25306	1.86663	96.11864	0.44939	0.20195
11	0.22143	1.63331	97.75195	0.42578	0.18129
12	0.15267	1.12615	98.8781	0.36394	0.13245
13	0.10074	0.74308	99.62118	0.30252	0.09152
14	0.05136	0.37882	100	0.22102	0.04885

Observing Table 7.22, it is identified that four dimensions of relationship are highly priced between the set of variables. The first function, as the major dimension explains 30.5 percentage of the shared variance between the dependent and independent variable sets. Successive functions selected for interpretation explains 15.6 percentages, 13.3 percentages and 12.4 percentages respectively. Explaining the variance within the function, by observing the Table 7.22, selected function’s squared canonical correlations are substantial. Collectively, the selected functions explain 71.95 percentage of the shared variance between criterion and predictor set variables for the period. Standardized canonical coefficients for covariates (Table 7.23) and Structure

Correlations of Canonical variables-Independent Variate (Table 7.24) are given in chapter appendix.

Table 7.25 Canonical Cross Loadings Large cap portfolio 2000

Variables	functions			
	1	2	3	4
BCC	-0.00506	0.02197	0.197858	-0.00727
BCG	0.202467	0.003215	-0.22053	**0.363852**
M3	**0.330197**	0.019315	-0.05094	0.152707
WPI	0.094875	0.096198	0.17011	0.141846
GOLD	**-0.41813**	**0.302551**	-0.24143	-0.04305
IIPG	**-0.48166**	**0.320003**	0.062616	0.01254
IIPE	-0.0346	0.048647	**0.341263**	0.097136
CALM	0.165457	0.24383	-0.09883	**-0.37241**
EXR	**0.412867**	-0.29136	0.064029	0.058565
EXP	0.210759	0.096866	0.029378	0.290013
IMP	0.009593	0.291603	0.15559	**0.539341**
FORX	0.116709	-0.03652	-0.17678	0.235892
FII	-0.00923	**0.417941**	-0.28223	-0.12725
BSET	-0.347	-0.0496	**-0.45892**	0.079336

Table 7.25 shows that, in highly priced function number one, IIPG, GOLD and BSET are significantly loaded in the opposite variate indicating an inverse relationship with the criterion set of variables. Other macroeconomic variables loaded in this dimension are EXR and M3 and these variables are cross loaded in the opposite variate with a direct relationship.

Macroeconomic variables loaded in the second dimension of relationship are GOLD, IIPG and FII. All these variables are cross loaded with the opposite variate of share returns with a positive sign, indicates a direct relationship. In the third dimension of relationship, IIPE cross loaded with a positive sign and BSET loaded negatively on the opposite variate. In the fourth function IMP and CALM loaded substantially on the opposite variate. CALM shows a negative relation with the opposite variate and IMP cross loaded positively indicating a direct relationship.

Table 7.26 Eigen value weighted Canonical cross loadings of priced variables- Large cap portfolio 2000

variables	dimensions		Effect size *
	1	2	
EXR	1.708328		1.708328
M3	1.366262		1.366262
IIPG	-1.99299	0.678827	-1.31416
GOLD	-1.73013	0.641805	-1.08832
IMP	0.908693		0.908693
FII	0.886582		0.886582
BSET	-0.83118		-0.83118
CALM	-0.62744		-0.62744
IIPE	0.618089		0.618089
BCG	0.613024		0.613024

*Magnitude only.
Sign of the effect size represents direction of relationship.

The overall effect and magnitude of relationship between dependent and independent set of variables are exhibited in Table 7.26. It is evident from the values, based on effect size; EXR is the major determinant variable that explains variation in the share return in the segment of large cap portfolios for the second phase of the study. Other prominent macroeconomic variables, in their order of importance are M3, IIPG and Gold. Exchange rate and M3 shows a positive relationship with share returns. IIPG and GOLD show a negative relationship with the share returns of large cap portfolio for the period of six years beginning from the year 2000. All other variables given in the Table 7.26 are priced variables but the effect size is moderate. Though GOLD and IIPG are highly priced determinant variables in one dimension of relationship, other dimension of relationship with an opposite sign existed in the market reduced the impact of these variables.

7.2.2 Large cap portfolio 1994

For analyzing the relationship between macroeconomic variables as independent variables and share returns of large cap portfolio as dependent variable, for a period covering six years from 1994, a canonical correlation analysis was performed.

Table 7.27 Multivariate Tests of Significance

Test name	value	Approx.F	Hypoth.DF	Error DF	Sig. of F
Pillais	5.19944	1.157	336	658	0.06
Hotellings	12.35789	1.1822	336	450	0.049
Wilks	**0.00052**	**1.18018**	**336**	**457.8**	**0.05**
Roys	0.74903				

Table 7.27 shows that as Wilk's lamda as 0.0052, indicates the unexplained variance in the model. 1-λ indicates the variance explained by the model (0.9994). Assumption of normality is also met with as Wilk's P value is 0.05, on a bare minimum basis. The overall model explains 99.94 percentage of the shared variance between criterion and predictor set variables.

Table 7.28 Eigen values and Canonical Correlations

Root No	Eigen value	%	Cum.%	Canon Cor	Sq.Can Cor
1	**2.98454**	**24.15091**	**24.15091**	**0.86547**	**0.74903**
2	**2.2689**	**18.35995**	**42.51086**	**0.83312**	**0.69409**
3	**1.83652**	**14.86112**	**57.37198**	**0.80465**	**0.64746**
4	**1.40058**	**11.33346**	**68.70545**	**0.76383**	**0.58343**
5	0.99227	8.02948	76.73492	0.70573	0.49806
6	0.70292	5.68804	82.42297	0.64248	0.41277
7	0.54484	4.40885	86.83182	0.59387	0.35268
8	0.40946	3.31331	90.14513	0.53899	0.29051
9	0.35757	2.89347	93.0386	0.51322	0.26339
10	0.31323	2.53468	95.57328	0.48839	0.23852
11	0.23604	1.91004	97.48332	0.437	0.19097
12	0.1572	1.27205	98.75537	0.36857	0.13584
13	0.08605	0.69635	99.45173	0.28149	0.07924
14	0.06775	0.54827	100	0.2519	0.06346

By observing Table 7.28, based on Eigen value criterion, four functions are identified as priced dimensions. From among the priced functions, more powerful function is that which accounts for 24 percentage of the shared variance in the model. Successive priced functions, accounts for 18.35, 14.86, 11.33 percentages of the shared variance between two sets of variables. Collectively all these functions identified for interpretation explains 68.7 percentage of the shared variance between dependent and independent set of variables, it could explain substantial variance of the model. Squared canonical correlations are given in Table 7.28 explains the variance explained by its own variate. These values are also substantial one. Standardized canonical coefficients for covariates (Table 7.29) and Structure Correlations of Canonical variables-Independent Variate (Table 7.30) are given in chapter appendix 2.

Table 7.31 Canonical Cross Loadings

Variables	Functions			
	1	2	3	4
BCC	0.175154	**-0.32489**	0.057365	-0.22908
BCG	-0.12705	0.260983	-0.17317	0.142462
M3	0.199699	-0.1621	-0.15307	-0.00518
WPI	-0.13326	-0.17516	0.061949	0.159152
GOLD	-0.17208	0.172114	-0.13254	-0.17192
IIPG	-0.1447	-0.17759	-0.05709	**-0.3444**
IIPE	-0.06236	-0.276	-0.24342*	-0.27286
CALM	-0.24068*	-0.18109	-0.04905	**0.311436**
EXR	-0.2621	0.27927	-0.04611	0.176468
EXP	-0.07782	**-0.40737**	0.037494	0.074672
IMP	-0.19309	**-0.44086**	-0.22909	0.069425
FORX	0.150289	**-0.43226**	-0.05646	-0.06143
FII	**0.690308**	0.030617	-0.10153	0.07827
BSET	0.246235	-0.21722	0.215196	-0.16393

*Loadings less than 0.3.

Table 7.31 shows the canonical cross loadings of predictor variables on the opposite variate of share returns. From the Table it is identified that in function number one, FII alone highly cross loaded on the opposite variate, with a positive sign indicates a direct relationship between dependent and independent set of variables.

In the second dimension of relationship four variables are identified as priced variables and all these variables are cross loaded in the opposite variate with a negative sign indicates an inverse relationship. The significantly loaded variables are IMP, FORX, EXP and BCC. In the third function, identified as a significantly priced, none of the variables cross loading achieved the bench mark of 0.3. Among the variables IIPE* is the highly loaded variable with a cross loading of -0.24342. In the fourth dimension of relationship CALM cross loaded in the opposite variate and the relationship is a direct one.

Table 7.32 Eigen value weighted canonical cross loadings of priced variables - Large Cap Portfolio 1994

variables	Dimensions	effect size *
	1	
FII	2.06025043	2.0602504
IMP	-1.000272	-1.000272
FORX	-0.9807456	-0.9807456
EXP	-0.9242834	-0.9242834
BCC	-0.737147	-0.737147
CALM	0.4361916	0.4361916

*Magnitude only.
Sign of the effect size represents direction of relationship.

Magnitude and direction of priced macroeconomic variables, among the selected dimensions are given in Table 7.32. By analyzing the result, it is evident that FII plays a prominent role in explaining the variations in share returns for large cap portfolio and shows a direct relationship with the variations in share returns for the period. Import (IMP), FORX and EXP are the other major players determining the variations in share returns, in the segment of the market. All these variables are inversely related to share returns of large cap portfolio.

The effect size of BCC and CALM are relatively lower one compared to other priced variables in this segment. BCC shows a negative relationship with share return variables. On the other hand CALM shows a direct relationship with share return variables.

7.2.3 Comparative Analysis (period) - Interpretation

Result of the CCA for large cap portfolios of 1994, 2000 and 2006 and its analysis are given in Table 7.33, reveals that return generating process follows a multifactor structure, magnitude and direction of relationship can be explained in tune with the APT frame work.

Table 7.33 Factor structures of Time period portfolios- Large Cap

Functions	Time period					
	1994		2000		2006	
	Eigen value	Cum%	Eigen value	Cum%	Eigen value	Cum%
1	2.98454	24.1509	4.13772	30.5211	6.25638	40.2066
2	2.2689	42.5109	2.12131	46.1685	2.5225	56.4175
3	1.83652	57.372	1.81118	59.5284	1.7451	67.6323
4	1.40058	68.7055	1.68482	71.9562	1.34155	76.2538
5					1.04986	83.0007

Table 7.33 shows that, the hypothesized multifactor structure is evident in all the time period for large portfolios and the models are substantially explained the shared variances between share returns and unanticipated changes in macroeconomic variables.

Table 7.34 Eigen value weighted Canonical cross loadings of priced variables- Time period Portfolios – Large Cap

variables	Time period					
	1994		2000		2006	
	effect size *	Rank	effect size *	Rank	effect size *	Rank
BSET			-0.83118	7	4.328218	1
FII	2.06025	1	0.886582	6	3.554826	2
IMP	-1.00027	2	0.908693	5	-2.68506	3
BCG			0.613024	10	2.71149	4
EXP	-0.92428	4			-1.98992	5
EXR			1.708328	1	-0.97667	6
FORX	-0.98075	3			0.880465	7
M3			1.366262	2	-0.73056	8
GOLD			-1.08832	4	-0.73043	9
BCC	-0.73715	5			-0.36832	10
CPI						
CALM	0.436192	6	-0.62744	8		
IIPG			-1.31416	3		
IIPE				9		

*Magnitude only.
Sign of the effect size represents direction of relationship.

In first phase of the study FII is the prominent priced variable where as in the second phase, EXR and in third phase, BSET are identified as the highly priced variable on the basis of effect size. In the first phase of the study FII loaded in the opposite variate with a direct relationship and it indicate that, as FII increases, downward variation in return also increases. The same relationship is also followed in third phase, but the magnitude of relationship is a higher one. Table 7.34 shows the eigen value weighted cross loadings in all the highly priced functions and the magnitude of FII in the second phase indicating a declining effect and is ranked sixth important variable. In this period, instead of FII, EXR priced as the dominant variable explaining the relationship. And the relationship is a direct one, indicating a positive change in EXR increases the downward variation of return and it may be the result of import orientation is greater than export orientation of shares of the portfolio. In the third phase BSET is identified as prominent variable on the basis of effect size and shows a direct relationship. It is ranked as seventh priced variable, explains relatively less variation in share return in the second phase. BSET is not at all priced in the first phase, in the segment of large cap portfolios.

In the order of importance, in phase one, the second important variable determining variation in share return is the IMP and shows a negative relationship. The same variable is also priced fifth and third in second and third phase of the study. In the second phase, the relationship is a direct one and the effect size is relatively lower compared to other phases – this relationship is in tune with the highly priced EXR in this period. (Both EXR and IMP show a positive loading on the opposite variate and an increase in EXR or IMP or both, increases the downward variation in share returns). It may be the result of import orientation of the firms during this period due to policy changes. Impact of IMP is doubled in the third phase compared to the first phase and following an inverse relationship. It indicates that increase in IMP decreases the downward variation in return. In the third phase this relationship coupled with a negative relationship of EXR explains the shared variance i.e. import (raw material or finished goods) is beneficial to large number of companies in this period and it may be the result of price difference in domestic and international markets. In addition, in the third phase EXP is also highly priced with a negative relationship, i.e. an increase in EXP coupled with an increase in EXR is beneficial to the export oriented firms and reduce the downward variation in share return.

Third important variable in the first phase is the FORX with a negative relationship and it is the seventh important variable in the third phase with a different direction of relationship. This relationship indicates that in the first phase an increase in FORX decreases the downward variation in return and this is in tune with the hypothesized relationship between the credibility of the economy and share returns. Increase in FORX may be the result of increase in FII, coupled with foreign direct investment, tightened policy measures and product substitution, i.e. domestic products are substituted for imported products and in turn increase the profitability of domestic firms, leads to a reduction in downward variations of share returns. The reverse relationship in the third phase may be the result of relationship between highly priced FII and FORX.

Money supply is not priced in the first phase, but it is the second important variable in the second phase with a direct relationship and in relatively lower mode. M3 priced in the third phase with an inverse relationship with share return. The direction of relationship in the second phase indicates that an increase in M3 increases the volatility in prices and resultant downward variation in return. (Increase in money supply increases investment and competition in the market that in turn leads to an increase in downward variation in return). In the third phase M3 priced with a negative relationship with a relatively low effect size.

IIPG loaded only in the second phase with a negative relationship. It indicates that an increase in IIPG (proxy variable of growth) reduces the variation in return and it follows the hypothesized relationship between share return and growth. GOLD is included in the study as a proxy variable for alternative investment opportunity and is moderately priced in second and third phase of the study. It is loaded in the opposite variate with a negative relationship indicating, as GOLD price increases downward variation in share return decreases. The relationship may be the result of investment switchover between shares and GOLD.

BCC priced in the first and third phase with relatively lower effect size and shows negative relationship with variation in return. CALM priced in the first and second phases with opposite directions. In the first phase, the direction of relationship indicates that an increase in call money interest rate increases the downward variation in return. But an opposite relationship is existed in large cap segment of stock market in the second phase. Inflation not priced in any of the phases in this segment of market. IIPE shows a positive relationship with a relatively low effect size and the direction of relationship may be the result of increased demand and resultant hike in price of power, considering the supply situation.

Even though, multicollinearity between these priced variables are considerably low, explaining the cause and effect relationship of these individual variables with share returns are experiencing much difficulty, as there exists combined effect of these variables in the market.

The comparative analysis based on time period given above reveals that at different points of time, numbers of highly priced functions are slightly varies. In addition to this, priced macroeconomic variables explaining the variations in the share return are also changed. In the first phase, highly priced variables are FII, IMP, FORX and EXP. In the second phase EXR, M3, IIPG and IMP are identified as highly priced variables. In the third phase BSET, FII, IMP and BCG are highly priced variables explaining the relationship between variations in share returns of large cap companies. Results indicate that from period to period, the magnitude of relationship is also varying and in case of certain variables the direction of relationship is changed from one period to other.

From this, it is evident that influence (magnitude and direction) of economy wide factors tends to vary on the basis of time. Moreover, influential economy wide factors itself changed from one period to other period with a reasonable time span, in tune with the developments in the economy and stock market. It leads to the conclusion that there is no chance to reject the hypothesis, as influence of economy wide factors tends to vary on the basis of time period for the segment of large cap shares.

Appendix -1

Table 7.3 Standardized canonical coefficients for covariates (Independent Variables)- Large cap portfolio 2006

COVARIATE	Functions				
	1	2	3	4	5
BCC	0.33307	0.68045	-0.16782	-0.55275	0.61158
BCG	0.35782	1.25266	-0.08406	-0.78543	-0.56354
M3	-0.15057	-0.34619	-0.35216	0.77699	0.30083
CPI	-0.27267	-0.53103	-0.01575	0.48629	0.16693
GOLD	0.15591	0.45111	-0.27777	-0.07286	0.45218
IIPG	-0.22003	-0.07313	0.18327	0.41351	-0.17707
IIPE	-0.0394	-0.16055	-0.11518	0.02891	0.08355
CALM	0.19585	0.55608	-0.50111	-0.10365	0.28923
EXR	0.09733	-0.62455	-0.28106	0.09818	-0.04147
EXP	-0.20779	-0.34268	0.15157	-0.56032	-0.73524
IMP	-0.17071	0.71705	0.05588	0.42248	0.03273
FORX	-0.11169	0.49551	-0.23125	0.18529	-0.41824
FII	0.46167	0.0885	-0.46418	-0.26142	-0.34716
BSET	0.60986	-0.07495	0.54872	0.4285	0.55622

Table 7.4 Structure Correlations of Canonical variables (Independent Variate) - Large cap portfolio2006

Covariate	functions				
	1	2	3	4	5
BCC	-0.29227	0.1978	0.16103	-0.36272	0.49619
BCG	0.46675	-0.03361	-0.17754	0.19677	-0.52864
M3	0.24253	0.05104	-0.52505	0.30129	0.06768
CPI	-0.26515	-0.16921	0.06806	0.30408	-0.22189
GOLD	-0.03113	0.22023	-0.52496	-0.10846	0.2865
IIPG	-0.08937	0.26709	0.12563	0.32122	-0.17543
IIPE	0.02602	-0.06571	-0.09283	0.19921	-0.1102
CALM	-0.14653	0.3006	-0.27402	0.06438	0.41523
EXR	0.17596	-0.45754	-0.48832	0.0601	0.02065
EXP	-0.34254	0.29763	0.11621	-0.28774	0.23598
IMP	-0.4622	0.28646	0.2667	0.21899	0.12217
FORX	-0.04816	0.41247	-0.11976	0.26946	-0.21002
FII	0.61192	-0.04757	-0.13936	0.10641	-0.47379
BSET	0.74505	0.15409	0.45429	0.35126	0.11119

Table 7.9. Standardized canonical coefficients for covariates (Independent Variables)- Mid cap portfolio 2006

variables	Functions					
	1	2	3	4	5	6
BCC	0.5767	0.19109	0.6544	-0.44209	0.98705	0.07231
BCG	0.36626	-0.35969	1.27218	-0.78087	0.01175	0.99066
M3	-0.38482	0.62004	-0.2967	0.01636	0.10138	0.08545
CPI	-0.14021	0.13174	-0.36966	-0.42244	-0.19862	-0.02766
GOLD	-0.70965	0.1801	0.31478	-0.21539	0.11417	-0.46375
IIPG	-0.11891	0.1645	-0.43655	0.20858	-0.44788	-0.29498
IIPE	-0.22843	-0.31698	0.06793	0.05291	0.12588	-0.71277
CALM	0.08476	-0.18846	0.4476	-0.53463	0.61872	0.29726
EXR	0.47259	-0.15994	-0.40612	0.60108	-0.35072	-0.21589
EXP	0.2813	0.01182	-0.72186	-0.38068	-1.3091	0.4478
IMP	-0.67931	-0.34643	0.44193	0.71143	0.69149	0.45983
FORX	0.00362	0.04012	-0.30326	-0.27713	0.01943	0.35061
FII	0.02926	0.42183	0.35438	0.2674	0.04425	-0.02297
BSET	0.09031	0.4089	-0.06437	0.19502	0.1959	-0.06901

Table 7.10. Structure Correlations of Canonical variables (Independent Variate) - Midcap portfolio2006

Variables	Functions				
	1	2	3	4	5
BCC	0.2005	0.13187	-0.45278	-0.15437	0.49048
BCG	0.00533	0.05129	0.72729	0.00126	-0.51249
M3	-0.30163	0.53753	0.14197	0.08055	-0.0327
CPI	-0.11384	-0.34222	0.07551	-0.14529	-0.19332
GOLD	-0.48869	0.16156	0.00409	-0.30094	-0.22041
IIPG	-0.18604	0.11197	-0.01753	-0.17413	-0.08856
IIPE	-0.15764	-0.12582	0.20352	0.04195	0.08054
CALM	-0.1369	-0.23837	-0.09838	-0.36224	0.42097
EXR	0.18522	-0.18066	0.11505	0.28767	-0.32759
EXP	-0.17336	0.03639	-0.48696	-0.0702	0.10484
IMP	-0.44519	-0.28992	-0.25314	0.35347	0.29546
FORX	-0.04485	0.27974	-0.41631	-0.28561	0.07151
FII	0.05242	0.54309	0.43434	0.2463	-0.19937
BSET	0.16044	0.49558	0.16683	0.25404	0.1388

Table 7.15 Standardized canonical coefficients for covariates (Independent Variables) - Small cap portfolio 2006

Variables	Functions			
	1	2	3	4
BCC	-0.03306	0.88342	0.18135	-0.21983
BCG	-0.48578	0.85937	0.2751	-0.4616
M3	-0.17346	-1.00501	-0.36465	0.07329
CPI	0.20697	-0.82506	0.04253	-0.11728
GOLD	-0.08377	-0.15006	-0.23573	0.23751
IIPG	0.14357	0.06426	-0.65946	0.08556
IIPE	-0.05784	-0.12536	-0.04321	-0.03263
CALM	0.19932	0.20602	0.07297	-0.19906
EXR	0.77661	0.06872	-0.09695	-0.47381
EXP	-0.18499	-0.53197	0.5273	-0.24526
IMP	0.02363	0.18159	0.23647	0.24822
FORX	-0.06315	0.04324	0.32041	0.23434
FII	-0.28933	0.05555	0.62222	-0.65786
BSET	-0.11563	0.08671	-0.5753	0.2096

Table 7.16. Structure Correlations of Canonical variables (Independent Variate) -Small Cap Portfolio 2006

Variables	Funcnctions			
	1	2	3	4
BCC	0.05607	0.23661	0.34407	0.33946
BCG	-0.26528	-0.04593	-0.41233	-0.61615
M3	-0.36766	-0.57136	-0.29474	-0.14072
CPI	0.3331	-0.15009	0.07679	-0.28715
GOLD	0.15806	-0.40047	-0.18126	0.14772
IIPG	-0.16402	0.09476	-0.35096	-0.09103
IIPE	-0.24619	-0.09383	-0.19568	-0.2512
CALM	0.34642	-0.06207	-0.051	0.10433
EXR	0.59782	-0.16269	-0.20169	-0.48198
EXP	-0.04904	-0.17386	0.44763	0.33084
IMP	0.12643	-0.18527	0.40042	0.30199
FORX	-0.14966	-0.00924	0.11842	0.42262
FII	-0.54573	-0.00865	0.09496	-0.659
BSET	-0.43314	0.23574	-0.37212	-0.01251

Table 7.23 Standardized Canonical coefficients for covariates (Independent Variables) - Large cap portfolio 2000

Variables	Functions			
	1	2	3	4
BCC	-0.52182	-0.45445	0.7368	0.68438
BCG	0.1132	-0.06514	-0.0718	0.79572
M3	0.65555	0.68828	-0.55788	-0.33157
WPI	-0.01117	0.16397	0.10009	0.04145
GOLD	-0.42679	0.17474	-0.09189	0.10791
IIPG	-0.30052	0.40711	-0.05956	0.04545
IIPE	-0.03467	-0.06488	0.70818	-0.04497
CALM	0.40446	0.47924	-0.00894	-0.43564
EXR	0.25665	-0.3294	0.03268	0.28727
EXP	0.39105	-0.18916	-0.29134	0.11434
IMP	0.00034	0.59071	0.25062	0.55536
FORX	-0.27531	-0.25247	0.00002	0.09817
FII	0.33168	0.54227	-0.15208	-0.06944
BSET	-0.32262	-0.46212	-0.5647	0.21524

Table 7.24 Structure Correlations of Canonical variables (Independent Variate) - Large cap portfolio 2000

Variables	functions			
	1	2	3	4
BCC	-0.00564	0.02665	0.2465	-0.00918
BCG	0.22561	0.0039	-0.27474	0.45931
M3	0.36794	0.02343	-0.06346	0.19277
WPI	0.10572	0.11669	0.21193	0.17906
GOLD	-0.46593	0.367	-0.30078	-0.05434
IIPG	-0.53672	0.38817	0.07801	0.01583
IIPE	-0.03856	0.05901	0.42516	0.12262
CALM	0.18437	0.29577	-0.12313	-0.47011
EXR	0.46006	-0.35343	0.07977	0.07393
EXP	0.23485	0.1175	0.0366	0.3661
IMP	0.01069	0.35372	0.19384	0.68084
FORX	0.13005	-0.0443	-0.22024	0.29778
FII	-0.01029	0.50697	-0.35162	-0.16063
BSET	-0.38666	-0.06016	-0.57174	0.10015

Table 7.29 Standardized canonical coefficients for covariates (Independent Variables) - Large cap portfolio 1994

Variables	function			
	1	2	3	4
BCC	0.21704	-0.35496	0.24172	-0.0145
BCG	-0.26561	-0.12084	-0.39867	0.25509
M3	0.32537	0.20505	-0.16335	-0.17192
WPI	-0.0301	0.01354	0.51657	0.10837
GOLD	-0.20284	0.30347	-0.24963	-0.24214
IIPG	-0.302	0.0913	-0.18048	-0.85775
IIPE	0.13689	0.08916	-0.3514	-0.25727
CALM	-0.1497	-0.18995	-0.19143	0.52095
EXR	0.07464	0.42125	-0.0322	0.22683
EXP	-0.13188	-0.17379	0.56853	0.44951
IMP	-0.23107	-0.48713	-0.79545	0.18288
FORX	0.01753	-0.72553	-0.30377	0.03663
FII	0.81717	0.23464	-0.45752	0.28519
BSET	0.06731	-0.06969	0.46746	-0.18416

Table 7.30 Structure Correlations of Canonical variables (Independent Variate) -Large cap portfolio 1994

Variables	Functions			
	1	2	3	4
BCC	0.20238	-0.38997	0.0886	-0.29991
BCG	-0.1468	0.31326	-0.26746	0.18651
M3	0.23074	-0.19457	-0.23642	-0.00678
WPI	-0.15397	-0.21025	0.09568	0.20836
GOLD	-0.19883	0.20659	-0.20471	-0.22507
IIPG	-0.16719	-0.21316	-0.08817	-0.45089
IIPE	-0.07205	-0.33129	-0.37596	-0.35723
CALM	-0.27809	-0.21736	-0.07576	0.40773
EXR	-0.30284	0.33521	-0.07121	0.23103
EXP	-0.08992	-0.48897	0.05791	0.09776
IMP	-0.2231	-0.52917	-0.35383	0.09089
FORX	0.17365	-0.51884	-0.08721	-0.08043
FII	0.79761	0.03675	-0.15681	0.10247
BSET	0.28451	-0.26073	0.33237	-0.21461

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Chapter 8

CONCLUSION AND IMPLICATION

Contents

Having done the selection of macroeconomic variables, forecasting the series and construction of residual series, construction of well diversified portfolio, and the concomitant test procedures and the empirical research analysis, the present chapter throws light to further research in the area.

8.1 Summary and conclusions

The primary objective of the study was to understand the risk return relationship and factor structure of the return generating process, in a multifactor frame work of Arbitrage pricing theory in the Indian stock market. The results of the study shows of the return generating process involved an identification of Arbitrage pricing theory factor structure, magnitude and direction of relationship in the Indian stock market with the help of a set of macroeconomic variables, as well as on the basis of theoretical a foundation that explains its effects on future cash flow and discount rate.

A portfolio consisting of 22 shares constructed from 145 selected shares based on a set of criteria, belonging to large cap, medium cap and small cap companies. The portfolio was randomly constructed and equally weighted, based on the criteria of the lowest normalized portfolio variance and theoretical considerations of diversification. The share returns are observed on monthly basis and log returns were used along with unanticipated changes in macroeconomic variables for multivariate normality testing. Result of the multivariate test in Canonical correlation analysis, indicates that the series of log returns and residuals of macroeconomic variables were endorsed to multivariate normality, and hence the factor structure, magnitude and direction of relationship identified from the analysis tenable to reliability assumptions which in turn leads to interpretations and generalizations of the result.

The macroeconomic variables have been selected on the basis of theoretical background, as the variables are affecting the future cash flow or discount rate or both. These variables used for generating a forecasted series by employing forecasting methods, ranging from Linear trend to Auto regressive integrated moving average methods, considering the nature of the data. The forecasted series are then used to generate unexpected movements in macroeconomics variables. Multicollinearity among the macroeconomic variables was tested through a series of repeated process, by using a linear regression, taking one of the macroeconomic variables as dependent variable. The final set of macroeconomic variables for factor identification test consists of fourteen macroeconomic variables.

The risk return relationship hypothesis of Arbitrage pricing theory was tested by using a set of standard methodologies, which have been modified to suit the Indian condition and statistical developments. Modifications made to the basic methodologies are in respect to the raw return of individual security returns instead of excess return of portfolio. The reason for this change is that data relating to excess return of portfolios is not available and the study is based on randomly constructed equally weighted portfolios which have been considered as a cross section of the market. In addition, the discount rate of treasury bills, which may consider as risk free rate, data based on the common procedure of issue is not available for the entire study period, as the procedure itself changed from fixed discount rate to auction driven market rate. Statistical development related to Canonical Correlation Analysis which overcomes the disadvantages of multiple regressions, facilitated to explore simultaneously, the many to many relationships is also a reason for modifying the methodology. Canonical Correlation Analysis which facilitate to carry out testing the APT hypothesis through factor extraction, identification of factors, its magnitude and dimension of relationship, and make it possible to explain the variation in the share returns with the help of variation in unanticipated changes in the macroeconomic variables.

The result from the APT test suggests that return generating process of the Indian stock market is characterized by a multifactor structure and identified that a four factor model substantially explains the variations in share returns. The maximum number of factors in this process is based on the lowest number of variables in the variable sets. Though, a fourteen factor or a twelve factor model provides a larger explanation for the variation in the portfolio returns, the marginal contribution of additional factors is low. Based on the criteria of marginal contribution of explanatory power, a model with smaller number factors may be more efficient in explaining the variations in share returns and it increases the practical use. Considering this, it may conclude that a four factor model substantially explains the return generating process in the Indian stock market. From these complex risk factors, identification of macroeconomic variables behind these risk factors were made by using canonical cross loadings, and its magnitude and direction of relationship were exposed by Eigen value weighted canonical cross loadings., From the complex risk factors, based on magnitude, Banking systems credit to government (BCG), which have multiple impact on growth in investments and credit environment, Net investments of foreign institutional investors (FII) which have directly linked to investment climate and credibility of the economy, Money supply (M3), connected to investment and credit environment and Market turnover (BSET) associated with liquidity environment were identified as the prominent state variables, explains the return generating process in the Indian stock market. This leads to the conclusion that, in Indian stock market, a four factor model substantially explained the variations in share returns in the APT frame work, and the major environments determining the return generating process in portfolio context were the credit, investment climate and liquidity.

Second objective of this study was to assess the impact of systematic risk factors influence on size of capitalization. For assessing the impact of risk factors on size of capitalization, for a period of five years from 2006, three portfolios were constructed based on size of capitalization. All these well diversified portfolios, for large, medium and small cap, were constructed by following the same criteria, as in the case of market portfolio and same set of macroeconomic variables were used. Multivariate test for normality assumptions endorsed the result. Test results of Arbitrage pricing theory indicated that for large cap shares, five factors substantially explained the return generating process, and the highly priced variables were Market turnover (BSET), Net investment of foreign institutional investors (FII) Import, (IMP), Banking sectors credit to government (BCG), Export (EXP) and Exchange rate (EXR). For the mid cap portfolio the highly priced variables in the order of impotence were, Net investment of foreign institutional investors (FII), Gold price (GOLD), Money supply (M3), Market turnover (BSET), banking sectors credit to government (BCG) and Export (EXP), for a factor structure of six highly priced relationships. A four factor model substantially explained the return generating process in small cap segment and the highly priced variables were Net investment of foreign institutional investors (FII), Money supply (M3), Market turnover (BSET), Exchange rate (EXR), Call money interest rate (CALM), Inflation (CPI) and Banking sectors credit to government (BCG). It leads to the conclusion that, based on size, the factor structure, systematic risk factors, its magnitude and direction of relationship were changed in explaining the return generating process during the period of 2006 to 2011.

Influence of time period on systematic risk factors is also considered as third objective this study. Time period based comparison was made for three phases on large cap portfolios. The reason for selecting the large cap portfolio is that before 2004, there was no standardized classification and reporting of data for small and medium sized companies. Three randomly selected equally weighted portfolios were constructed for this purpose on large cap segment for the three phases. Return on these portfolios was explained by fourteen macro economic variables, which are proxies of systematic risk factors. After endorsing the conditions of multivariate normality, the result of the Arbitrage pricing theory test reveals that, for the period of 1994 to 2000, a four factor model substantially explained the return generating process. Important priced variables in this period were Net investment of foreign institutional investors, Import, Foreign exchange reserve, and Export. In the second phase the highly priced variables were Exchange rate, Money supply, Index of industrial production general, Gold price, Import and Net investment of foreign institutional investors, in a factor structure consisting four highly loaded functions. In the third phase the highly priced macroeconomic variables representing systematic risk factors were Market turnover, Net investment of foreign institutional investors, Banking sectors credit to government, Export, and Exchange rate, for a five factor model that substantially explaining the return generating process. Result of the study reveals that, the factor structure, number of priced factors, magnitude and direction of relationship were changed among the three phases of the study. It led to the conclusion, that in tune with the openness of the economy and related policy changes, the systematic risk factors, its magnitude and direction of relationship were varying with periods selected for the study covering a reasonable time span, in Indian stock market.

8.2 Implications

The research results suggest that APT based multifactor return generating process could be endorsed in the Indian context. An understanding of the factor structure of the return generating process and the impact of specific systematic risk factors; its magnitude and direction of relationship on asset returns is expected to be of value to a fund manager in formulating strategies for risk management of portfolios. Another implication of this study is that, in formulating policies on stock market and for its orderly development, an understanding about the return generating process, the factor structure, magnitude and direction of relationship may provide a better insight and expect to yield the desired result to the government.

Based on structure correlations of individual company's share returns to its variate and its magnitude and direction of relationship are identifiable. This facilitated to analyse the relationship with identified systematic risk factors; an understanding about the return generating process may provide a better insight to investors and more fruitful in their investment decision making, as they are mainly concentrating on firm specific variables. Based on the platform of Arbitrage pricing theory and the magnitude and direction of relationship of identified risk factors, an analysis of industry and firm specific variables may provide a better insight for investment decision making on individual firm's shares and expected to be worth full for further research.

A modified research design using canonical correlation analysis to explain the return generating process based on Arbitrage pricing theory frame work and introduction of Eigen value weighted canonical cross loadings for identifying the relative importance and direction of relationship of systematic risk factors are useful direction of this study and the same has been applied first time in India. Therefore, it is appropriate that, research findings and the resulting conclusions are considered only as a starting point for future research in this area. In addition, as the study reports, systematic risk factors were varying in tune with the time period covering five to six years, a study based on shorter period in an overlapping nature may provide valuable inputs for formulating more accurate trading and risk management strategies and may be a fruitful direction for future research.

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APPENDICES

Appendix -1

Phase -1

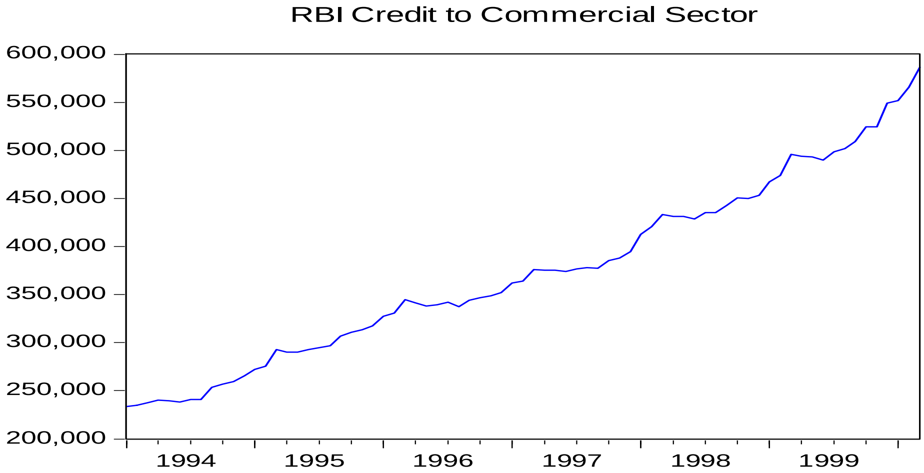

Figure A.1.1 Line Graph of BCC

Table A.1.1 Regression Results of Exponential Trend Model of BCC

Variables	**Coefficient**	**Standard error**	**t – statistics**	**P –value**
C(1)	234320.9	1813.120	129.2363	0.0000*
C(2)	0.011513	0.000148	77.85857	0.0000*
R^2 = **0.988905** Prob(F-statistic)		Adjusted R^2 = 0.988753 0.000000		

* denotes significant at 1 per cent level.

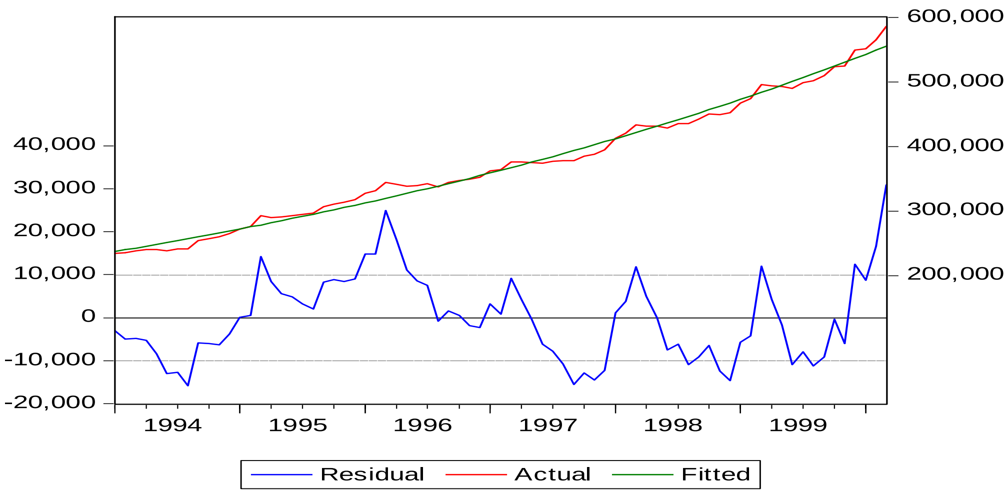

Figure A. 1.2 Graph of actual, fitted and residual values of BCC from Exponential Trend Model

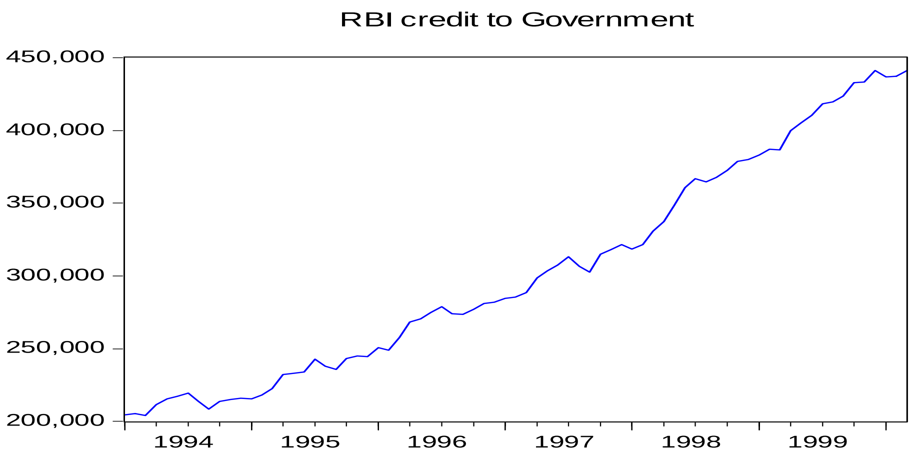

Figure A .1.3 Line graph of BCG

Table A.1.2 Regression Results of Quadratic Trend Model of BCG

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	202292.5	2073.794	97.54705	0.0000*
Time	1249.333	125.9300	9.920855	0.0000*
$Time^2$	27.92821	1.605704	17.39312	0.0000*
R^2 = **0.994070**		Adjusted R^2 =	0.993906	
Prob(F-statistic)			0.000000	

* denotes significant at 1 per cent level.

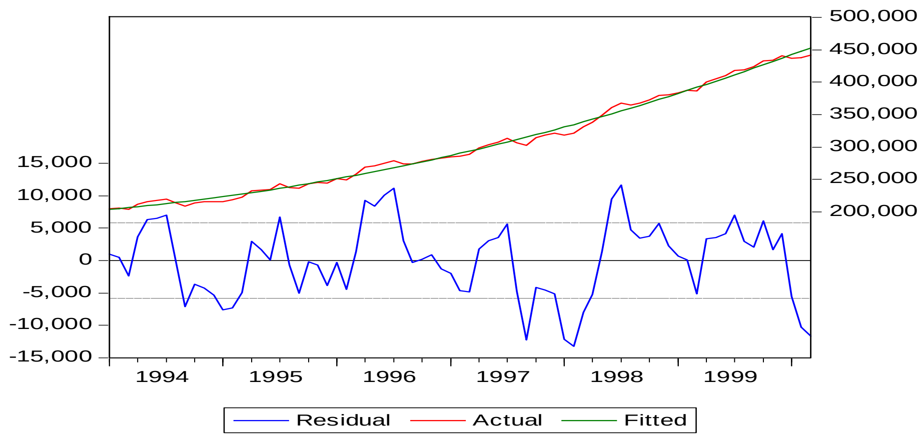

Figure A.1.4 Graph of Actual, fitted and residual values of BCG from Quadratic Trend Model

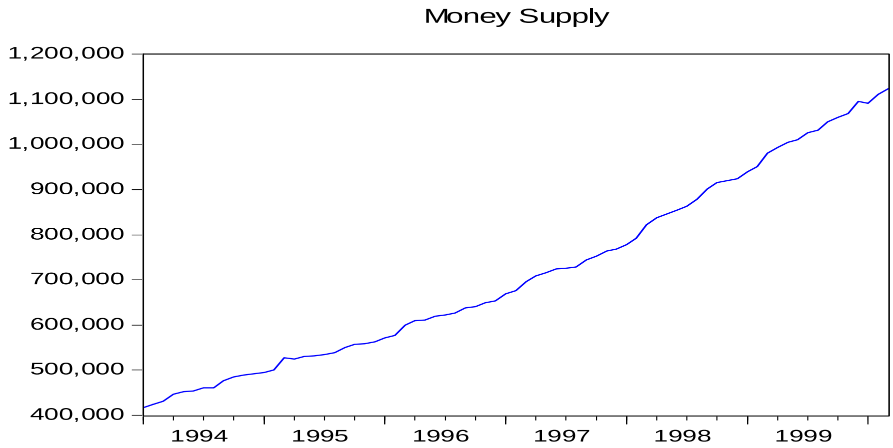

Figure A.1.5 Line graph of Money Supply (M3)

Table A.1.3 Regression Results of Quadratic Trend Model of Money Supply

Variables	**Coefficient**	**Standard error**	**t – statistics**	**P –value**
Constant	430143.7	3125.448	137.6263	0.0000*
Time	3936.623	189.7910	20.74188	0.0000*
$Time^2$	72.36230	2.419982	29.90199	0.0000*
R^2 =**0.998267**		Adjusted R^2 = 0.998219		
Prob(F-statistic)		0.000000		

* denotes significant at 1 per cent level.

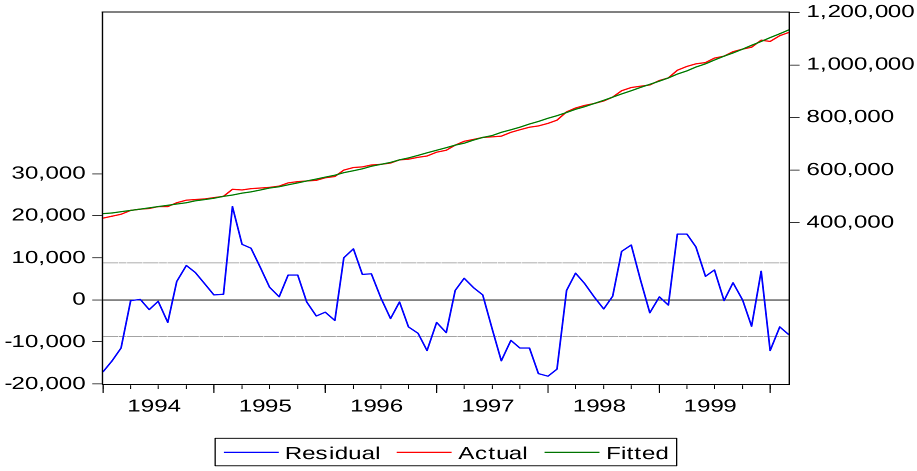

Figure A.1.6 Graph of Actual, fitted and residual values of Money Supply from Quadratic Trend Model

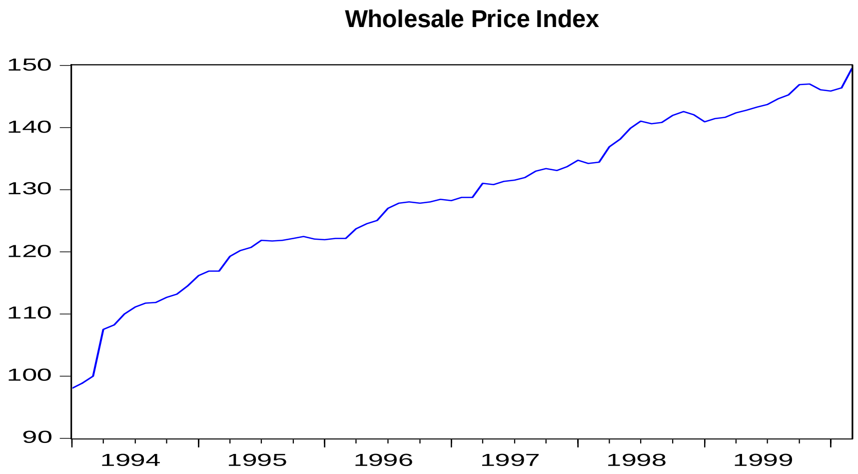

Figure A.1.7 Line graph of WPI

Table A.1.4 Regression Results of Quadratic Trend Model of WPI

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	103.8119	0.716258	144.9364	0.0000*
Time	0.826451	0.043494	19.00132	0.0000*
$Time^2$	-0.003363	0.000555	-6.064258	0.0000*
R^2 =**0.975478** Adjusted R^2 =0.974797				
Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

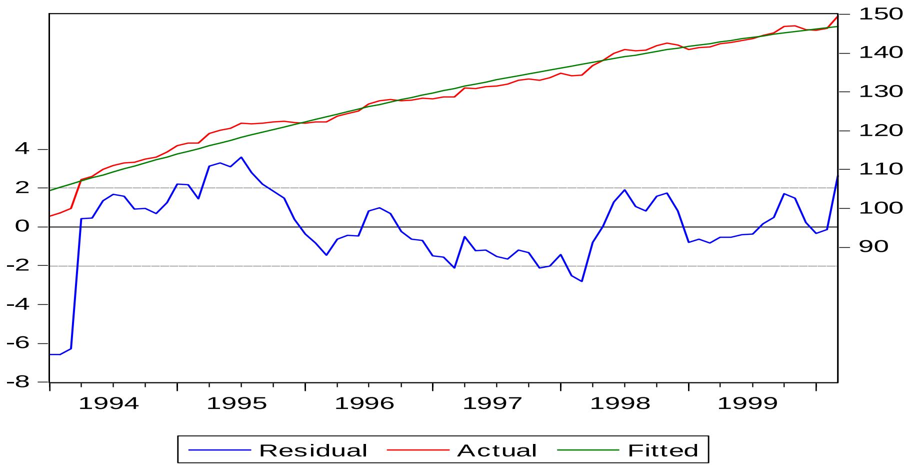

Figure A.1.8 Graph of Actual, fitted and residual values of WPI from Quadratic Trend Model

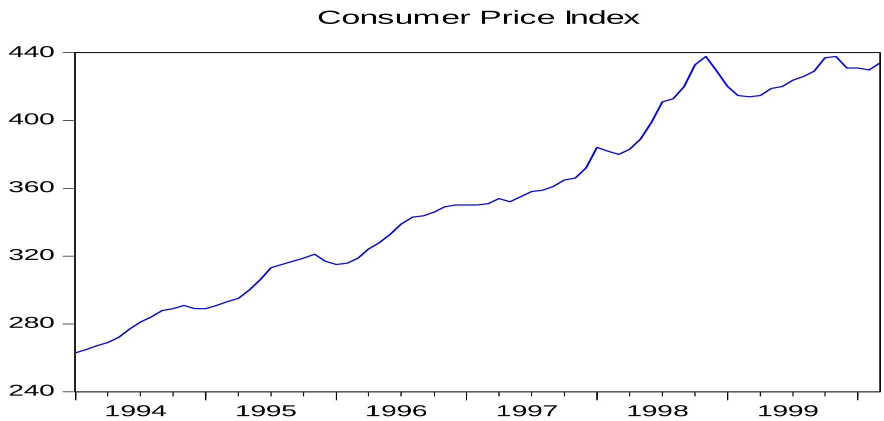

Figure A.1.9 Line graph of CPI

Table A.1.5 Regression Results of Linear Trend model of CPI

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	259.8523	1.954292	132.9649	0.0000*
Time	2.478976	0.044686	55.47565	0.0000*
R^2 = **0.976829** Prob(F-statistic)		Adjusted R^2 = 0.976512 0.000000		

* denotes significant at 1 per cent level.

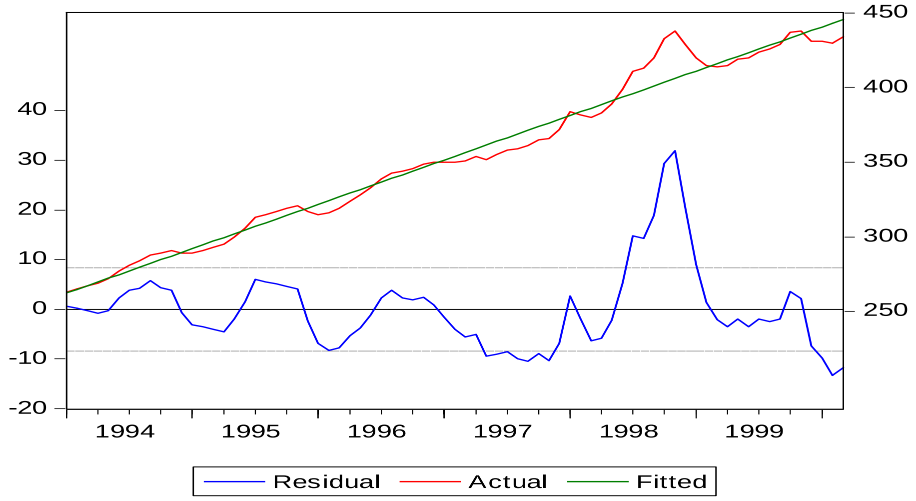

Figure A.1.10 Graph of Actual, fitted and residual values of CPI from Linear Trend Model

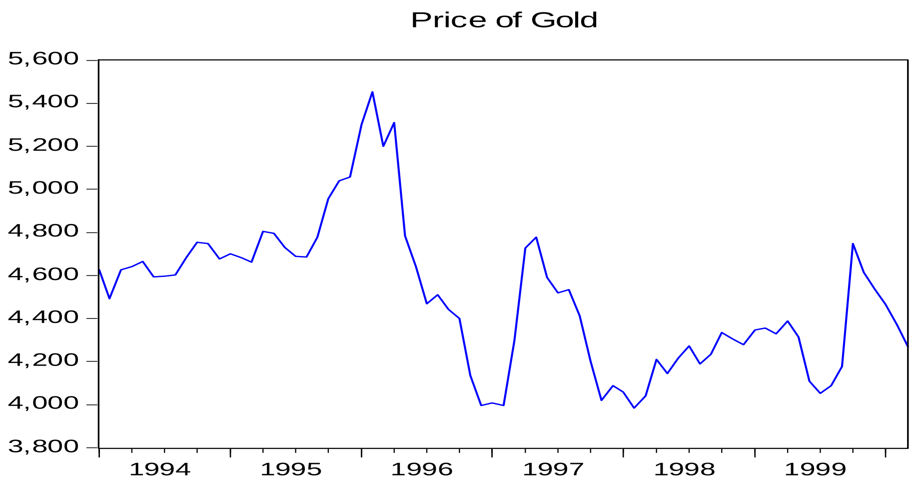

Figure A.1.11 Line graph of GOLD

Table A.1.6 Results of Augmented Dicky Fuller (ADF) Tests for GOLD

Constraints	MacKinnon (1996) one-sided p-values in Level	MacKinnon (1996) one-sided p-values in First Difference
Intercept	0.1209	0.0002*
Intercept and Trend	0.1150	0.0014*

Note: * denotes significant at 1 per cent level.

Correlogram of GOLD in first difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*. |	. |*. |	1	0.177	0.177	2.4120	0.120
. | . |	. | . |	2	0.051	0.020	2.6158	0.270
.*| . |	.*| . |	3	-0.086	-0.101	3.1978	0.362
.*| . |	.*| . |	4	-0.162	-0.137	5.3054	0.257
.*| . |	.*| . |	5	-0.204	-0.155	8.6919	0.122
. | . |	. | . |	6	0.003	0.069	8.6926	0.192
.*| . |	.*| . |	7	-0.083	-0.110	9.2778	0.233
.*| . |	.*| . |	8	-0.084	-0.117	9.8833	0.273
. | . |	. | . |	9	-0.044	-0.057	10.051	0.346
.*| . |	**| . |	10	-0.190	-0.229	13.212	0.212
.*| . |	.*| . |	11	-0.107	-0.091	14.230	0.221
. |*. |	. | . |	12	0.103	0.073	15.192	0.231
. | . |	.*| . |	13	-0.011	-0.138	15.203	0.295
. | . |	.*| . |	14	0.012	-0.096	15.216	0.364
. |*. |	. | . |	15	0.151	0.062	17.386	0.296
. |*. |	. | . |	16	0.102	0.045	18.391	0.302

Table A.1.7 Regression Results of ARIMA (1,1,0) Model of GOLD

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	-2.969245	21.22604	-0.139887	0.8891
AR(1)	**0.177849**	**0.116508**	**1.526491**	**0.1313**
	R^2 =0.031776	Adjusted R^2 =0.018140		
	Prob(F-statistic)		0.131330	

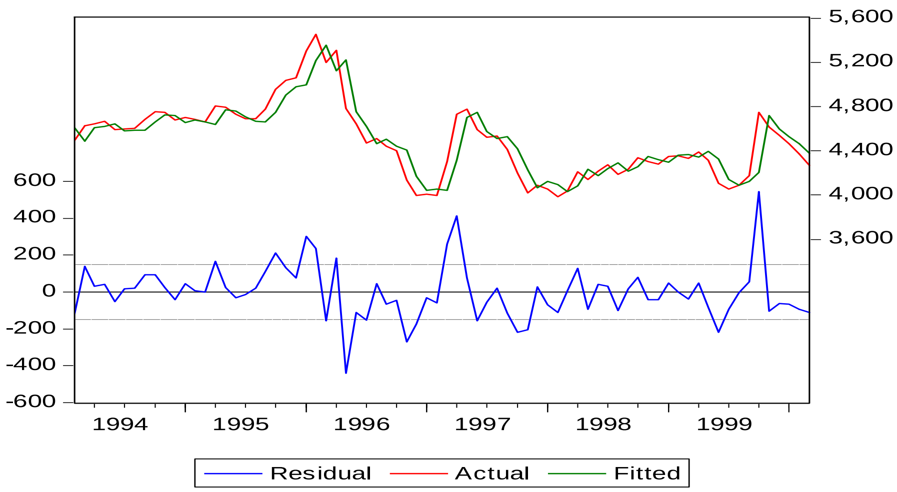

Figure A.1.12 Graph of Actual, fitted and residual values of GOLD from ARIMA (1,1,0)

Correlogram of residuals of GOLD from ARIMA(1,1,0)

<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>0.009</td><td>0.009</td><td>0.0068</td><td></td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>2</td><td>0.038</td><td>0.038</td><td>0.1206</td><td>0.728</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>3</td><td>-0.069</td><td>-0.070</td><td>0.4946</td><td>0.781</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>4</td><td>-0.126</td><td>-0.127</td><td>1.7595</td><td>0.624</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>5</td><td>-0.186</td><td>-0.183</td><td>4.5512</td><td>0.337</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>6</td><td>0.051</td><td>0.057</td><td>4.7660</td><td>0.445</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>7</td><td>-0.069</td><td>-0.075</td><td>5.1584</td><td>0.524</td></tr>
<tr><td>. | . |</td><td>.*| . |</td><td>8</td><td>-0.062</td><td>-0.114</td><td>5.4833</td><td>0.601</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>9</td><td>0.003</td><td>-0.038</td><td>5.4839</td><td>0.705</td></tr>
<tr><td>.*| . |</td><td>**| . |</td><td>10</td><td>-0.179</td><td>-0.222</td><td>8.2820</td><td>0.506</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>11</td><td>-0.095</td><td>-0.131</td><td>9.0741</td><td>0.525</td></tr>
<tr><td>. |*. |</td><td>. |*. |</td><td>12</td><td>0.130</td><td>0.082</td><td>10.602</td><td>0.477</td></tr>
<tr><td>. | . |</td><td>.*| . |</td><td>13</td><td>-0.034</td><td>-0.107</td><td>10.708</td><td>0.554</td></tr>
<tr><td>. | . |</td><td>.*| . |</td><td>14</td><td>-0.001</td><td>-0.108</td><td>10.709</td><td>0.635</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>15</td><td>0.138</td><td>0.039</td><td>12.511</td><td>0.565</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>16</td><td>0.064</td><td>0.049</td><td>12.903</td><td>0.610</td></tr>
</table>

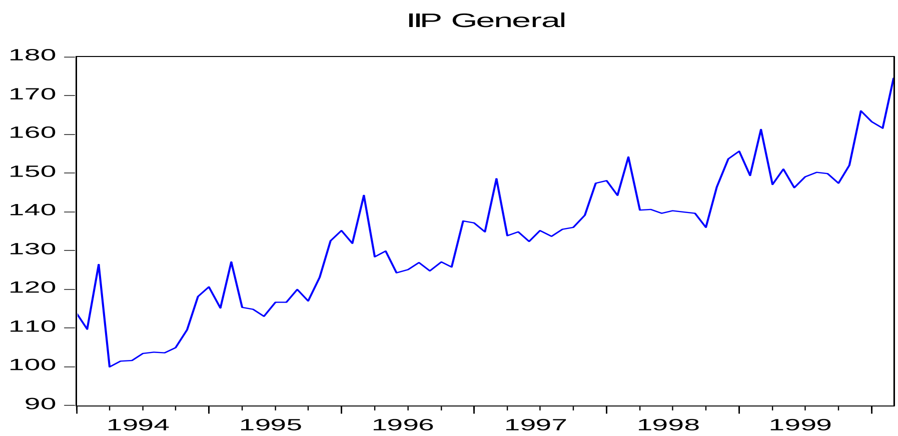

Figure A.1.13 Line graph of IIPG

Table A.1.8 Regression Results of Linear Multiplicative model of IIPG

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	96.94597	11.54002	8.400848	0.0000*
Time	0.712371	0.110021	6.474835	0.0000*
AR(12)	0.814511	0.063638	12.79919	0.0000*
R^2 =**0.951700**		Adjusted R^2 = 0.950359		
Prob(F-statistic)		0.000000		

* denotes significant at 1 per cent level.

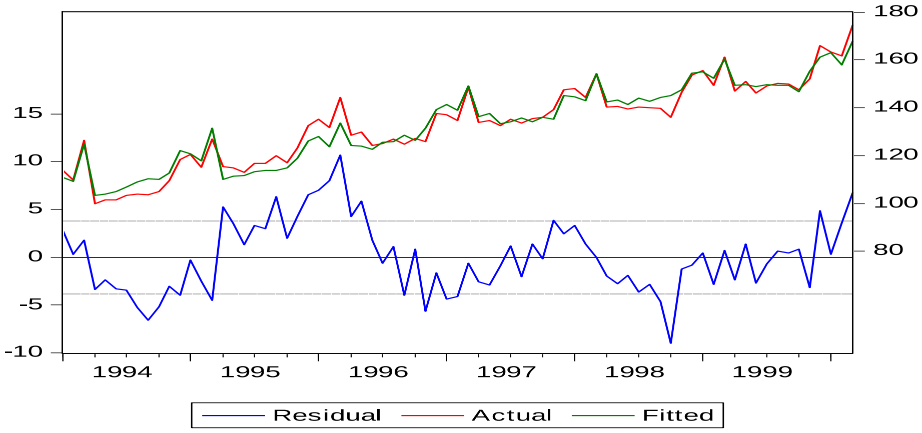

Figure A.1.14 Graph of Actual, fitted and residual values of IIPG from Linear Multiplicative Model

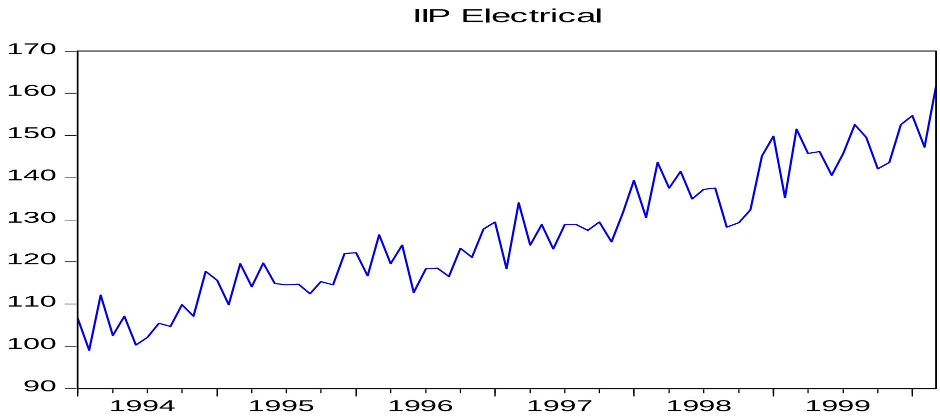

Figure A.1.15 Line graph of IIPE

Table A.1.9 Regression Results of Quadratic Multiplicative model of IIPE

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	156.3352	56.47698	2.768122	0.0072
Time	-0.684993	0.900367	-0.760793	0.4493
$Time^2$	0.008398	0.004534	1.852137	0.0682***
AR(12)	0.733770	0.085744	8.557650	0.0000*
R^2 =**0.946266**		Adjusted R^2 =0.943995		
Prob(F-statistic)		0.000000		

*,*** denotes significant at 1 per cent and 10 per cent level respectively.

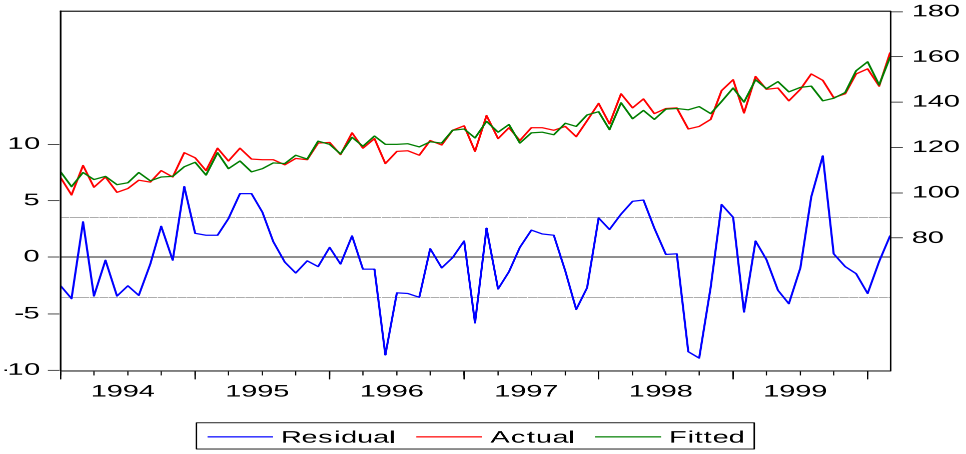

Figure A.1.16 Graph of Actual, fitted and residual values of IIPE from Quadratic Multiplicative Model

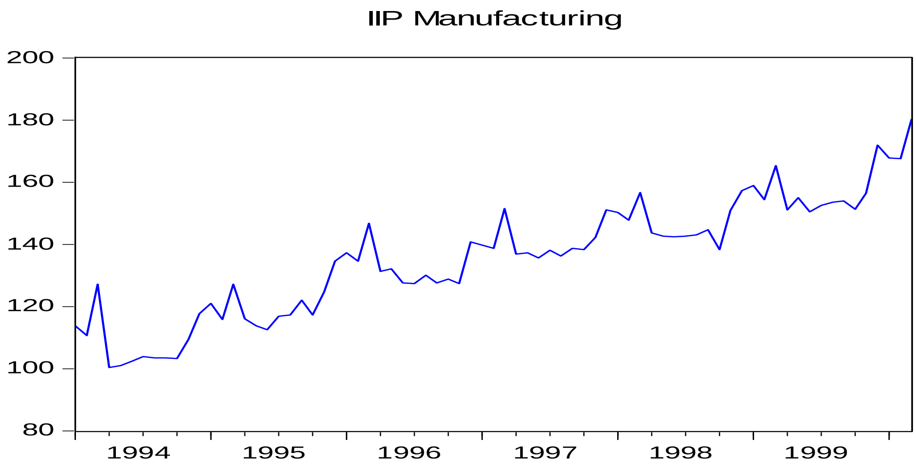

Figure A.1.17 Line graph of IIPM

Table A.1.10 Regression Results of Linear Multiplicative Model of IIP Manufacturing

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	91.79715	9.716315	9.447733	0.0000*
Time	0.822264	0.104154	7.894723	0.0000*
AR(12)	0.764843	0.072320	10.57585	0.0000*
R^2 = 0.942138 Adjusted R^2 =0.940531 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

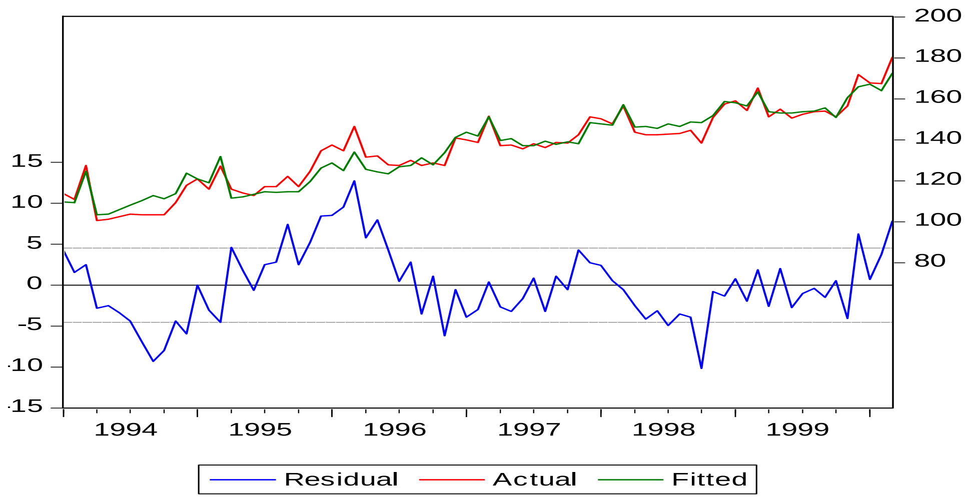

Figure A.1.18 Graph of Actual, fitted and residual values of IIP Manufacturing from Linear Multiplicative Model

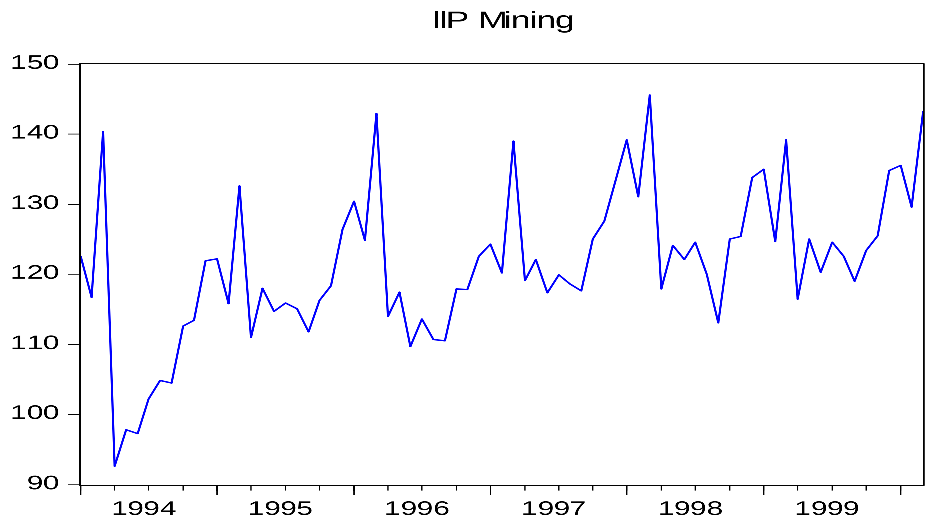

Figure A.1.19 Line graph of IIP MINING

Table A.1.11 Results of Augmented Dicky Fuller (ADF) Tests for IIP Mining

Constraints	MacKinnon (1996) one-sided p-values in Level
Intercept	0.0249**
Intercept and Trend	0.0012*

*,** denotes significant at 1 per cent and 5 per cent level respectively

Correlogram of IIP Mining in level

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*** |	. |*** |	1	0.435	0.435	14.788	0.000
. |**** |	. |*** |	2	0.502	0.386	34.739	0.000
. |** |	.*| . |	3	0.247	-0.080	39.635	0.000
. |*. |	**| . |	4	0.098	-0.211	40.423	0.000
. | . |	. | . |	5	0.050	0.001	40.627	0.000
.*| . |	.*| . |	6	-0.145	-0.149	42.387	0.000
. | . |	. |*. |	7	-0.007	0.141	42.391	0.000
. | . |	. |*. |	8	-0.023	0.154	42.439	0.000
. |*. |	. |*. |	9	0.087	0.088	43.094	0.000
. |** |	. |** |	10	0.254	0.223	48.807	0.000
. |*. |	.*| . |	11	0.142	-0.123	50.630	0.000
. |**** |	. |*** |	12	0.553	0.464	78.675	0.000
. |*. |	**| . |	13	0.158	-0.343	80.989	0.000
. |** |	.*| . |	14	0.260	-0.134	87.390	0.000
. |*. |	. | . |	15	0.075	0.025	87.935	0.000
. | . |	. | . |	16	-0.032	-0.042	88.033	0.000

Table A.1.12 Regression Results of ARMA (2,4) Model of IIP Mining

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	121.7881	1.921033	63.39722	0.0000
AR(1)	0.107964	0.087800	1.229664	0.2232
AR(2)	-0.679188	0.089060	-7.626184	0.0000
MA(1)	0.126337	0.038403	3.289793	0.0016
MA(2)	1.617217	0.025299	63.92302	0.0000
MA(3)	0.118727	0.034956	3.396505	0.0012
MA(4)	0.907294	0.020581	44.08352	0.0000
R^2 = 0.631067 Adjusted R^2 =0.597528 Prob(F-statistic) 0.000000				

Correlogram of residuals from ARMA (2,4) Model of IIP Mining

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*. |	. |*. |	1	0.122	0.122	1.1355	
. | . |	. | . |	2	0.009	-0.006	1.1413	
. |** |	. |** |	3	0.214	0.217	4.7171	
. | . |	. | . |	4	0.025	-0.030	4.7668	
. | . |	. | . |	5	0.025	0.033	4.8179	
. | . |	.*| . |	6	-0.029	-0.088	4.8872	
.*| . |	.*| . |	7	-0.121	-0.112	6.1103	0.013
.*| . |	.*| . |	8	-0.134	-0.131	7.6328	0.022
. |** |	. |** |	9	0.220	0.297	11.765	0.008
. |*. |	. |*. |	10	0.082	0.076	12.353	0.015
. | . |	. | . |	11	-0.051	0.007	12.582	0.028
. |**** |	. |**** |	12	0.540	0.530	38.787	0.000
. | . |	**| . |	13	-0.005	-0.297	38.789	0.000
. | . |	. |*. |	14	0.058	0.148	39.098	0.000
. |*. |	.*| . |	15	0.158	-0.170	41.459	0.000
. | . |	. | . |	16	-0.058	-0.021	41.781	0.000

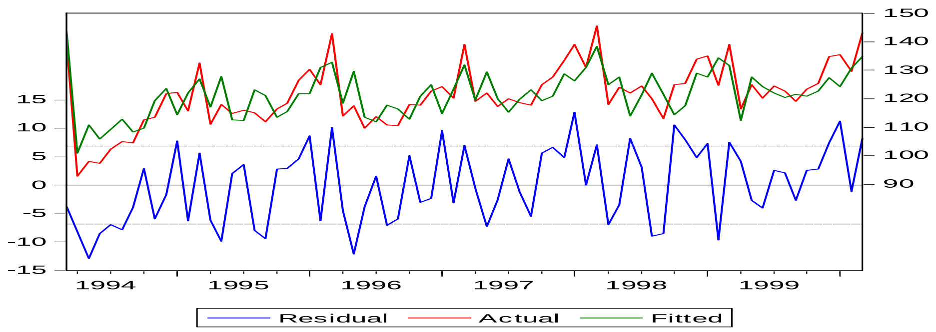

Figure A.1.20 Graph of Actual, fitted and residual values of IIP Mining from ARMA (2,4) Model

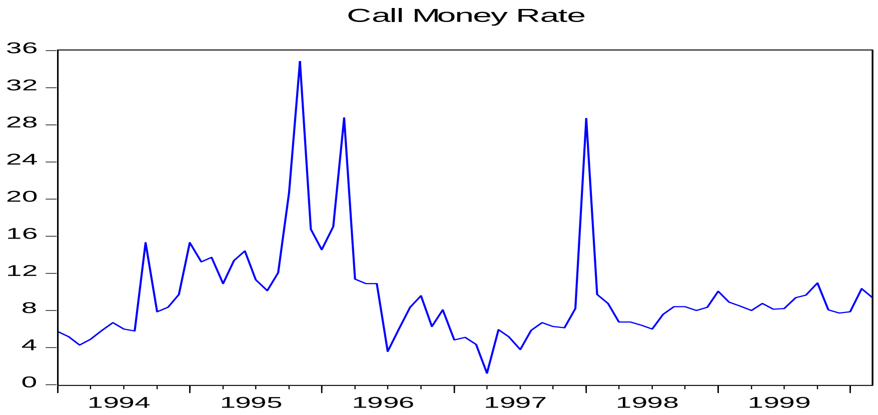

Figure A.1.21 Line graph of Call money rate (CALM)

Table A.1.13 Results of Augmented Dicky Fuller (ADF) Tests for Call money rate

Constraints	MacKinnon (1996) one-sided p-values in Level
Intercept	0.0400**
Intercept and Trend	0.0183**

** denotes significant at 5 per cent level.

Correlogram of Call money rate in level

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |**** |	. |**** |	1	0.516	0.516	20.764	0.000
. |** |	. |*. |	2	0.338	0.099	29.822	0.000
. |** |	. |*. |	3	0.312	0.143	37.642	0.000
. |*** |	. |*. |	4	0.371	0.205	48.854	0.000
. |** |	.*| . |	5	0.224	-0.093	52.988	0.000
. |*. |	.*| . |	6	0.106	-0.082	53.926	0.000
. |*. |	. | . |	7	0.080	-0.021	54.471	0.000
. | . |	.*| . |	8	0.040	-0.079	54.607	0.000
. | . |	. | . |	9	0.030	0.030	54.687	0.000
. | . |	. | . |	10	0.001	0.007	54.687	0.000
. | . |	.*| . |	11	-0.056	-0.071	54.969	0.000
.*| . |	. | . |	12	-0.080	-0.022	55.552	0.000
.*| . |	. | . |	13	-0.097	-0.055	56.435	0.000
.*| . |	. | . |	14	-0.092	-0.018	57.244	0.000
.*| . |	.*| . |	15	-0.195	-0.140	60.905	0.000
**| . |	.*| . |	16	-0.252	-0.116	67.124	0.000

Table A.1.14 Regression Results of ARMA (1,1) Model of Call Money Rate

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	9.944873	1.635526	6.080534	0.0000
AR(1)	0.810065	0.115544	7.010847	0.0000
MA(1)	-0.450897	0.178905	-2.520315	0.0140
R^2 =**0.292215**		Adjusted R^2 =0.272277		
Prob(F-statistic)		0.000005		

Correlogram of residuals from ARMA (1,1) Model of Call money rate

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.051	0.051	0.2032	
.*| . |	.*| . |	2	-0.130	-0.133	1.5188	
. | . |	. | . |	3	-0.039	-0.026	1.6416	0.200
. |*. |	. |*. |	4	0.209	0.200	5.1614	0.076
. | . |	. | . |	5	0.028	-0.004	5.2263	0.156
.*| . |	. | . |	6	-0.084	-0.041	5.8072	0.214
. | . |	. | . |	7	-0.020	0.006	5.8408	0.322
. | . |	.*| . |	8	-0.016	-0.073	5.8626	0.439
. | . |	. | . |	9	0.009	0.003	5.8693	0.555
. | . |	. | . |	10	0.021	0.039	5.9083	0.657
. | . |	. | . |	11	-0.027	-0.032	5.9714	0.743
. | . |	. | . |	12	-0.009	0.016	5.9788	0.817
. | . |	. | . |	13	-0.002	-0.006	5.9791	0.875
. |*. |	. | . |	14	0.077	0.060	6.5365	0.887
. | . |	. | . |	15	-0.061	-0.064	6.8946	0.908
.*| . |	.*| . |	16	-0.093	-0.075	7.7255	0.903

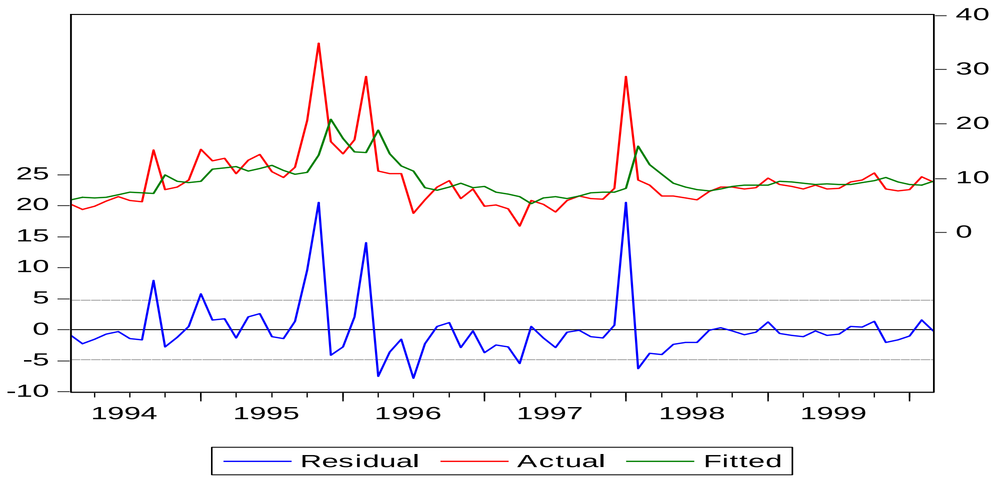

Figure A.1.22 Graph of Actual, fitted and residual values of Call Money Rate from ARMA (1,1) Model

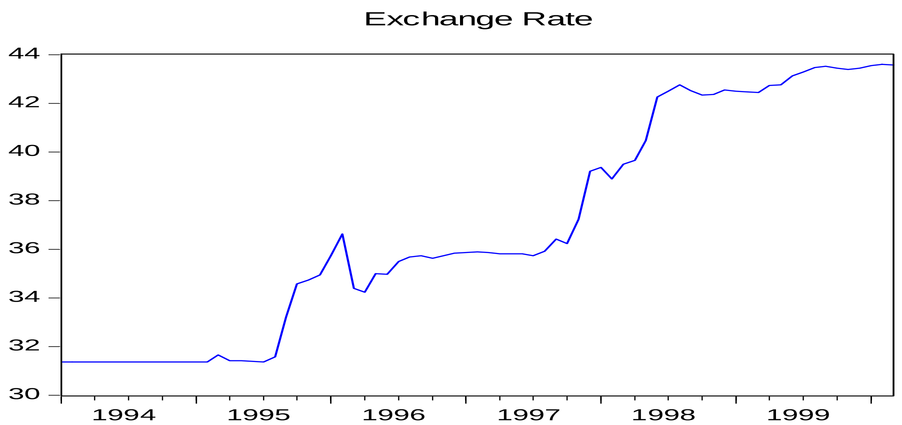

Figure A.1.23 Line graph of Exchange Rate (EXR)

Table A.1.15 Results of Augmented Dicky Fuller (ADF) Tests for Exchange rate

Constraints	MacKinnon (1996) one-sided p-values in Level	MacKinnon (1996) one-sided p-values in First Difference
Intercept	0.9306	0.0014*
Intercept and Trend	0.3977	0.0086*

* denotes significant at 1 per cent level.

Correlogram of Exchange rate in first difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*. |	. |*. |	1	0.190	0.190	2.7941	0.095
.*| . |	**| . |	2	-0.171	-0.215	5.0850	0.079
. |*. |	. |*. |	3	0.099	0.196	5.8660	0.118
. | . |	.*| . |	4	-0.005	-0.129	5.8683	0.209
.*| . |	. | . |	5	-0.110	-0.017	6.8502	0.232
. | . |	. | . |	6	-0.019	-0.033	6.8796	0.332
. | . |	. | . |	7	0.069	0.072	7.2823	0.400
. | . |	. | . |	8	-0.020	-0.051	7.3156	0.503
. | . |	. | . |	9	-0.041	0.005	7.4605	0.589
. | . |	.*| . |	10	-0.037	-0.077	7.5783	0.670
. | . |	. | . |	11	-0.021	0.015	7.6187	0.747
. | . |	.*| . |	12	-0.059	-0.080	7.9294	0.791
. | . |	. | . |	13	-0.063	-0.021	8.2977	0.824
.*| . |	.*| . |	14	-0.076	-0.108	8.8371	0.841
.*| . |	. | . |	15	-0.067	-0.029	9.2675	0.863
. | . |	. | . |	16	-0.008	-0.021	9.2736	0.902

Table A.1.16 Regression Results of ARIMA(2,1,2) Model of Exchange Rate

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	0.209863	0.022669	9.257634	0.0000
AR(1)	0.375029	0.181761	2.063311	0.0430
AR(2)	0.380616	0.175429	2.169628	0.0336
MA(1)	-0.148189	0.117152	-1.264934	0.2103
MA(2)	-0.817598	0.115424	-7.083437	0.0000
R^2 = 0.190076 Adjusted R^2 = 0.141723 Prob(F-statistic) 0.006312				

Correlogram of residuals from ARIMA (2,1,2) for Exchange rate

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.005	0.005	0.0018	
. | . |	. | . |	2	0.023	0.023	0.0408	
. | . |	. | . |	3	0.058	0.058	0.3037	
. | . |	. | . |	4	0.061	0.060	0.5909	
.*| . |	.*| . |	5	-0.094	-0.098	1.2995	0.254
. | . |	. | . |	6	0.001	-0.004	1.2996	0.522
. | . |	. | . |	7	0.049	0.048	1.4988	0.683
. | . |	. | . |	8	-0.044	-0.037	1.6580	0.798
. | . |	. | . |	9	-0.032	-0.023	1.7443	0.883
.*| . |	.*| . |	10	-0.071	-0.085	2.1814	0.902
. | . |	. | . |	11	-0.020	-0.019	2.2163	0.947
.*| . |	.*| . |	12	-0.098	-0.079	3.0757	0.930
. | . |	. | . |	13	-0.056	-0.051	3.3540	0.949
.*| . |	.*| . |	14	-0.106	-0.101	4.3779	0.929
.*| . |	.*| . |	15	-0.066	-0.067	4.7839	0.941

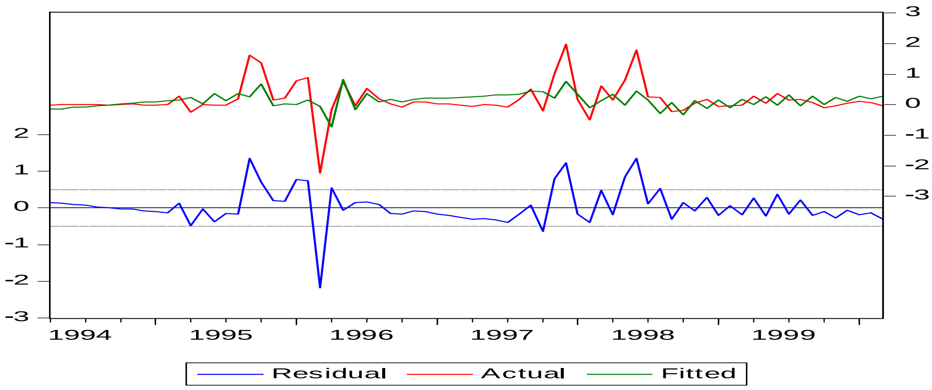

Figure A.1.24 Graph of Actual, fitted and residual values of Exchange Rate from ARIMA (2,1,2) Model

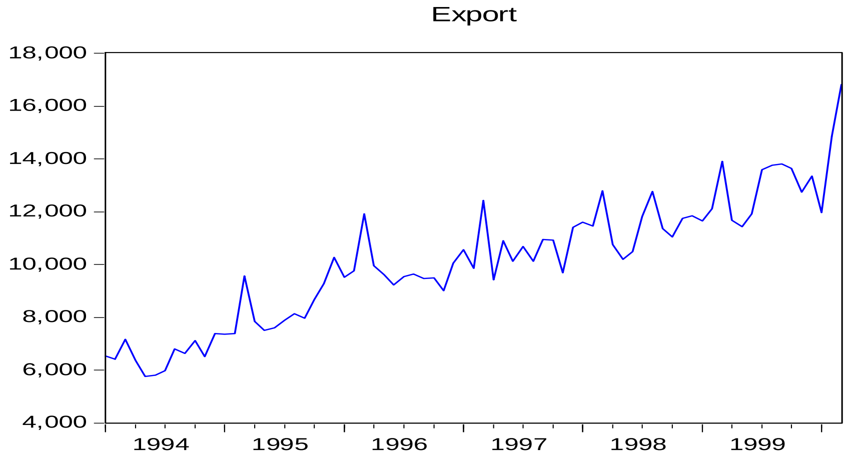

Figure A.1.25 Line graph of Export (EXP)

Table A.1.17 Regression Results of Linear Multiplicative model of Export

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	5259.198	857.4574	6.133480	0.0000*
Time	99.01837	11.45355	8.645212	0.0000*
AR(12)	0.637408	0.113896	5.596404	0.0000*
	R^2 = **0.897357**	Adjusted R^2 = 0.894506		
	Prob(F-statistic)	0.000000		

* denotes significant at 1 per cent level.

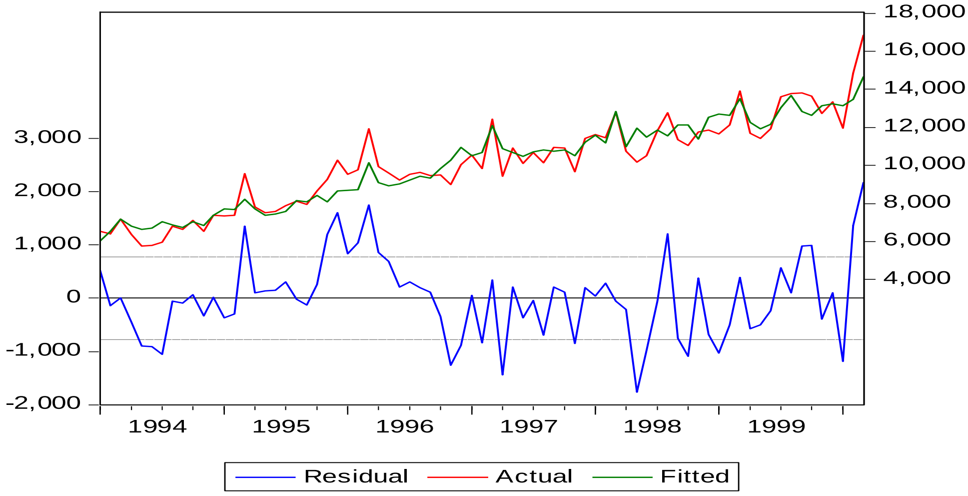

Figure A.1.26 Graph of Actual, fitted and residual values of Export from Linear Multiplicative Model

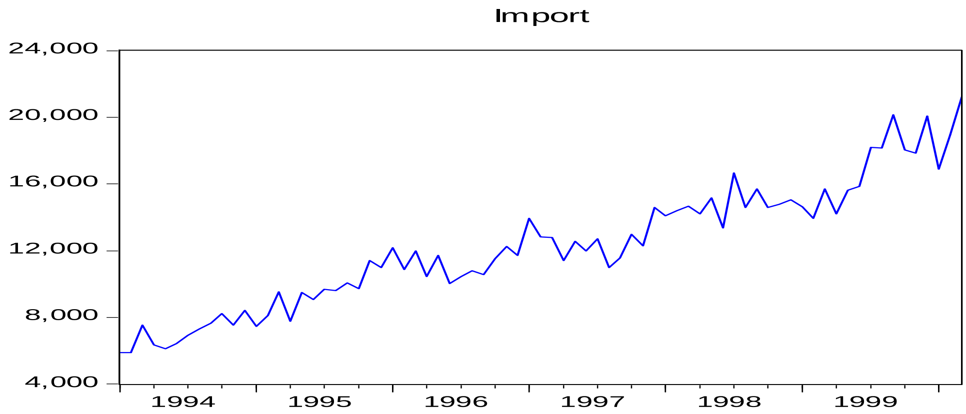

Figure A.1.27 Line graph of import (IMP)

Table A.1.18 Regression Results of Linear Quadratic model of Import

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	11733.87	3777.834	3.105977	0.0029
Time	-80.53508	128.6732	-0.625888	0.5338
$Time^2$	2.436341	1.114378	2.186278	0.0328
AR(12)	0.362162	0.162809	2.224456	0.0300
	R^2 = 0.882006	Adjusted R^2 = 0.882006		
	Prob(F-statistic)		0.000000	

* denotes significant at 1 per cent level.

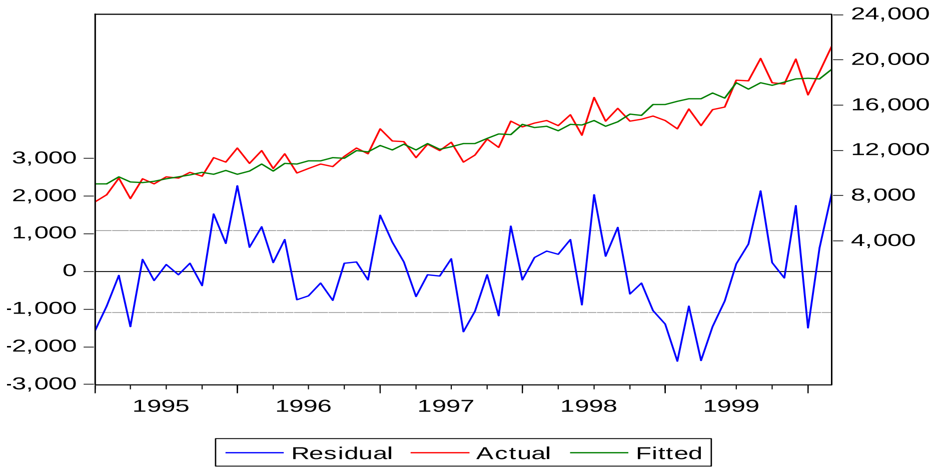

Figure A.1.28 Graph of Actual, fitted and residual values of Import from Quadratic Multiplicative Model

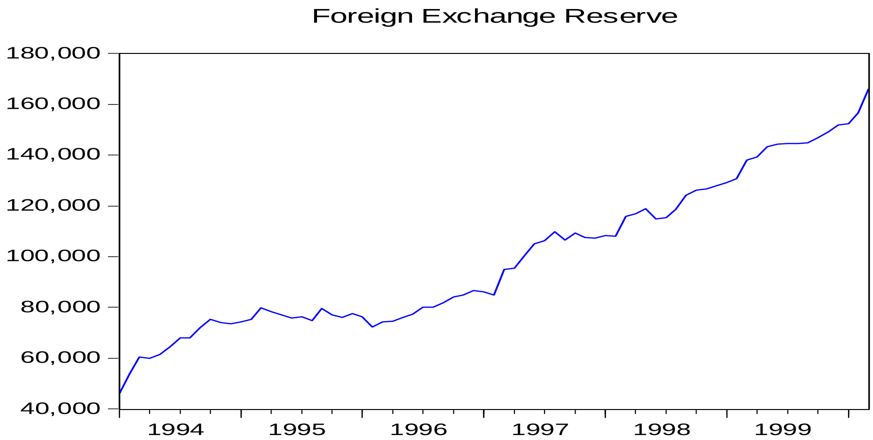

Figure A.1.29 Line graph of Foreign Exchange Reserve (FORX)

Table A.1.19 Regression Results of Quadratic Trend model of Foreign exchange reserve

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	62304.12	1751.277	35.57639	0.0000
Time	311.1657	106.3453	2.925994	0.0046
$Time^2$	13.28423	1.355985	9.796739	0.0000
	R^2 =**0.973331** Prob(F-statistic)	Adjusted R^2 = **0.972590** 0.000000		

* denotes significant at 1 per

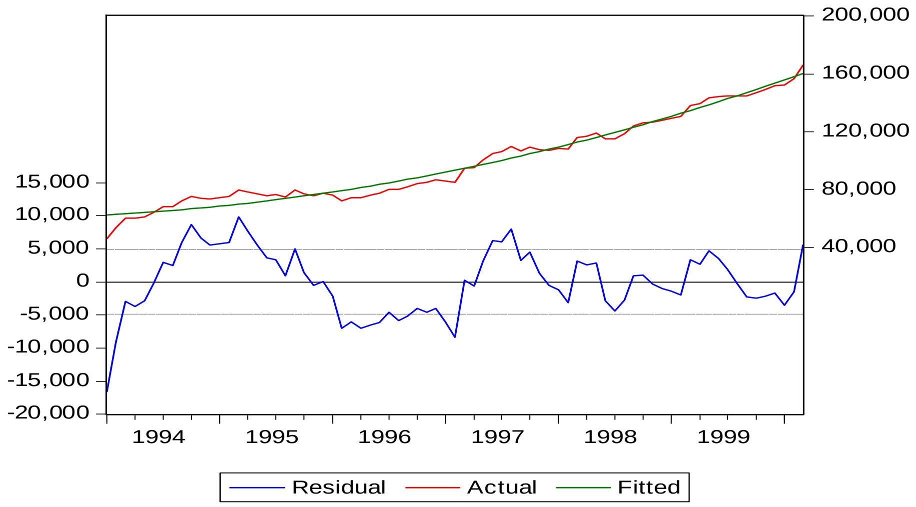

Figure A.1.30 Graph of Actual, fitted and residual values of Foreign exchange reserve from Quadratic Model

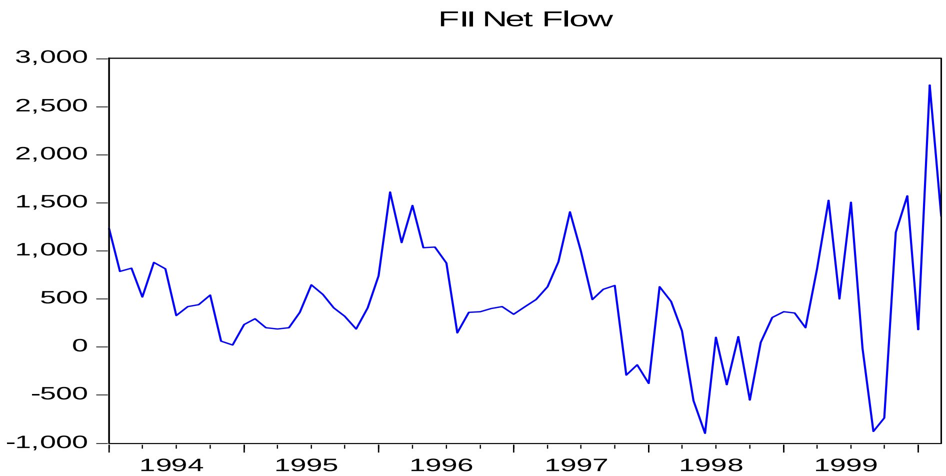

Figure A.1.31 Line graph of FII Net flow (FII)

Table A.1.20 Results of Augmented Dicky Fuller (ADF) Tests for FII

Constraints	MacKinnon (1996) one-sided p-values in Level
Intercept	0.0193**
Intercept and Trend	0.1019

** denotes significant at 5 per cent level

Correlogram of FII in level

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*** |	. |*** |	1	0.448	0.448	15.629	0.000
. |** |	. | . |	2	0.241	0.051	20.241	0.000
. |*. |	. | . |	3	0.129	0.005	21.579	0.000
. | . |	. | . |	4	0.018	-0.064	21.604	0.000
. | . |	. | . |	5	-0.054	-0.059	21.843	0.001
.*| . |	. | . |	6	-0.075	-0.028	22.315	0.001
. |*. |	. |*. |	7	0.106	0.213	23.268	0.002
. | . |	.*| . |	8	-0.008	-0.139	23.274	0.003
. | . |	. | . |	9	0.042	0.070	23.426	0.005
. | . |	. | . |	10	0.036	-0.023	23.541	0.009
.*| . |	.*| . |	11	-0.089	-0.139	24.250	0.012
.*| . |	. | . |	12	-0.075	0.027	24.771	0.016
.*| . |	. | . |	13	-0.107	-0.040	25.834	0.018
. | . |	. | . |	14	-0.047	0.000	26.041	0.026
. | . |	. |*. |	15	0.007	0.105	26.047	0.038
.*| . |	.*| . |	16	-0.078	-0.194	26.643	0.046

Table A.1.21 Regression Results of ARMA (1,1) Model of FII

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	6.462387	14.46580	0.446735	0.6564
AR(1)	0.409884	0.080873	5.068251	0.0000
MA(1)	-1.176419	0.079487	-14.80008	0.0000
R^2 = **0.434309**		Adjusted R^2 = 0.418146		
Prob(F-statistic)		0.000000		

Correlogram of Residuals for FII from ARMA (1,1) model

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	-0.005	-0.005	0.0023	
. | . |	. | . |	2	0.033	0.033	0.0863	
. | . |	. | . |	3	0.009	0.009	0.0926	0.761
. | . |	. | . |	4	-0.030	-0.031	0.1642	0.921
. | . |	. | . |	5	-0.046	-0.047	0.3391	0.953
.*| . |	.*| . |	6	-0.145	-0.144	2.0821	0.721
. |*. |	. |*. |	7	0.175	0.180	4.6509	0.460
.*| . |	.*| . |	8	-0.112	-0.109	5.7240	0.455
. | . |	. | . |	9	0.070	0.067	6.1428	0.523
. |*. |	. |*. |	10	0.096	0.090	6.9593	0.541
.*| . |	.*| . |	11	-0.079	-0.096	7.5165	0.584
. | . |	. | . |	12	0.001	-0.008	7.5166	0.676
.*| . |	. | . |	13	-0.095	-0.054	8.3416	0.682
. | . |	. | . |	14	0.001	-0.050	8.3417	0.758
. |*. |	. |*. |	15	0.106	0.196	9.4214	0.740
. | . |	.*| . |	16	-0.028	-0.067	9.4977	0.798

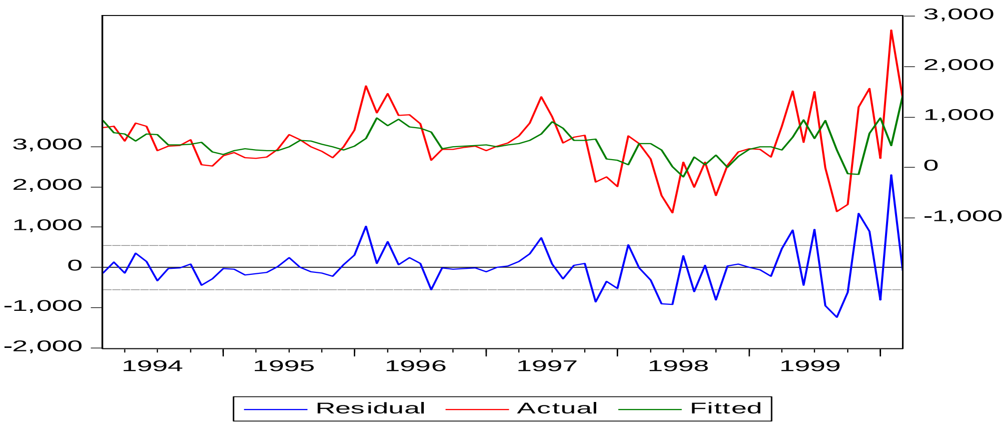

Figure A.1.32 Graph of Actual, fitted and residual values of FII from ARMA (1,1) Model

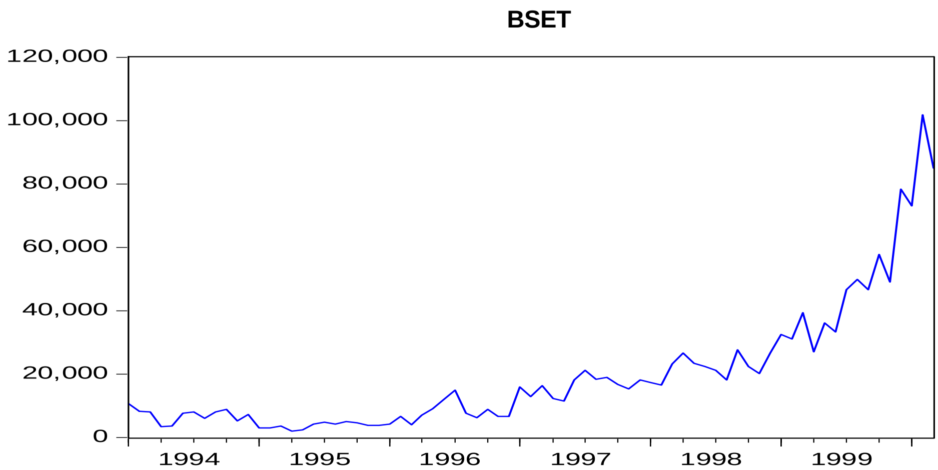

Figure A.1.33 Line graph of BSET

Table A.1.22 Regression Results of Exponential Trend Model of BSET

Variables	Coefficient	Standard error	t – statistics	P –value
C(1)	912.5164	197.7258	4.615060	0.0000
C(2)	0.059593	0.003204	18.59913	0.0000
R^2 = 0.903353		Adjusted R^2 = 0.902029		
Prob(F-statistic)		0.000000		

* denotes significant at 1 per cent level.

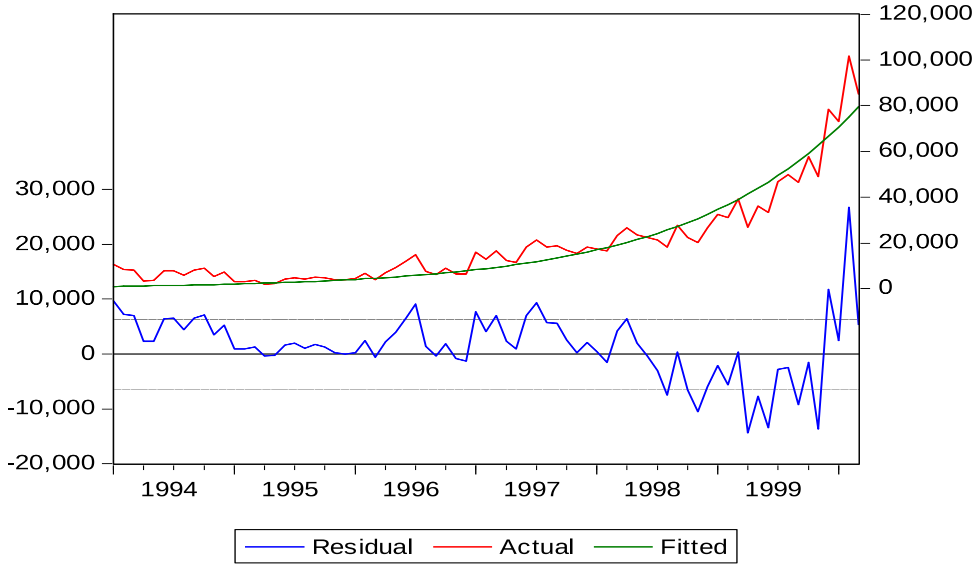

Figure A.1.34 Graph of actual, fitted and residual values of BSE from Exponential Trend Model

Appendix -2

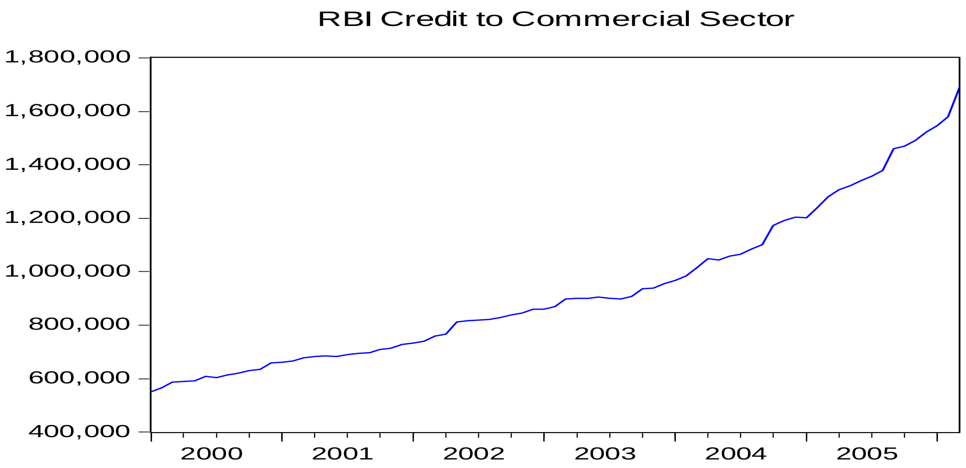

Figure A.2.1 Line Graph of BCC

Table A.2.1 Regression Results of Quadratic Trend Model of BCC

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	617088.5	12373.29	49.87263	0.0000
Time	-354.3872	751.3610	-0.471660	0.6386
$Time^2$	173.6741	9.580434	18.12800	0.0000
R^2 = **0.986147** Adjusted R^2 =0.985763				
Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

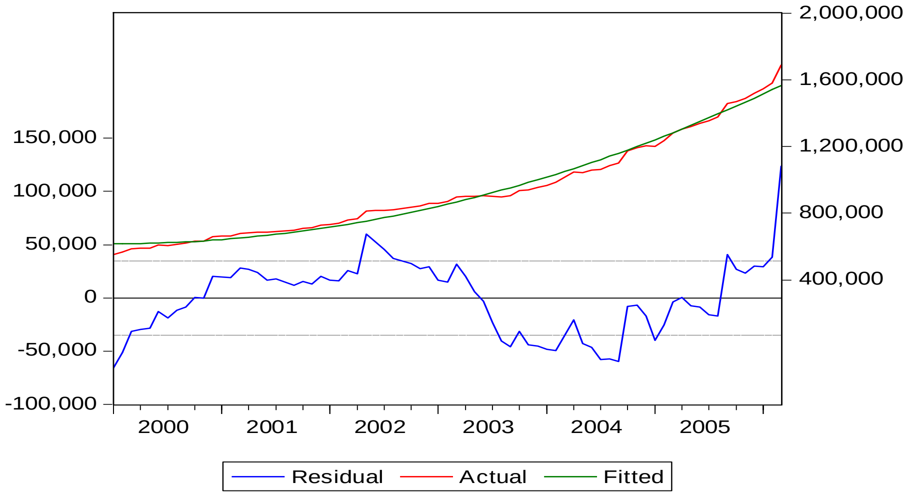

Figure A.2.2 Graph of actual, fitted and residual values of BCC from Quadratic Trend Model

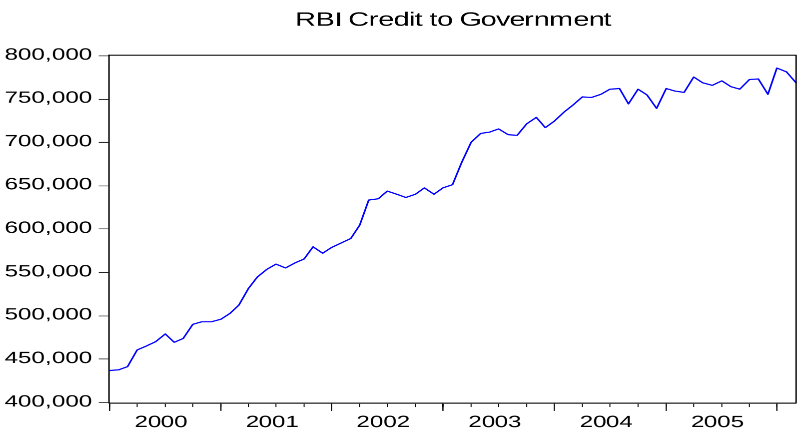

Figure A.2.3 . Line graph of BCG

Table A.2.2 Regression Results of Quadratic Trend Model of BCG

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	405002.5	4805.603	84.27714	0.0000
Time	9054.822	291.8175	31.02906	0.0000
$Time^2$	-53.37327	3.720899	-14.34419	0.0000
R^2 =0.985864		Adjusted R^2 = 0.985471		
Prob(F-statistic)		0.000000		

* denotes significant at 1 per cent level.

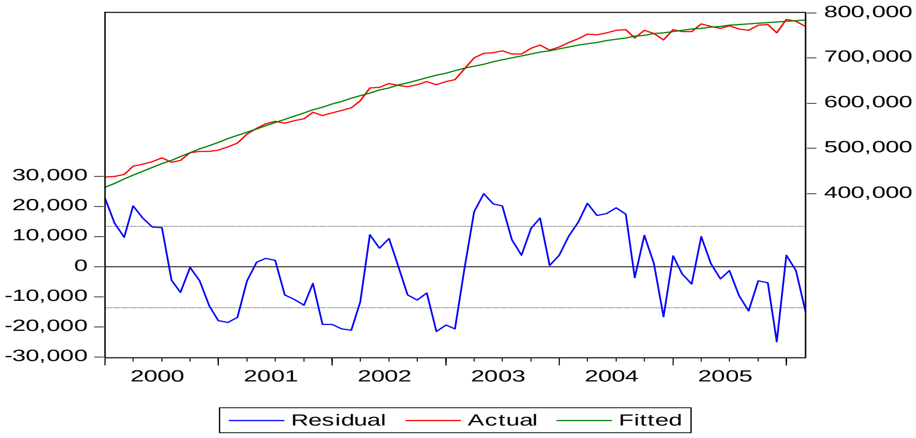

Figure A.2.4 Graph of Actual, fitted and residual values of BCG from Quadratic Trend Model

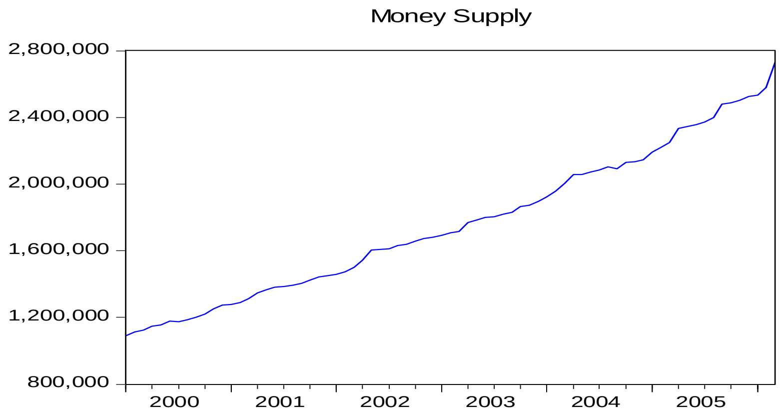

Figure A.2.5 Line graph of Money Supply (M3)

Table A.2.3 Regression Results of Exponential Trend Model of Money Supply

Variables	Coefficient	Standard error	t – statistics	P –value
C(1)	1103504.	4782.977	230.7149	0.0000
C(2)	0.011542	8.28E-05	139.3982	0.0000
R^2 = **0.996519** Adjusted R^2 = 0.996471 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

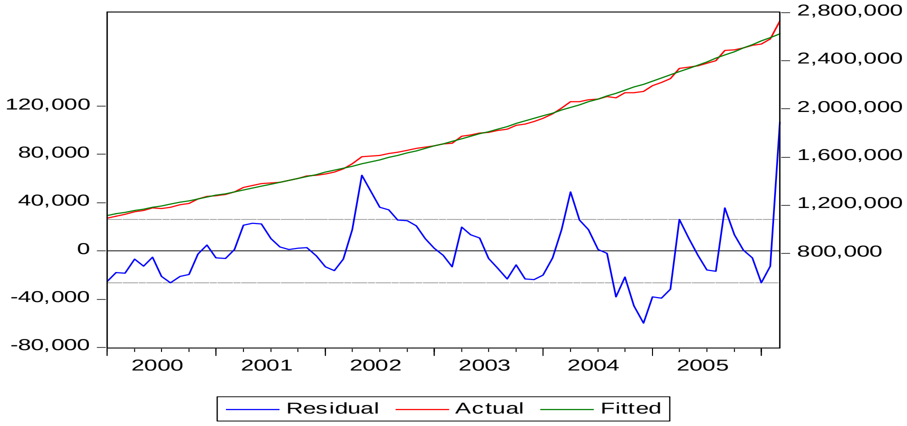

Figure A.2.6 Graph of Actual, fitted and residual values of Money Supply from Exponential Trend Model

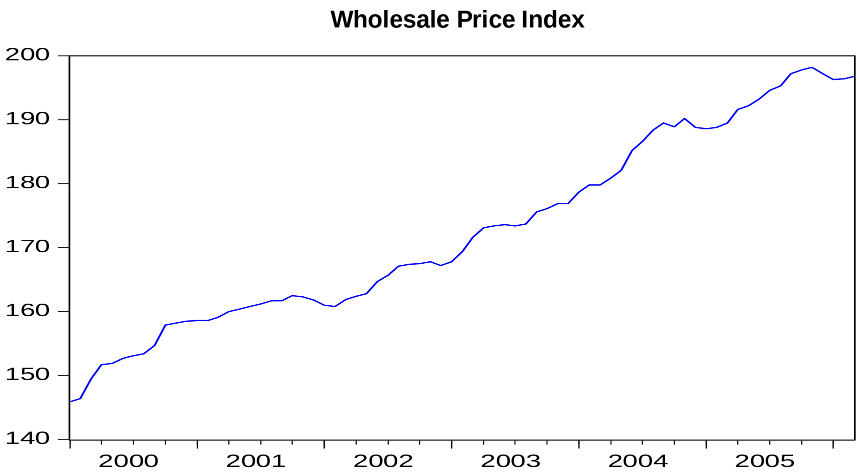

Figure A.2.7 Line graph of WPI

Table A.2.4 Regression Results of Quadratic Trend Model of WPI

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	149.7269	0.700055	213.8787	0.0000
Time	0.453332	0.042510	10.66401	0.0000
$Time^2$	0.003008	0.000542	5.549263	0.0000
R^2 = **0.983359** Adjusted R^2 =0.982896				
Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

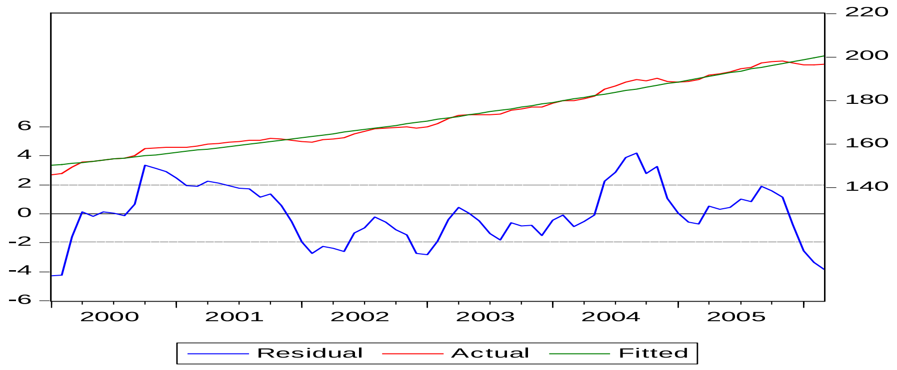

Figure A.2.8 Graph of Actual, fitted and residual values of WPI from Quadratic Trend Model

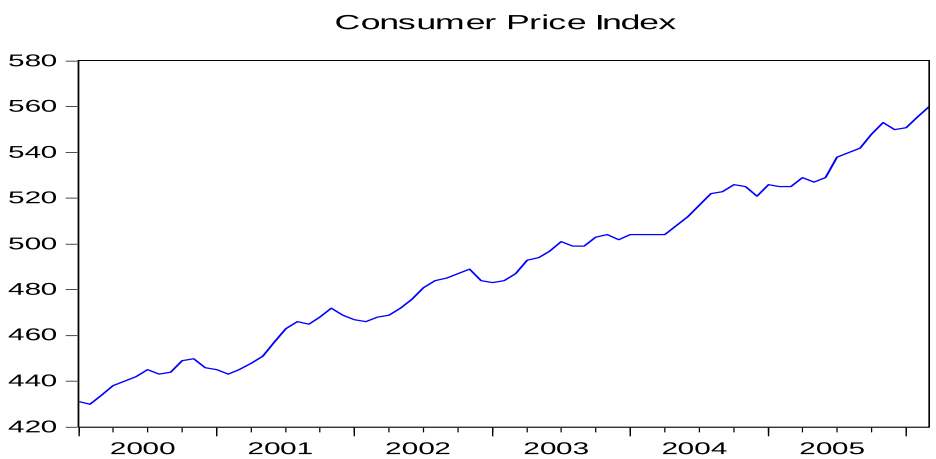

Figure A.2.9 Line graph of CPI

Table A.2.5 Regression Results of Exponential Trend model of CPI

Variables	Coefficient	Standard error	t – statistics	P –value
C(1)	430.4388	0.898999	478.7977	0.0000
C(2)	0.003326	4.50E-05	73.87571	0.0000
R^2 =**0.986867** Adjusted R^2 = 0.986687 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

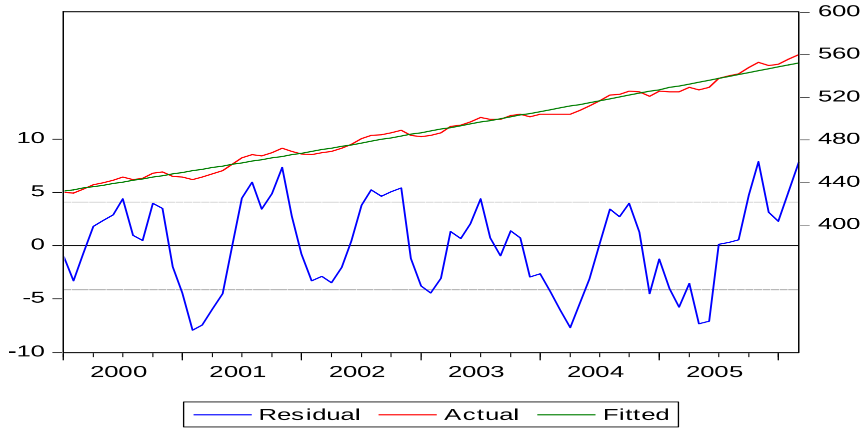

Figure A.2.10 Graph of Actual, fitted and residual values of CPI from Exponential Trend Model

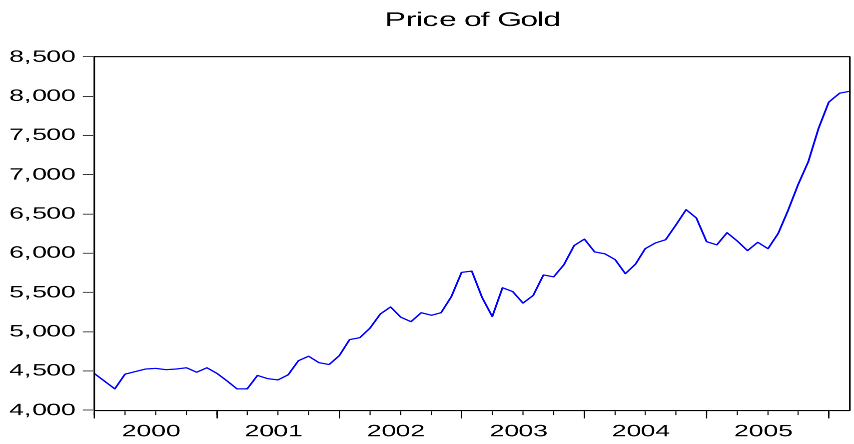

Figure A.2.11 Line graph of GOLD

Table A.2.6 Results of Augmented Dicky Fuller (ADF) Tests for GOLD

Constraints	MacKinnon (1996) one-sided p-values in Level	MacKinnon (1996) one-sided p-values in First Difference
Intercept	0.9882	0.0034
Intercept and Trend	0.1525	0.0052

* denotes significant at 1 per cent level.

Correlogram of GOLD in first difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |** |	. |** |	1	0.341	0.341	8.9480	0.003
.*| . |	**| . |	2	-0.130	-0.279	10.278	0.006
. |*. |	. |** |	3	0.105	0.315	11.148	0.011
. |*. |	. | . |	4	0.210	-0.009	14.692	0.005
.*| . |	**| . |	5	-0.183	-0.280	17.435	0.004
**| . |	. | . |	6	-0.266	-0.012	23.287	0.001
. | . |	. | . |	7	-0.015	-0.038	23.307	0.002
. | . |	. | . |	8	0.046	0.024	23.487	0.003
.*| . |	. | . |	9	-0.108	-0.014	24.494	0.004
. | . |	. | . |	10	-0.045	0.035	24.676	0.006
. |*. |	. | . |	11	0.105	0.008	25.666	0.007
. | . |	. | . |	12	0.029	-0.060	25.742	0.012
. | . |	. | . |	13	-0.036	0.057	25.860	0.018
. | . |	. | . |	14	0.009	-0.054	25.867	0.027
. | . |	. | . |	15	0.027	0.000	25.935	0.039
. | . |	. | . |	16	-0.058	-0.038	26.256	0.051

Table A.2.7 Regression Results of ARIMA (0,1,1) Model of GOLD

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	48.35658	24.85504	1.945544	0.0556
MA(1)	0.534208	0.099504	5.368709	0.0000
R^2 = 0.204556 Adjusted R^2 =**0.193508** Prob(F-statistic) 0.000052				

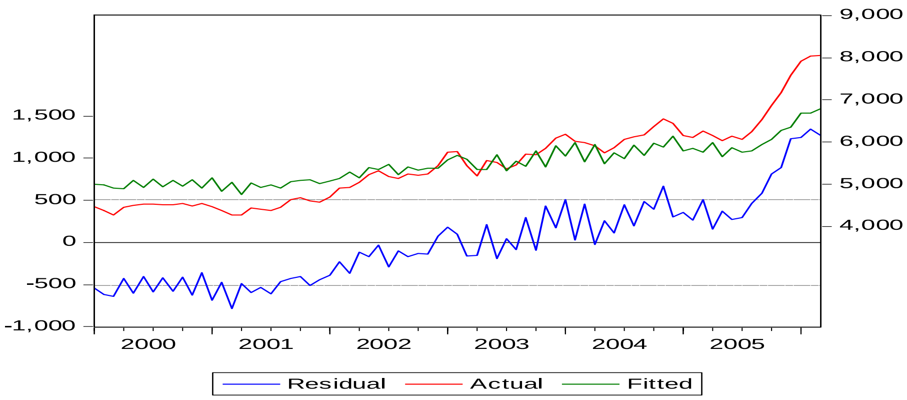

Figure A.2.12 Graph of Actual, fitted and residual values of GOLD from ARIMA(0,1,1)

Figure 3 Correlogram of residuals of GOLD from ARIMA(0,1,1)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	-0.027	-0.027	0.0580	
.*| . |	.*| . |	2	-0.133	-0.134	1.4329	0.231
. | . |	. | . |	3	0.040	0.032	1.5572	0.459
. |** |	. |** |	4	0.279	0.268	7.7958	0.050
**| . |	**| . |	5	-0.223	-0.216	11.837	0.019
.*| . |	.*| . |	6	-0.179	-0.140	14.498	0.013
. | . |	. | . |	7	0.022	-0.045	14.540	0.024
. |*. |	. | . |	8	0.084	-0.000	15.144	0.034
.*| . |	. | . |	9	-0.120	0.004	16.384	0.037
. | . |	. | . |	10	-0.049	-0.010	16.593	0.055
. |*. |	. | . |	11	0.129	0.065	18.081	0.054
. | . |	.*| . |	12	-0.012	-0.072	18.095	0.079
. | . |	. | . |	13	-0.030	0.029	18.180	0.110
. | . |	. | . |	14	-0.002	-0.013	18.180	0.151
. | . |	. | . |	15	0.057	-0.014	18.488	0.185
. | . |	. | . |	16	-0.064	-0.023	18.889	0.219

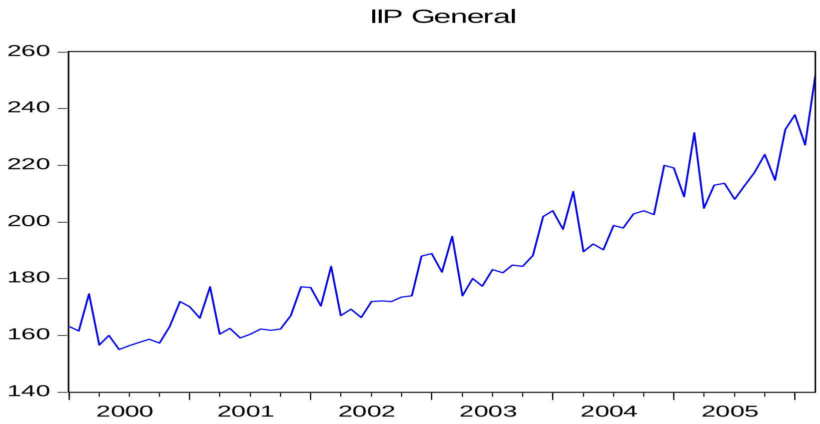

Figure A.2.13 Line graph of IIPG

Table A.2.8 Results of Augmented Dicky Fuller (ADF) Tests for IIPG

Constraints	MacKinnon (1996) one-sided p-values in Level	MacKinnon (1996) one-sided p-values in First Difference
Intercept	0.9770	0.0001
Intercept and Trend	0.1018	0.0001

Correlogram of IIPG in first difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
****| . |	****| . |	1	-0.518	-0.518	20.659	0.000
. |*. |	.*| . |	2	0.152	-0.159	22.458	0.000
. |*. |	. |*. |	3	0.137	0.205	23.949	0.000
.*| . |	. | . |	4	-0.188	0.002	26.793	0.000
. | . |	.*| . |	5	0.011	-0.178	26.802	0.000
. | . |	**| . |	6	-0.042	-0.212	26.949	0.000
. | . |	. | . |	7	0.048	0.028	27.145	0.000
.*| . |	.*| . |	8	-0.200	-0.173	30.553	0.000
. | . |	**| . |	9	0.045	-0.262	30.732	0.000
. |** |	. |** |	10	0.224	0.222	35.141	0.000
****| . |	***| . |	11	-0.505	-0.350	57.897	0.000
. |***** |	. |**** |	12	0.741	0.509	107.71	0.000
**| . |	. |** |	13	-0.337	0.217	118.18	0.000
. |*. |	. |*. |	14	0.080	0.108	118.77	0.000
. |*. |	.*| . |	15	0.095	-0.164	119.64	0.000
.*| . |	.*| . |	16	-0.117	-0.087	120.97	0.000

Table A.2.9 Regression Results of ARIMA (2,1,2) Model of IIPG

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	0.925845	0.734196	1.261033	0.2117
AR(1)	-0.998773	0.061226	-16.31284	0.0000
AR(2)	-0.934539	0.068770	-13.58940	0.0000
MA(1)	0.603136	0.035504	16.98779	0.0000
MA(2)	0.967784	0.020562	47.06632	0.0000
R^2 = 0.468880 Adjusted R^2 =0.437171				
Prob(F-statistic) 0.000000				

Correlogram of residuals for IIPG ARIMA (2,1,2)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.*| . |	.*| . |	1	-0.143	-0.143	1.5248	
. | . |	. | . |	2	0.043	0.023	1.6669	
.*| . |	.*| . |	3	-0.097	-0.090	2.3945	
. | . |	. | . |	4	-0.012	-0.040	2.4065	
. | . |	. | . |	5	0.002	-0.001	2.4067	0.121
**| . |	***| . |	6	-0.329	-0.347	11.162	0.004
. | . |	.*| . |	7	-0.011	-0.129	11.172	0.011
. | . |	. | . |	8	0.008	-0.005	11.178	0.025
**| . |	***| . |	9	-0.225	-0.356	15.468	0.009
. |*. |	. | . |	10	0.132	-0.003	16.962	0.009
.*| . |	.*| . |	11	-0.131	-0.183	18.470	0.010
. |***** |	. |**** |	12	0.698	0.600	61.715	0.000
. | . |	. |*. |	13	-0.052	0.134	61.961	0.000
. |*. |	. |*. |	14	0.081	0.199	62.571	0.000
.*| . |	.*| . |	15	-0.096	-0.165	63.424	0.000
. | . |	.*| . |	16	-0.063	-0.080	63.804	0.000

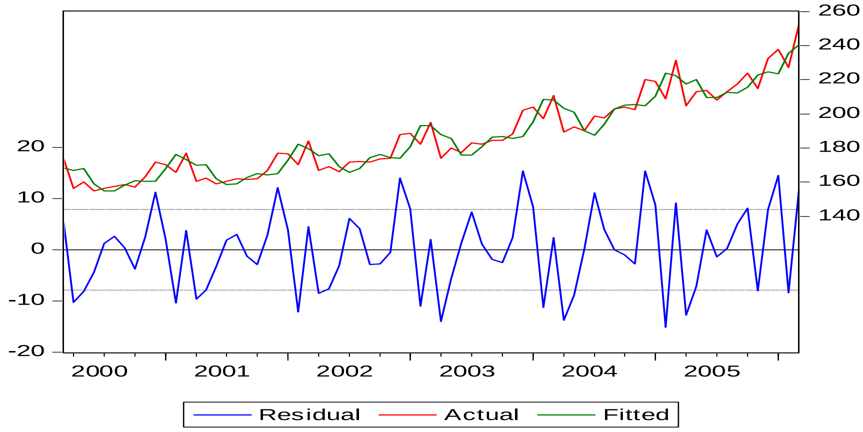

Figure A.2.14 Graph of Actual, fitted and residual values of IIPG ARIMA (2,1,2)

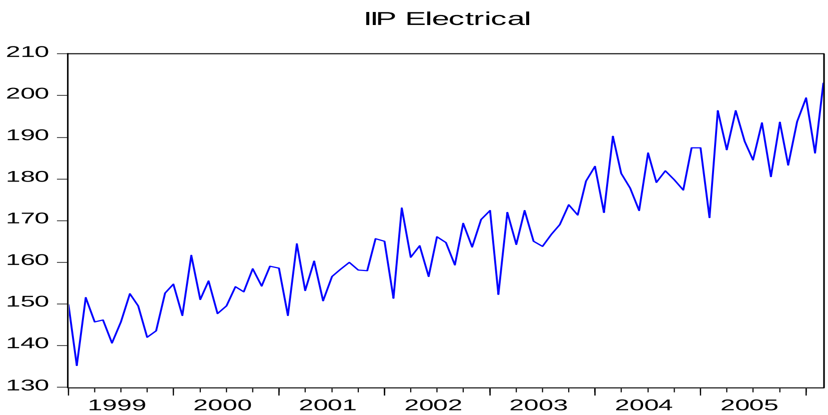

Figure A.2.15 Line graph of IIPE

Table A.2.10 Regression Results of Quadratic Multiplicative model of IIPE

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	167.5624	20.15919	8.311960	0.0000
Time	-0.281192	0.504192	-0.557708	0.5788
$Time^2$	0.007088	0.003472	2.041627	0.0449
AR(12)	0.607980	0.097225	6.253352	0.0000
R^2 = **0.895735** Adjusted R^2 =0.891330 Prob(F-statistic) 0.000000				

*,*** denotes significant at 1 per cent and 10 per cent level respectively.

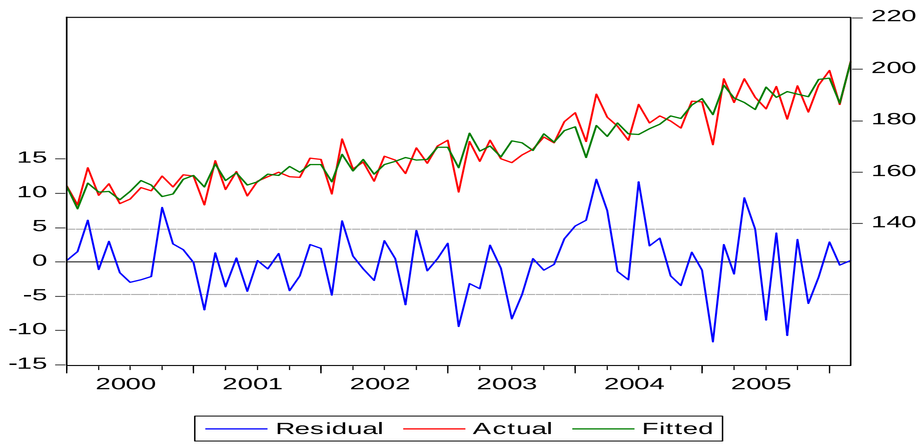

Figure A.2.16 Graph of Actual, fitted and residual values of IIPE from Quadratic Multiplicative Model

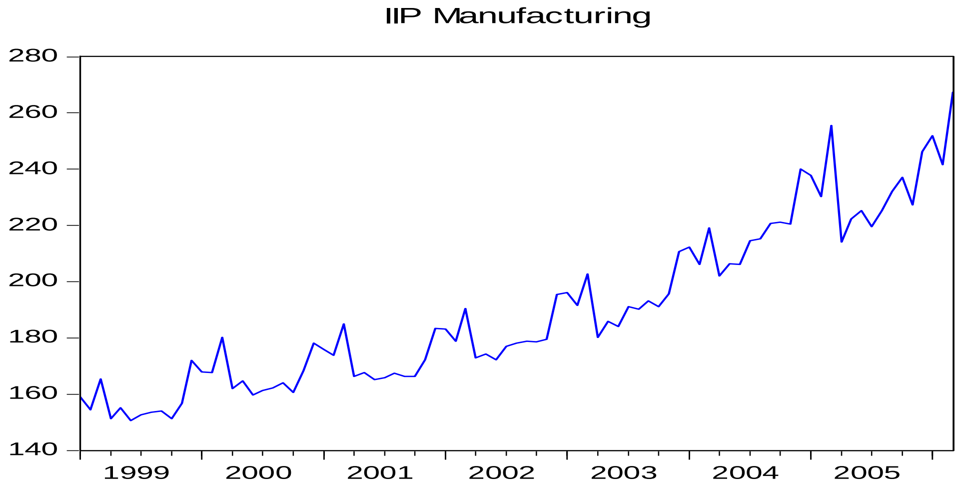

Figure A.2.17 Line graph of IIPM

Table A.2.11 Regression Results of Linear Multiplicative model of IIP Manufacturing

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	-19.16905	149.5739	-0.128158	0.8984
Time	2.303650	0.721127	3.194511	0.0021
AR(12)	0.867284	0.068397	12.68023	0.0000
	R^2 =**0.953681**	Adjusted R^2 =0.952394		
	Prob(F-statistic)	0.000000		

* denotes significant at 1 per cent level.

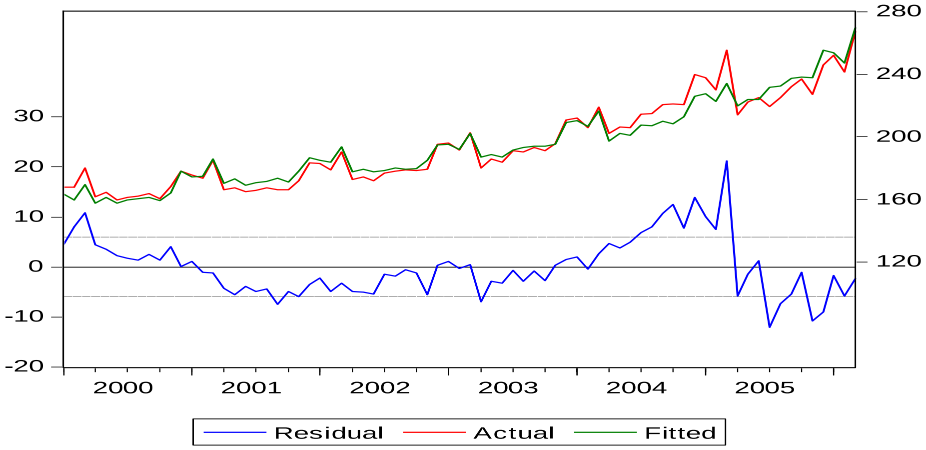

Figure A.2.18 Graph of Actual, fitted and residual values of IIP Manufacturing from Linear Multiplicative Model

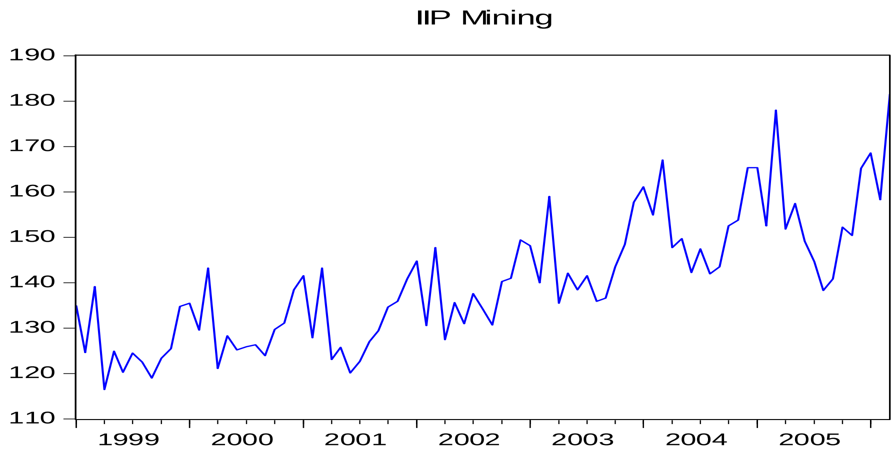

Figure A.2.19 Line graph of IIP MINING

Table A.2.12 Results of Augmented Dicky Fuller (ADF) Tests for IIP Mining

Constraints	MacKinnon (1996) one-sided p-values in Level
Intercept	0.2910
Intercept and Trend	0.0000

Note: * denotes significant

Correlogram of IIP Mining in level

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |***** |	. |***** |	1	0.652	0.652	33.157	0.000
. |***** |	. |*** |	2	0.700	0.479	71.967	0.000
. |**** |	. | . |	3	0.526	-0.055	94.140	0.000
. |*** |	**| . |	4	0.366	-0.315	105.04	0.000
. |** |	. | . |	5	0.316	0.019	113.29	0.000
. |*. |	. |*. |	6	0.208	0.111	116.90	0.000
. |** |	. |** |	7	0.280	0.313	123.57	0.000
. |** |	. |** |	8	0.311	0.264	131.90	0.000
. |*** |	. |*. |	9	0.403	0.147	146.10	0.000
. |**** |	. |*. |	10	0.529	0.176	170.93	0.000
. |*** |	**| . |	11	0.440	-0.317	188.41	0.000
. |***** |	. |*** |	12	0.683	0.416	231.12	0.000
. |*** |	**| . |	13	0.410	-0.300	246.80	0.000
. |*** |	.*| . |	14	0.463	-0.076	267.11	0.000
. |** |	.*| . |	15	0.320	-0.066	276.94	0.000
. |*. |	. | . |	16	0.191	-0.024	280.51	0.000

Table A.2.13 Regression Results of ARMA(1,2) Model of IIP Mining

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	145.2382	6.213863	23.37326	0.0000
AR(1)	0.830741	0.078948	10.52258	0.0000
MA(1)	-0.598126	0.080792	-7.403296	0.0000
MA(2)	0.769760	0.078839	9.763722	0.0000
R^2 =0.702932 Adjusted R^2 =0.690200 Prob(F-statistic) 0.000000				

Correlogram of residuals from ARMA (2,1,2) Model of IIP Mining

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.020	0.020	0.0297	
. | . |	. | . |	2	-0.002	-0.002	0.0298	
. | . |	. | . |	3	-0.042	-0.042	0.1677	
. | . |	. | . |	4	0.005	0.006	0.1694	0.681
. | . |	. | . |	5	0.054	0.054	0.4087	0.815
**| . |	**| . |	6	-0.219	-0.224	4.3726	0.224
.*| . |	.*| . |	7	-0.089	-0.082	5.0338	0.284
.*| . |	.*| . |	8	-0.077	-0.072	5.5417	0.353
. | . |	. | . |	9	0.007	-0.013	5.5458	0.476
. | . |	. | . |	10	0.073	0.067	6.0125	0.538
. | . |	. | . |	11	-0.042	-0.027	6.1687	0.628
. |***** |	. |***** |	12	0.636	0.644	42.815	0.000
.*| . |	.*| . |	13	-0.067	-0.205	43.224	0.000
. |*. |	. |*. |	14	0.079	0.169	43.811	0.000
. | . |	. |*. |	15	0.059	0.104	44.141	0.000
. | . |	. | . |	16	0.043	0.018	44.317	0.000

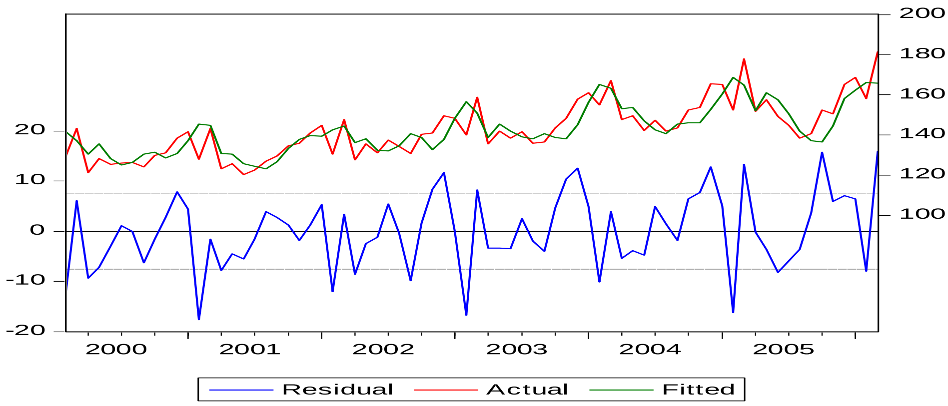

Figure A.2.20 Graph of Actual, fitted and residual values of IIP Mining from ARMA (1,2) Model

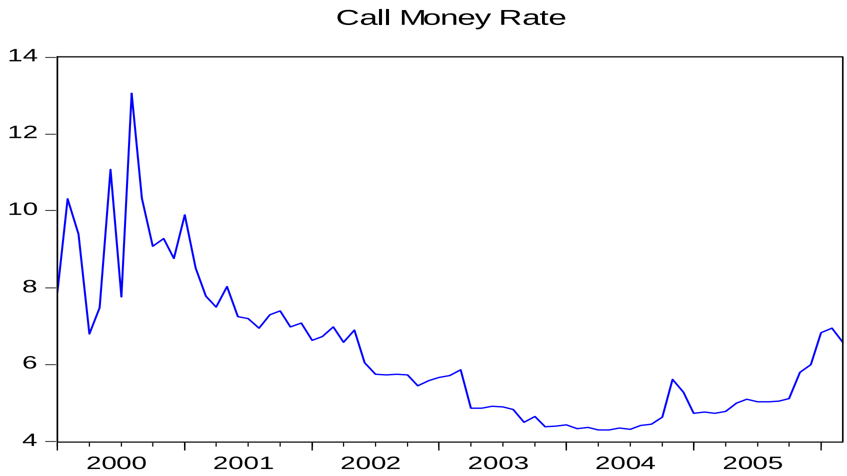

Figure. A.2.21 Line graph of Call money rate (CALM)

Table 4.14 Results of Augmented Dicky Fuller (ADF) Tests for Call money rate

Constraints	MacKinnon (1996) one-sided p-values in Level	MacKinnon (1996) one-sided p-values in First Difference
Intercept	0.7262	0.0000
Intercept and Trend	0.9880	0.0000

. ** denotes significant at 5 per cent level.

Correlogram of Cal money rate

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
****| . |	****| . |	1	-0.486	-0.486	18.194	0.000
. | . |	**| . |	2	0.039	-0.258	18.314	0.000
. | . |	. | . |	3	0.063	-0.054	18.628	0.000
.*| . |	.*| . |	4	-0.144	-0.168	20.294	0.000
. |*. |	.*| . |	5	0.084	-0.089	20.863	0.001
. |*. |	. |*. |	6	0.097	0.112	21.634	0.001
. | . |	. |*. |	7	-0.017	0.170	21.657	0.003
. | . |	. | . |	8	-0.061	0.030	21.973	0.005
. | . |	. | . |	9	0.005	-0.024	21.976	0.009
. | . |	.*| . |	10	-0.056	-0.084	22.255	0.014
. |*. |	. | . |	11	0.115	0.054	23.426	0.015
.*| . |	. | . |	12	-0.072	-0.041	23.900	0.021
. | . |	.*| . |	13	-0.011	-0.099	23.911	0.032
. | . |	. | . |	14	0.016	-0.058	23.934	0.047
. | . |	. |*. |	15	0.022	0.076	23.981	0.065
. | . |	. |*. |	16	0.047	0.151	24.190	0.085

Table A.2.15 Regression Results of ARIMA (2,1,2) Model of Call Money Rate

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	-0.027516	0.107358	-0.256307	0.7985
AR(1)	0.549500	0.100066	5.491397	0.0000
AR(2)	-0.431967	0.085816	-5.033648	0.0000
MA(1)	-0.983384	0.031350	-31.36743	0.0000
MA(2)	0.963506	0.019906	48.40170	0.0000
R^2 = 0.434805 Adjusted R^2 =0.401062 Prob(F-statistic) 0.000000				

Correlogram of residuals from ARMA (2,1,2) Model of Call money rate

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
**| . |	**| . |	1	-0.288	-0.288	6.2359	
. | . |	. | . |	2	0.047	-0.040	6.4032	
.*| . |	.*| . |	3	-0.161	-0.173	8.4079	
.*| . |	.*| . |	4	-0.083	-0.200	8.9440	
. |*. |	. |*. |	5	0.158	0.077	10.935	0.001
. | . |	. | . |	6	-0.064	-0.031	11.267	0.004
. | . |	. | . |	7	0.069	0.004	11.655	0.009
. | . |	. | . |	8	-0.009	0.050	11.661	0.020
. | . |	. | . |	9	0.027	0.068	11.722	0.039
.*| . |	.*| . |	10	-0.118	-0.119	12.926	0.044
. | . |	. | . |	11	-0.011	-0.062	12.936	0.074
. | . |	.*| . |	12	-0.052	-0.087	13.178	0.106
. | . |	. | . |	13	0.044	-0.053	13.351	0.147
. | . |	. | . |	14	0.042	-0.012	13.511	0.196
. | . |	. | . |	15	0.040	0.066	13.660	0.252
. |*. |	. |*. |	16	0.074	0.121	14.187	0.289

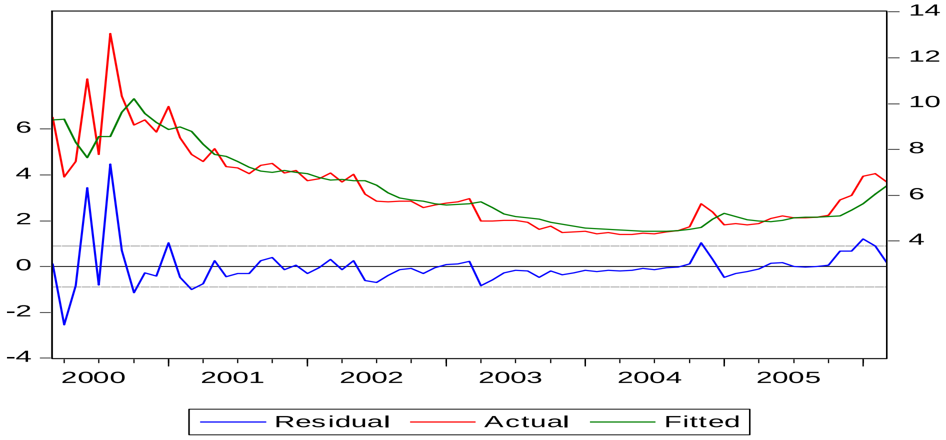

Figure A.2.22 Graph of Actual, fitted and residual values of Call Money Rate from ARIMA (2,1,2) Model

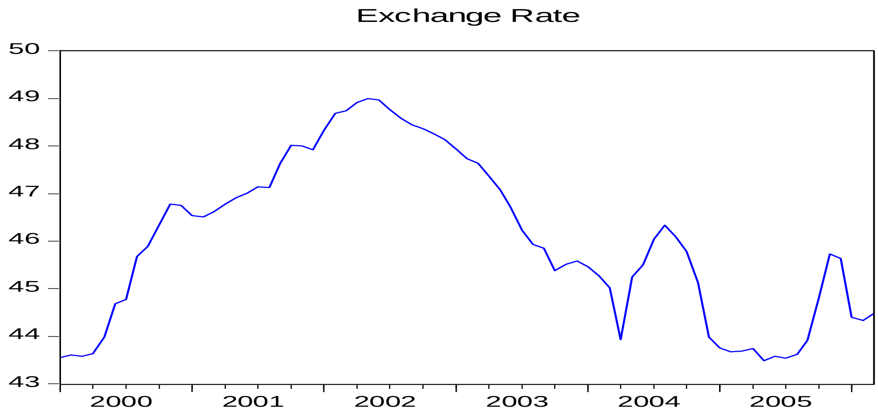

Figure A.2.23 Line graph of Exchange Rate (EXR)

Table A.2.16 Results of Augmented Dicky Fuller (ADF) Tests for Exchange rate

Constraints	MacKinnon (1996) one-sided p-values in Level	MacKinnon (1996) one-sided p-values in First Difference
Intercept	0.3855	0.0013
Intercept and Trend	0.2223	0.0031

* denotes significant at 1 per cent level.

Correlogram of Exchange rate in first difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |** |	. |** |	1	0.311	0.311	7.4556	0.006
. |*. |	. | . |	2	0.138	0.045	8.9338	0.011
. | . |	. | . |	3	0.010	-0.050	8.9416	0.030
. | . |	. | . |	4	-0.056	-0.057	9.1899	0.057
. | . |	. | . |	5	0.002	0.045	9.1902	0.102
. | . |	. | . |	6	0.043	0.047	9.3415	0.155
. | . |	.*| . |	7	-0.045	-0.087	9.5095	0.218
. |*. |	. |** |	8	0.172	0.220	12.036	0.150
. | . |	.*| . |	9	0.030	-0.078	12.116	0.207
.*| . |	.*| . |	10	-0.075	-0.116	12.607	0.246
.*| . |	. | . |	11	-0.079	-0.024	13.167	0.283
.*| . |	. | . |	12	-0.090	-0.014	13.903	0.307
. |*. |	. |*. |	13	0.127	0.200	15.381	0.284
. |*. |	. | . |	14	0.148	0.025	17.433	0.234
. |*. |	. |*. |	15	0.151	0.113	19.613	0.187
. |*. |	. | . |	16	0.150	0.031	21.792	0.150

Table A.2.17 Regression Results of ARIMA(1,1,0) Model of Exchange Rate

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	0.012431	0.068199	0.182274	0.8559
AR(1)	0.311564	0.112855	2.760731	0.0073
R^2 =0.096941 Adjusted R^2 =0.084222 Prob(F-statistic) 0.007334				

Correlogram of residuals from ARIMA (1,1,0) for Exchange rate

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	-0.014	-0.014	0.0142	
. | . |	. | . |	2	0.057	0.057	0.2675	0.605
. | . |	. | . |	3	-0.022	-0.021	0.3064	0.858
.*| . |	.*| . |	4	-0.076	-0.080	0.7609	0.859
. | . |	. | . |	5	0.010	0.010	0.7684	0.943
. | . |	. |*. |	6	0.066	0.076	1.1238	0.952
.*| . |	.*| . |	7	-0.127	-0.132	2.4664	0.872
. |*. |	. |*. |	8	0.213	0.203	6.2793	0.508
. | . |	. | . |	9	0.002	0.022	6.2796	0.616
.*| . |	.*| . |	10	-0.073	-0.102	6.7387	0.664
. | . |	. | . |	11	-0.039	-0.051	6.8761	0.737
.*| . |	.*| . |	12	-0.126	-0.089	8.2977	0.686
. |*. |	. |*. |	13	0.133	0.162	9.9232	0.623
. |*. |	. | . |	14	0.083	0.039	10.567	0.647
. |*. |	. |*. |	15	0.081	0.114	11.187	0.671
. |*. |	. | . |	16	0.082	0.043	11.835	0.692

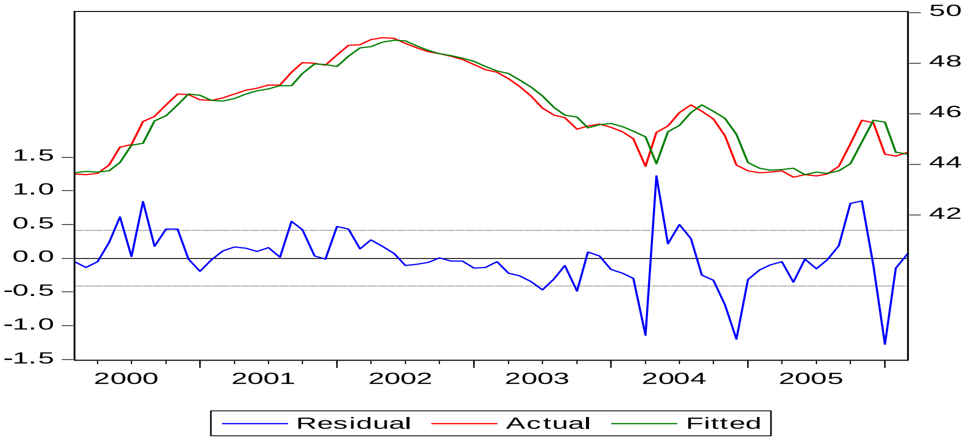

Figure A.2.24 Graph of Actual, fitted and residual values of Exchange Rate from ARIMA (1,1,0) Model

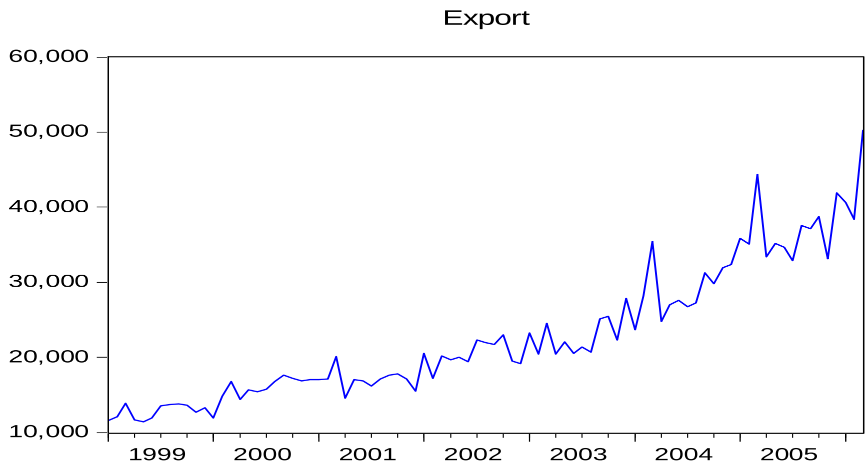

Figure A.2.25 Line graph of Export (EXP)

Table A.2.18 Regression Results of Quadratic Multiplicative model of Export

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	29989.82	10569.46	2.837403	0.0059
Time	-482.1020	252.2663	-1.911084	0.0600
Time^2	7.180963	1.670601	4.298432	0.0001
AR(12)	0.560061	0.112091	4.996471	0.0000
R^2 = **0.930540** Adjusted R^2 =0.927606 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

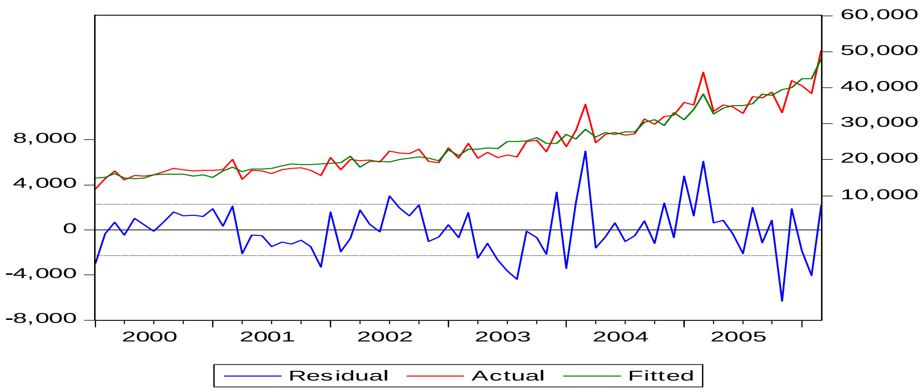

Figure A.2.26 Graph of Actual, fitted and residual values of Export from Quadratic Multiplicative Model

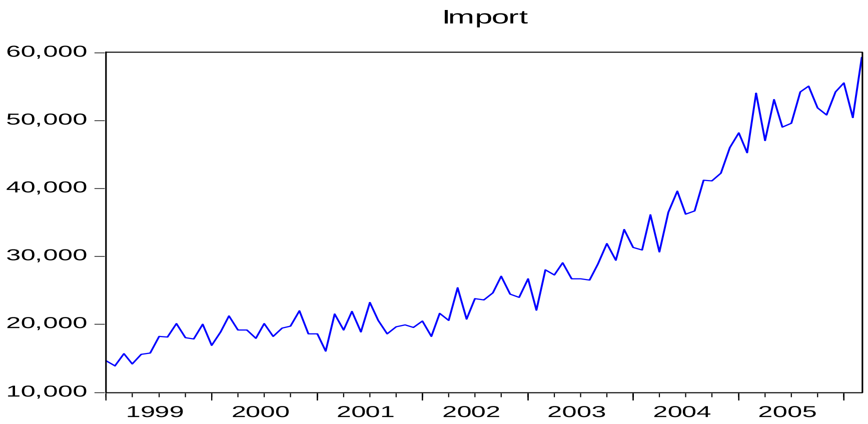

Figure A.2.27 Line graph of import (IMP)

Table A.2.19 Regression Results of Quadratic model of Import

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	25069.94	2320.190	10.80512	0.0000
Time	-478.7041	90.77951	-5.273261	0.0000
$Time^2$	10.02848	0.825682	12.14569	0.0000
AR(12)	0.130947	0.112936	1.159473	0.2501
R^2 = **0.963838** Adjusted R^2 =0.962310 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

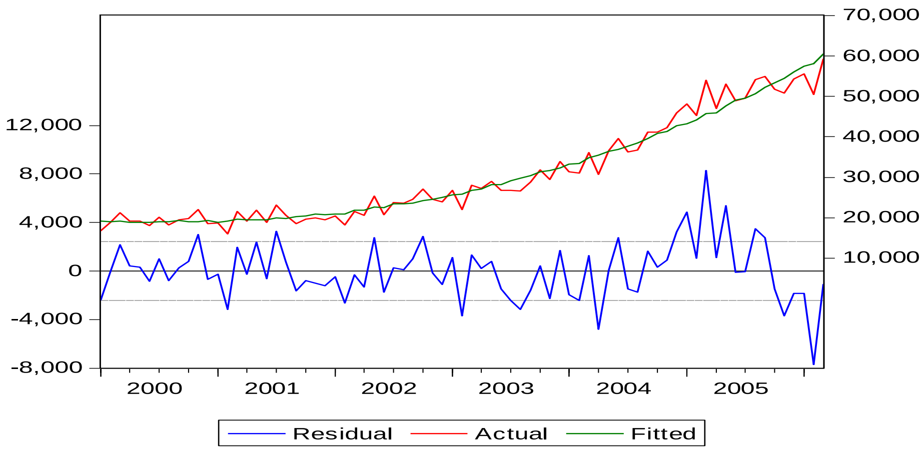

Figure A.2.28 Graph of Actual, fitted and residual values of Import from Quadratic Multiplicative Model

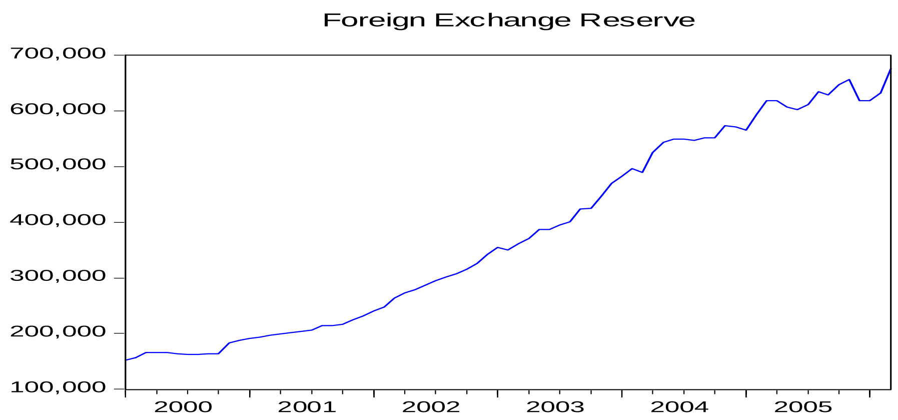

Figure A.2.29 Line graph of Foreign Exchange Reserve (FORX)

Table A.2.20 Regression Results of Quadratic Trend model of Foreign exchange reserve

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	117543.1	8730.315	13.46378	0.0000
Time	5068.044	530.1434	9.559760	0.0000
$Time^2$	36.57100	6.759739	5.410120	0.0000
R^2 =**0.980529** Adjusted R^2 =0.979988 Prob(F-statistic) 0.000000				

* denotes significant at 1 per

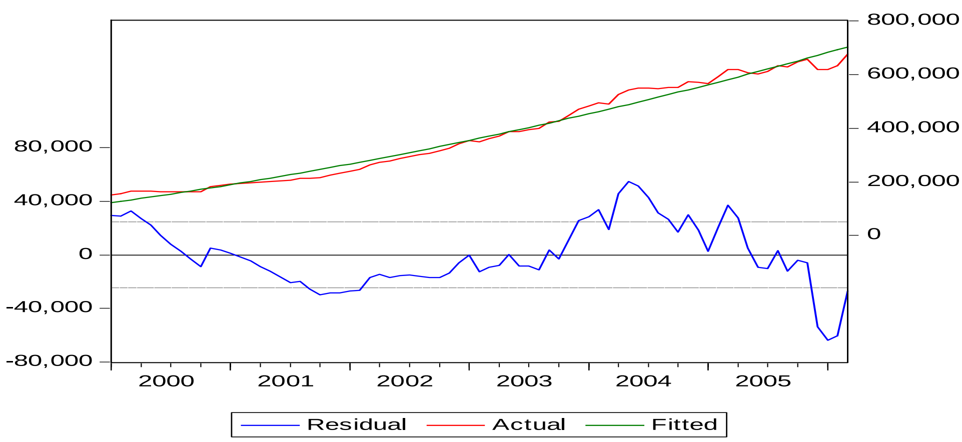

Figure A.2.30 Graph of Actual, fitted and residual values of Foreign exchange reserve from Quadratic Model

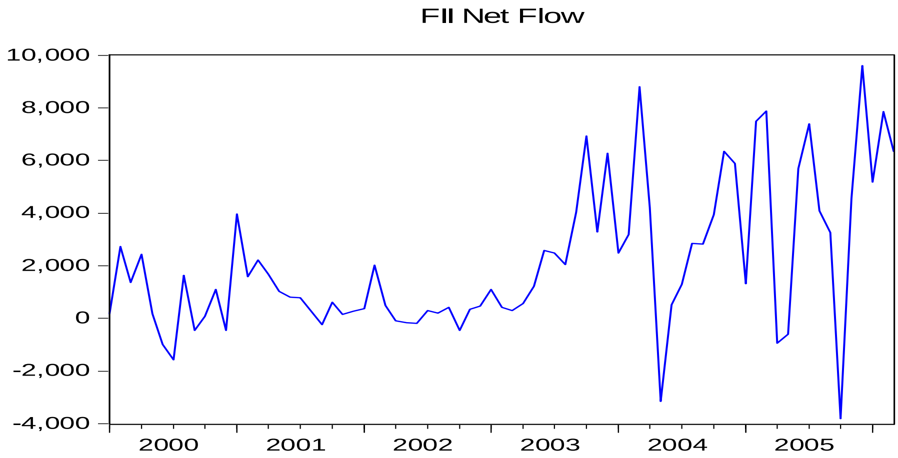

Figure A.2.31 Line graph of FII Net flow (FII)

Table A.2.21 Results of Augmented Dicky Fuller (ADF) Tests for Exchange rate

Constraints	MacKinnon (1996) one-sided p-values in Level
Intercept	0.0930
Intercept and Trend	0.0059

** denotes significant at 5 per cent level

Correlogram of FII in level

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*** |	. |*** |	1	0.446	0.446	15.509	0.000
. |*. |	.*| . |	2	0.141	-0.072	17.082	0.000
. |** |	. |** |	3	0.259	0.280	22.444	0.000
. |** |	. | . |	4	0.238	0.019	27.061	0.000
. |** |	. |*. |	5	0.261	0.204	32.699	0.000
. |** |	. | . |	6	0.243	0.023	37.632	0.000
. | . |	.*| . |	7	0.068	-0.103	38.030	0.000
. |*. |	. |*. |	8	0.136	0.124	39.632	0.000
. |*. |	. | . |	9	0.201	0.005	43.161	0.000
. |*. |	. | . |	10	0.084	-0.040	43.784	0.000
. |** |	. |** |	11	0.254	0.276	49.606	0.000
. |** |	. | . |	12	0.299	0.040	57.782	0.000
. |*. |	. | . |	13	0.126	-0.011	59.253	0.000
. |*. |	. | . |	14	0.131	-0.001	60.866	0.000
. |** |	. |*. |	15	0.238	0.129	66.335	0.000
. |*. |	. | . |	16	0.200	-0.014	70.260	0.000

Table A.2.22 Regression Results of ARMA (0,1) Model of FII

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	2126.774	447.2572	4.755148	0.0000
MA(1)	0.582718	0.093359	6.241669	0.0000
R^2 =0.239957 Adjusted R^2 = 0.229546 Prob(F-statistic) 0.000008				

Correlogram of Residuals for FII from ARMA (0,1) model

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	-0.025	-0.025	0.0488	
. |*. |	. |*. |	2	0.077	0.077	0.5239	0.469
. |*. |	. |*. |	3	0.178	0.183	3.0675	0.216
. |*. |	. |*. |	4	0.107	0.117	3.9984	0.262
. |*. |	. |*. |	5	0.128	0.116	5.3461	0.254
. |*. |	. |*. |	6	0.186	0.162	8.2413	0.143
. | . |	.*| . |	7	-0.035	-0.071	8.3481	0.214
. | . |	. | . |	8	0.052	-0.032	8.5792	0.284
. |** |	. |*. |	9	0.221	0.157	12.840	0.117
.*| . |	.*| . |	10	-0.098	-0.123	13.701	0.133
. |*. |	. |*. |	11	0.201	0.154	17.357	0.067
. |*. |	. |*. |	12	0.193	0.178	20.789	0.036
. | . |	. | . |	13	0.027	0.041	20.859	0.052
. | . |	. | . |	14	0.041	-0.050	21.020	0.073
. |*. |	. |*. |	15	0.188	0.090	24.430	0.041
. | . |	. | . |	16	0.062	0.054	24.806	0.053

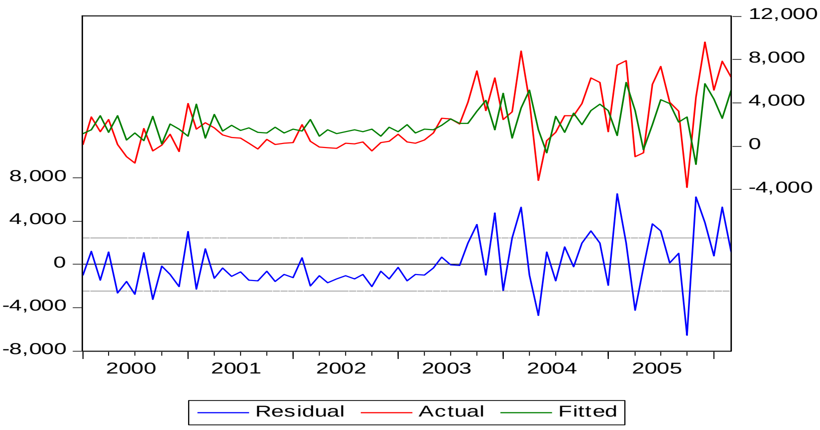

Figure A.2.32 Graph of Actual, fitted and residual values of FII from ARMA (0,1) Model

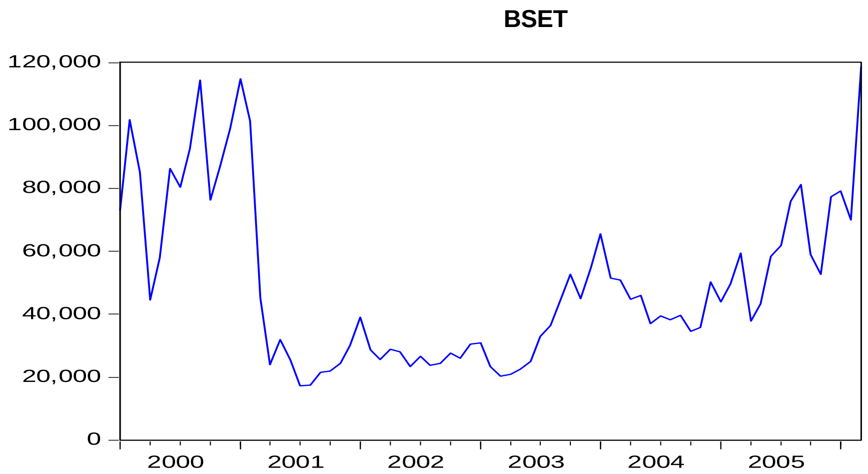

Figure A.2.33 Line graph of BSET

Table A.2.23 Results of Augmented Dicky Fuller (ADF) Tests for BSET

Constraints	MacKinnon (1996) one-sided p-values in Level	MacKinnon (1996) one-sided p-values in First difference
Intercept	0.7417	0.0101
Intercept and Trend	0.9615	0.0154

** denotes significant at 5 per cent level

Correlogram of BSET in level

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	-0.003	-0.003	0.0007	0.978
**| . |	**| . |	2	-0.327	-0.327	8.3761	0.015
. |*. |	. |*. |	3	0.135	0.148	9.8128	0.020
. | . |	.*| . |	4	-0.010	-0.140	9.8209	0.044
.*| . |	. | . |	5	-0.077	0.028	10.301	0.067
. |*. |	. | . |	6	0.128	0.071	11.662	0.070
. | . |	. | . |	7	0.028	0.019	11.726	0.110
.*| . |	.*| . |	8	-0.138	-0.074	13.351	0.100
.*| . |	.*| . |	9	-0.094	-0.122	14.123	0.118
.*| . |	.*| . |	10	-0.077	-0.152	14.650	0.145
. |*. |	. |*. |	11	0.127	0.122	16.101	0.137
. |*. |	. |*. |	12	0.188	0.133	19.320	0.081
.*| . |	. | . |	13	-0.121	-0.048	20.661	0.080
. | . |	. | . |	14	-0.057	0.032	20.960	0.103
. | . |	. | . |	15	0.066	-0.015	21.374	0.125
. | . |	. | . |	16	0.014	0.073	21.393	0.164

Table A.2.24 Regression Results of ARIMA (3,1,2) Model of BSET

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	55694.20	17448.79	3.191866	0.0022
AR(1)	-0.141676	0.083174	-1.703360	0.0932
AR(2)	0.173034	0.087207	1.984164	0.0514
AR(3)	0.686223	0.076103	9.017010	0.0000
MA(1)	1.274558	0.017156	74.29221	0.0000
MA(2)	0.945521	0.013282	71.18702	0.0000
R^2 = 0.786454 Adjusted R^2 =0.770276 Prob(F-statistic) 0.000000				

Correlogram of residuals from ARIMA (3,1,2) Model of BSET

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.011	0.011	0.0094	
.*| . |	.*| . |	2	-0.095	-0.095	0.6953	
. |*. |	. |*. |	3	0.111	0.114	1.6393	
. | . |	. | . |	4	-0.013	-0.027	1.6534	
. | . |	. | . |	5	0.033	0.056	1.7386	
. |*. |	. | . |	6	0.074	0.057	2.1862	0.139
. | . |	. | . |	7	-0.005	0.005	2.1882	0.335
.*| . |	.*| . |	8	-0.084	-0.083	2.7689	0.429
. | . |	. | . |	9	-0.046	-0.057	2.9483	0.567
. | . |	. | . |	10	-0.040	-0.056	3.0855	0.687
. | . |	. | . |	11	-0.061	-0.060	3.4141	0.755
. |*. |	. |*. |	12	0.118	0.120	4.6412	0.704
. | . |	. | . |	13	-0.024	-0.025	4.6952	0.790
. | . |	. | . |	14	-0.015	0.041	4.7146	0.858
. | . |	. | . |	15	0.035	0.013	4.8320	0.902
. | . |	. | . |	16	0.010	0.026	4.8406	0.939

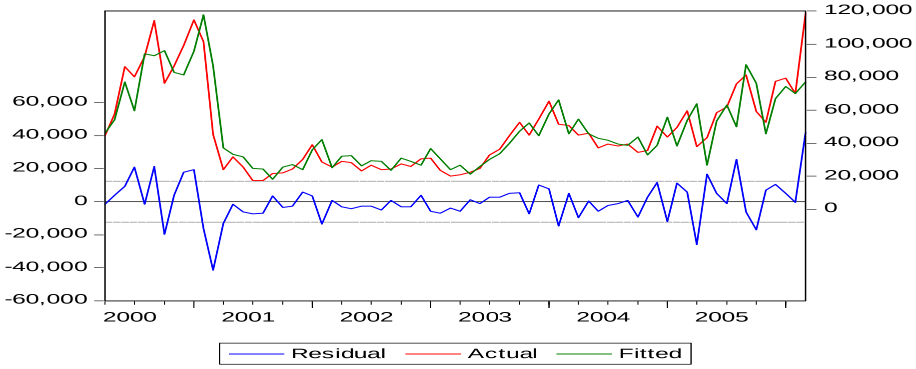

Figure A.2.34 Graph of Actual, fitted and residual values of BSET from ARIMA (3,1,2) Model

Appendix -3

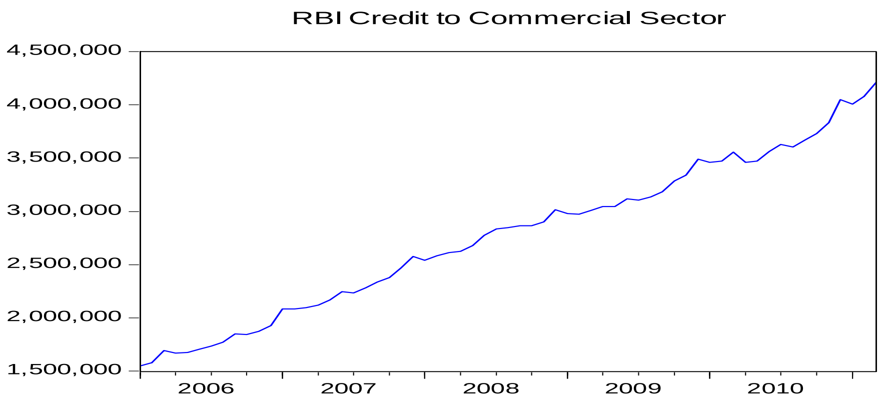

Figure A.3.1 Line Graph of BCC

Table A.3.1 Regression Results of Linear Trend Model of BCC

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	1502587.	17996.40	83.49376	0.0000
Time	39641.31	488.9556	81.07343	0.0000
R^2 = **0.990805** Adjusted R^2 =0.990654 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

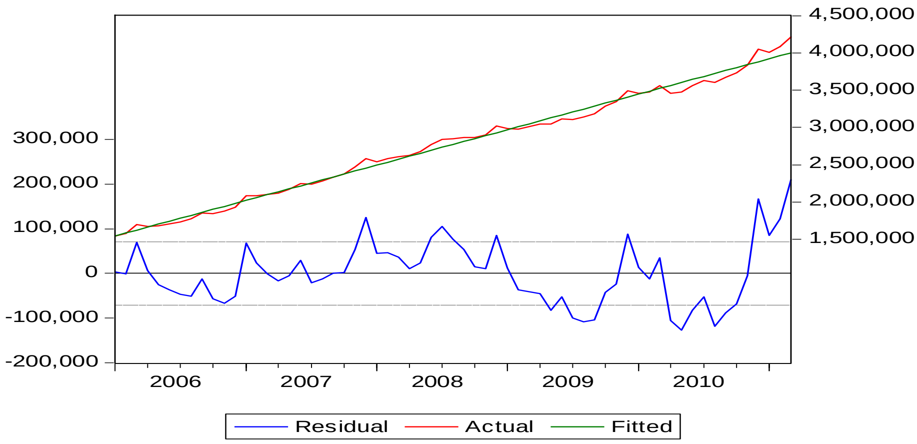

Figure A.3.2 Graph of actual, fitted and residual values of BCC from Quadratic Trend Model

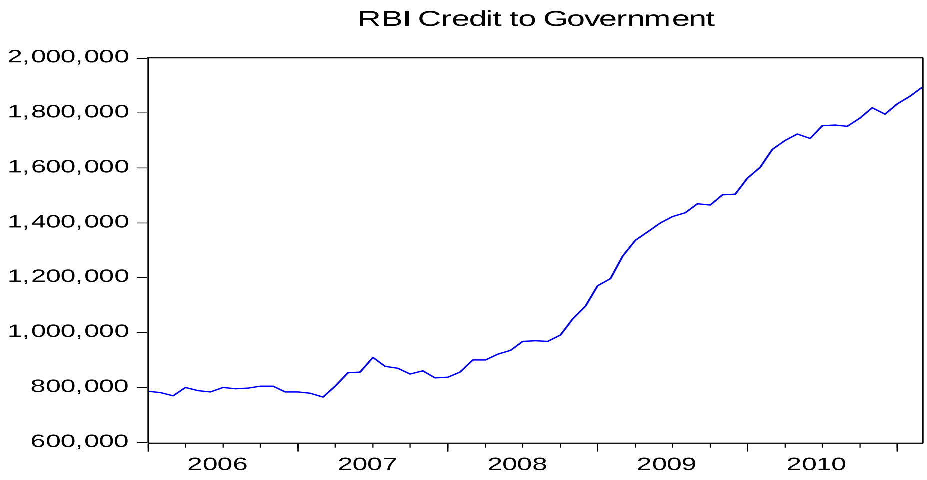

Figure A.3.3 Line graph of BCG

Table A.3.2 Regression Results of Quadratic Trend Model of BCG

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	764700.4	26146.16	29.24714	0.0000
Time	-2211.025	1885.124	-1.172880	0.2455
$Time^2$	351.1005	28.54829	12.29848	0.0000
R^2 = **0.971651** Prob(F-statistic)		Adjusted R^2 =0.970706 0.000000		

* denotes significant at 1 per cent level.

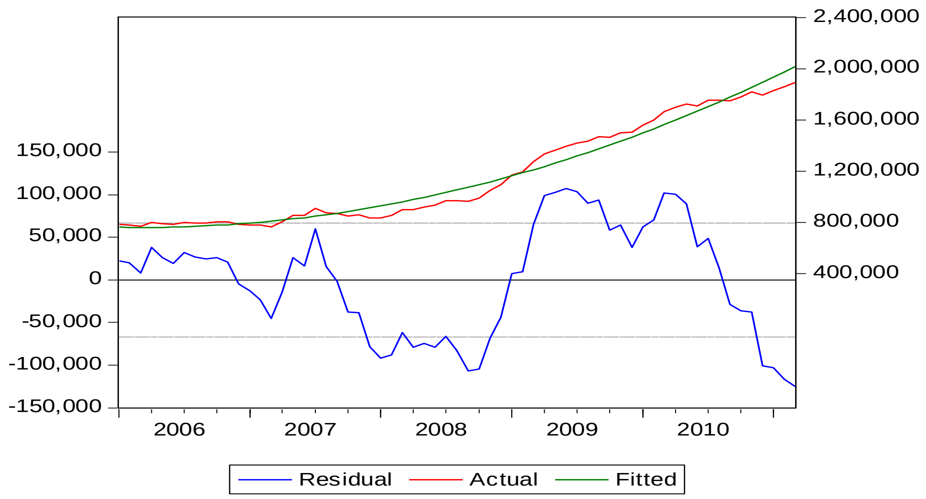

Figure A.3.4 Graph of Actual, fitted and residual values of BCG from Quadratic Trend Model

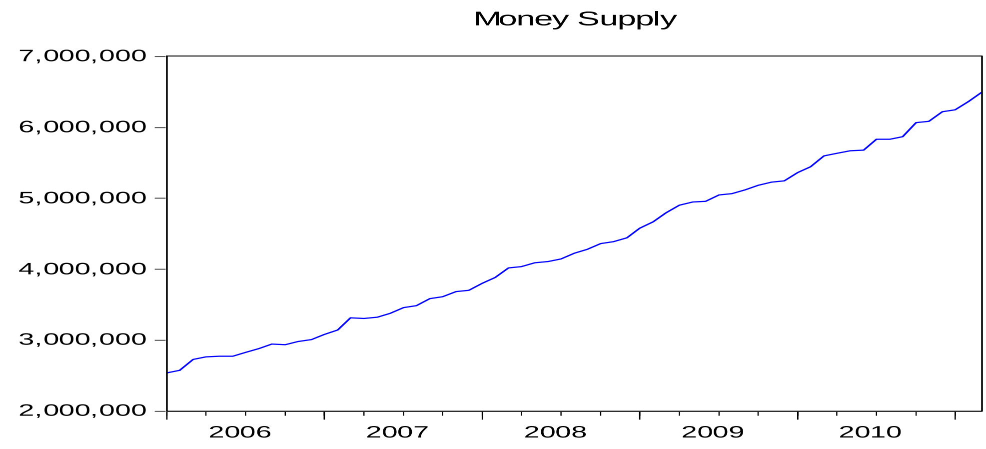

Figure A.3.4 Line graph of Money Supply (M3)

Table A.3.3 Regression Results of Quadratic Trend Model of Money Supply

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	2487270.	20147.15	123.4552	0.0000
Time	47104.65	1452.599	32.42785	0.0000
$Time^2$	247.3789	21.99813	11.24545	0.0000
R^2 = **0.998074** Prob(F-statistic)		Adjusted R^2 =0.998010 0.000000		

* denotes significant at 1 per cent level.

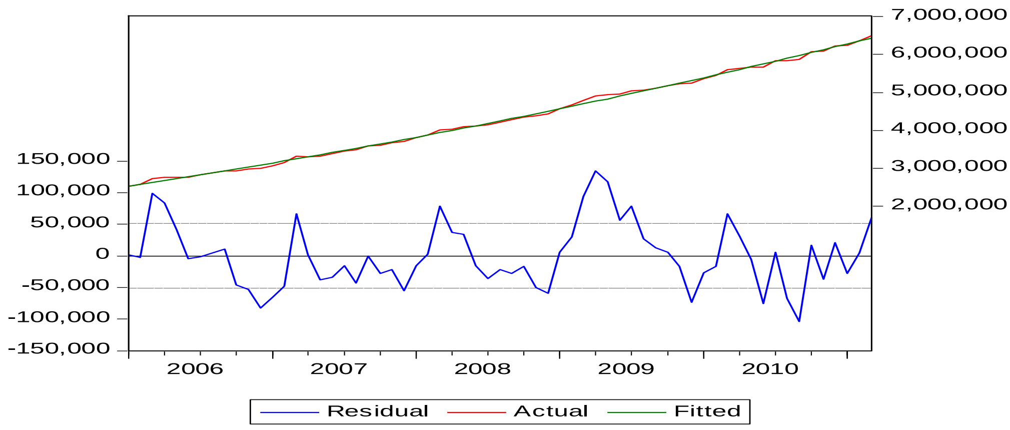

Figure A.3.5 Graph of Actual, fitted and residual values of Money Supply from Quadratic Trend Model

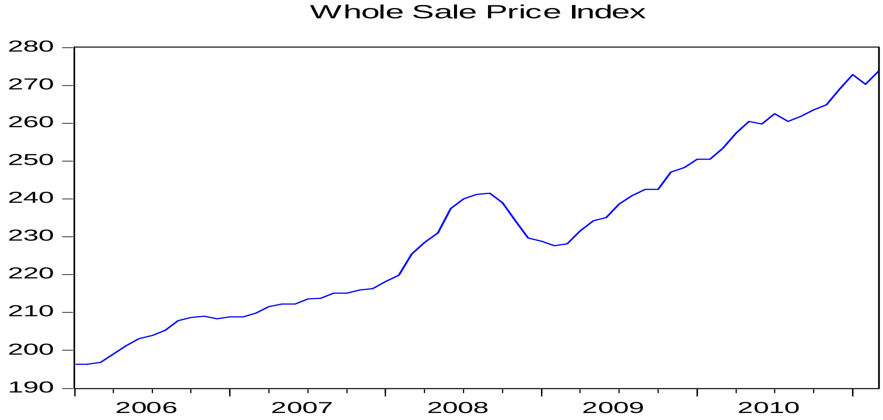

Figure A.3.6 Line graph of WPI

Table A.3.4 Regression Results of Quadratic Trend Model of WPI

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	197.4744	1.762184	112.0623	0.0000
Time	0.776744	0.127053	6.113568	0.0000
Time^2	0.006402	0.001924	3.327148	0.0015
R^2 = **0.960253** Adjusted R^2 =0.958928 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

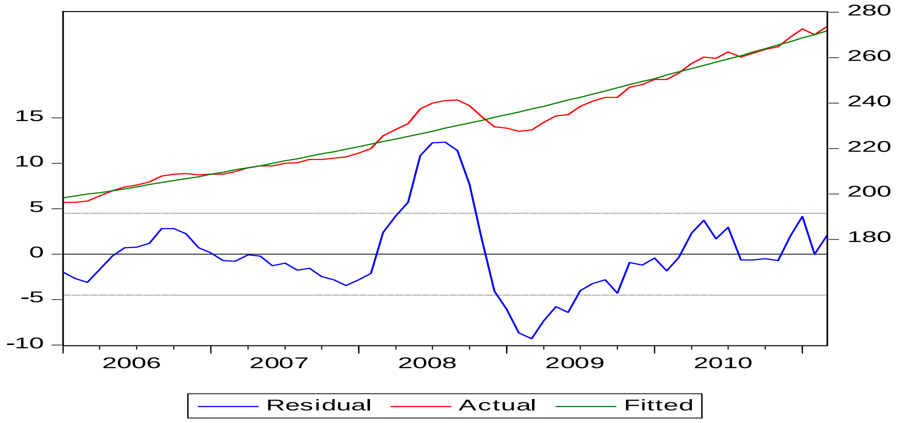

Figure A.3.7 Graph of Actual, fitted and residual values of WPI from Quadratic Trend Model

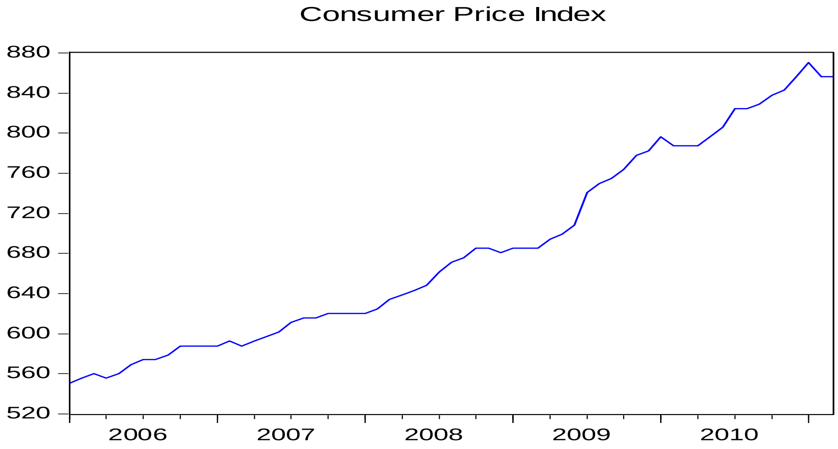

Figure A.3.8 Line graph of CPI

Table A.3.5 Regression Results of Quadratic Trend model of CPI

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	553.8651	3.859179	143.5189	0.0000
Time	1.747023	0.278245	6.278727	0.0000
$Time^2$	0.054464	0.004214	12.92532	0.0000
R^2 =**0.990101** Adjusted R^2 =0.989771 Prob(F-statistic) 0.000000				

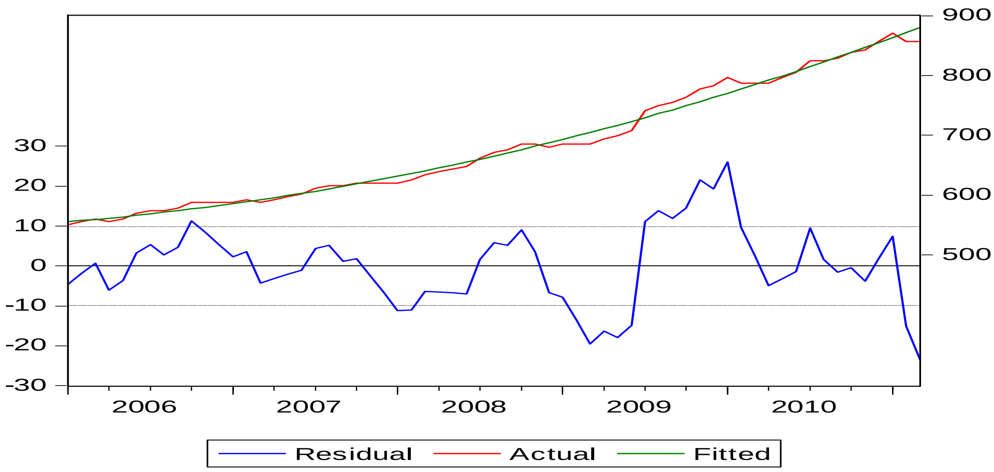

Figure A.3.9 Graph of Actual, fitted and residual values of CPI from Quadratic Trend Model

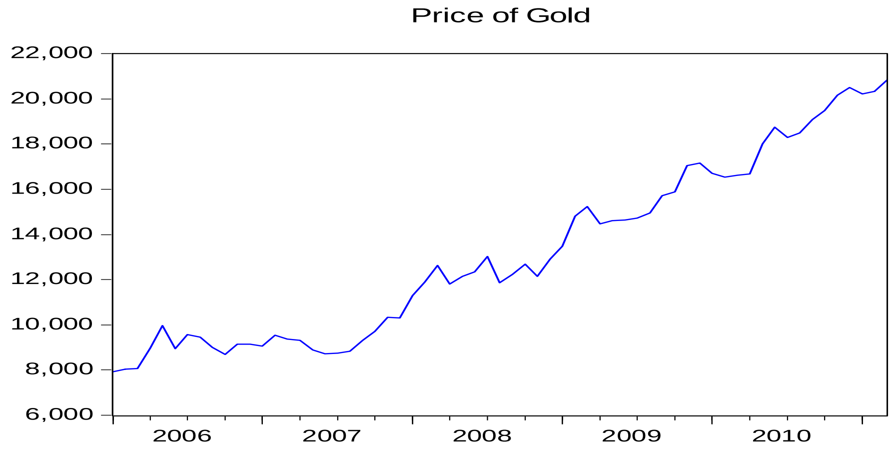

Figure A.3.10 Line graph of GOLD

Table A.3.6 Regression Results of Quadratic Trend model of GOLD

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	8213.841	248.2990	33.08044	0.0000
Time	48.07050	17.90222	2.685169	0.0094
$Time^2$	2.520126	0.271111	9.295551	0.0000
R^2 =0.975025 Adjusted R^2 =0.974192 Prob(F-statistic) 0.000000				

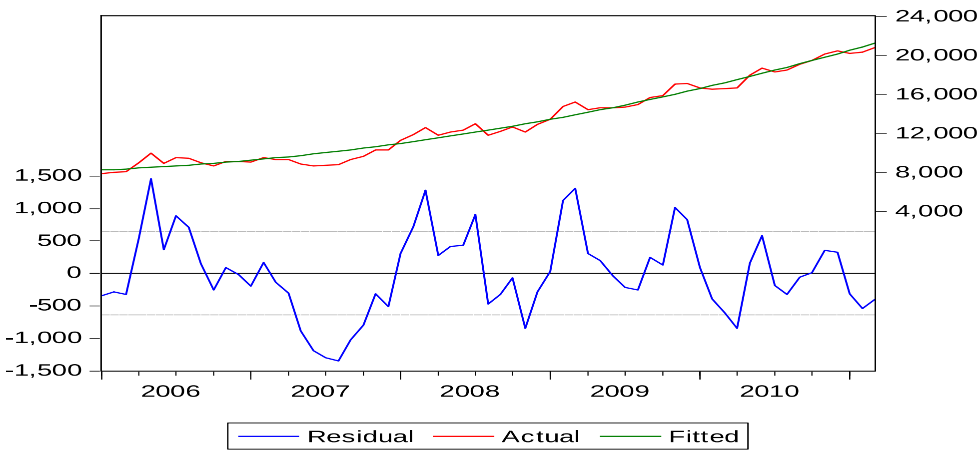

Figure A.3.11 Graph of Actual, fitted and residual values of GOLD from Quadratic Trend Model

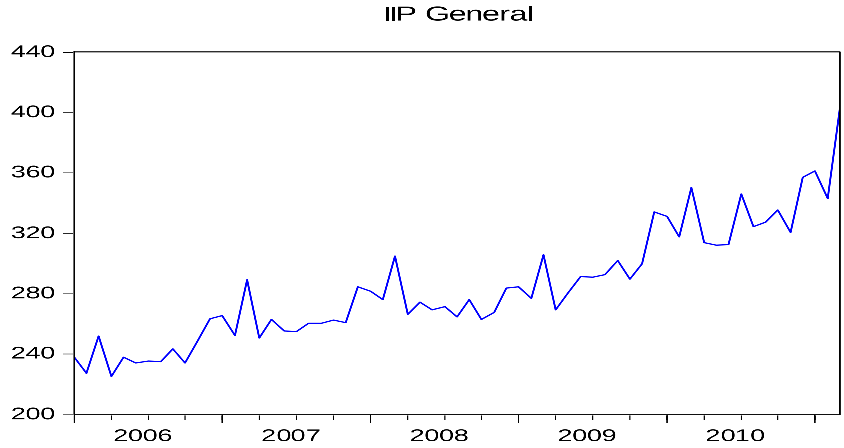

Figure A.3.12 Line graph of IIPG

Table A.3.7 Regression Results of Quadratic Multiplicative model of IIPG

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	957.1357	918.5974	1.041953	0.3017
Time	-12.59429	11.36675	-1.107993	0.2724
Time^2	0.088922	0.044923	1.979437	0.0524
AR(12)	0.774690	0.105215	7.362929	0.0000
R^2 =**0.920894** Adjusted R^2 =0.916872 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

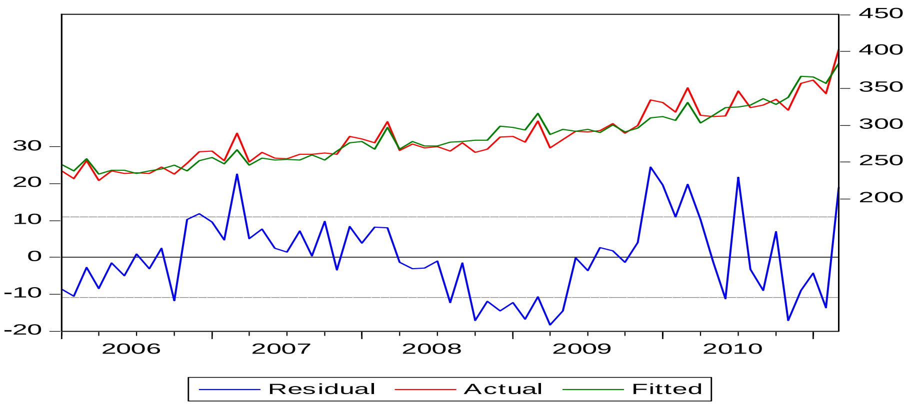

Figure A.3.13 Graph of Actual, fitted and residual values of IIPG from Quadratic Multiplicative Model

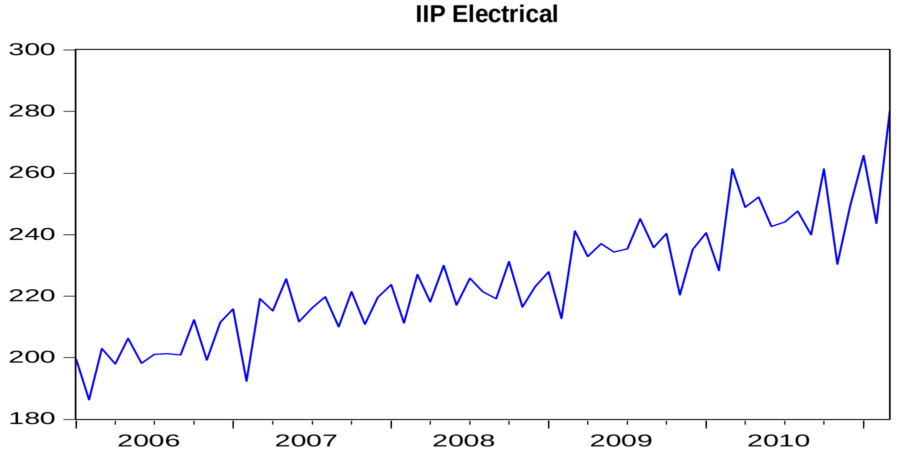

Figure A.3.14 Line graph of IIPE

Table A.3.8 Regression Results of Quadratic Multiplicative model of IIPE

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	1386.488	2597.124	0.533855	0.5954
Time	-11.36187	17.68625	-0.642413	0.5231
$Time^2$	-0.100406	0.019458	-5.160156	0.0000
AR(12)	0.879165	0.091542	9.603999	0.0000
R^2 =**0.919884** Adjusted R^2 =0.915810 Prob(F-statistic) 0.000000				

*,*** denotes significant at 1 per cent and 10 per cent level respectively.

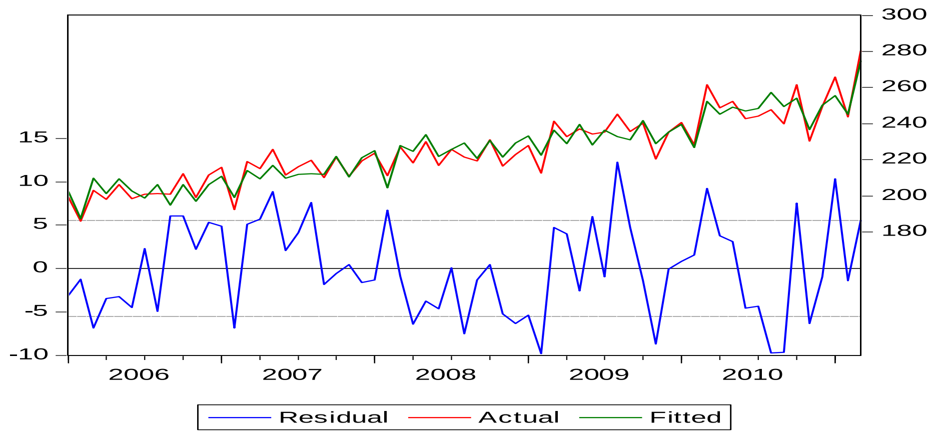

Figure A.3.15 Graph of Actual, fitted and residual values of IIPE from Quadratic Multiplicative Model

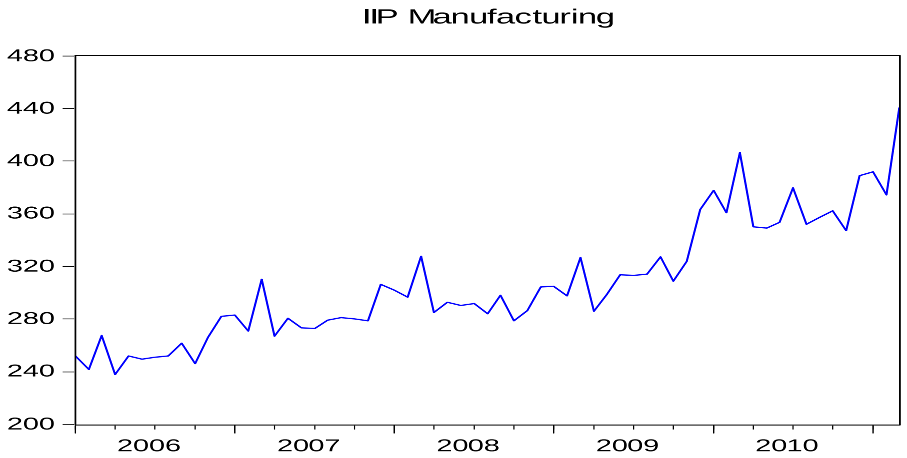

Figure A.3.16 Line graph of IIPM

Table A.3.9 Regression Results of Quadratic Multiplicative model of IIP Manufacturing

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	360.2711	96.92770	3.716906	0.0005
Time	-3.019471	2.457003	-1.228924	0.2240
AR(12)	0.046888	0.017881	2.622256	0.0111
$Time^2$	0.569676	0.114247	4.986338	0.0000
R^2 = **0.887121** Adjusted R^2 =0.881382 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

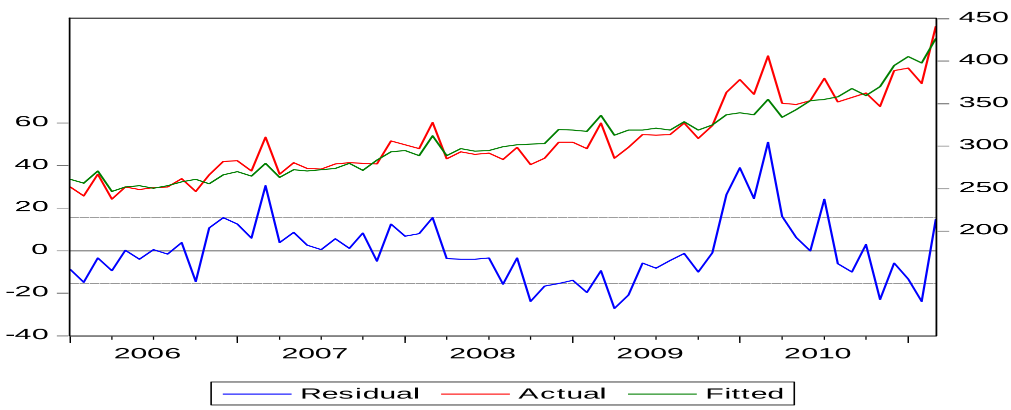

Figure A.3.17 Graph of Actual, fitted and residual values of IIP Manufacturing from Quadratic Multiplicative Model

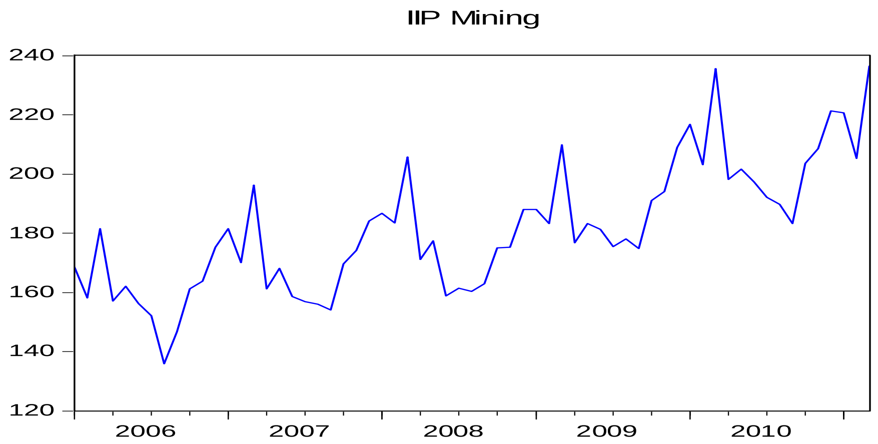

Figure A.3.18 Line graph of IIP MINING

Table A.3.10 Regression Results of Quadratic Multiplicative model of IIP Mining

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	-58.20221	222.5763	-0.261493	0.7946
Time	2.144997	0.901686	2.378875	0.0206
Time^2	0.900527	0.056713	15.87880	0.0000
R^2 = **0.918886** Adjusted R^2 =0.916182				
Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

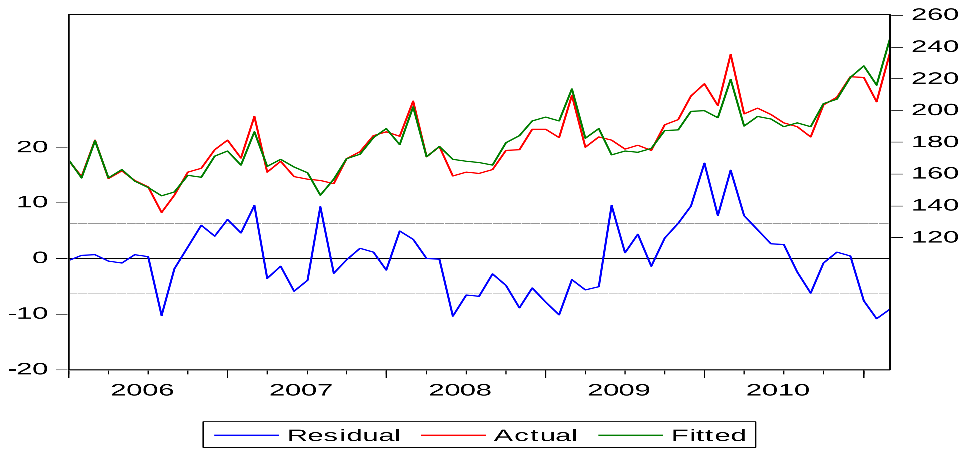

Figure A.3.19 Graph of Actual, fitted and residual values of IIP Mining from Linear Multiplicative Model

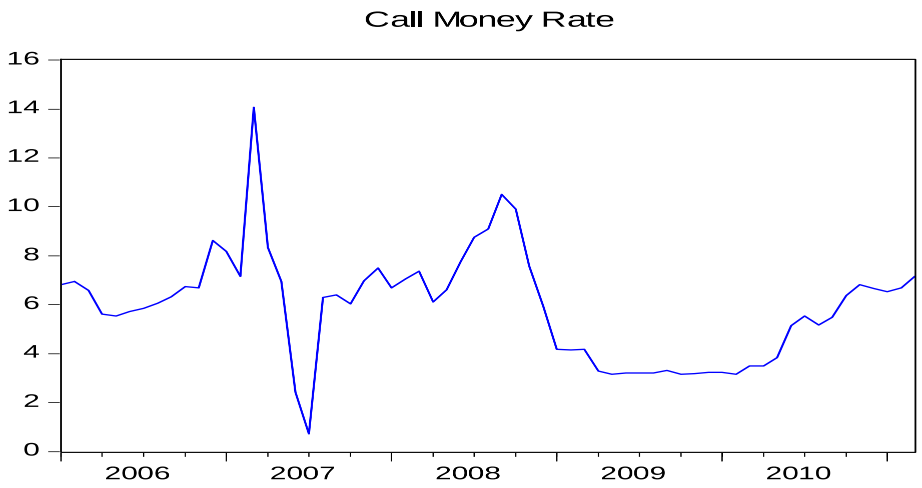

Figure A.3.20 Line graph of Call money rate (CALM)

Table A.3.11 Results of Augmented Dicky Fuller (ADF) Tests for Call money rate

Constraints	MacKinnon (1996) one-sided p-values in Level
Intercept	0.0765
Intercept and Trend	0.0355

** denotes significant at 5 per cent level.

Correlogram of Cal money rate

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |***** |	. |***** |	1	0.726	0.726	34.838	0.000
. |**** |	. | . |	2	0.531	0.008	53.787	0.000
. |*** |	. | . |	3	0.359	-0.062	62.596	0.000
. |*. |	.*| . |	4	0.201	-0.087	65.401	0.000
. |*. |	. |** |	5	0.203	0.217	68.311	0.000
. |*. |	.*| . |	6	0.118	-0.151	69.313	0.000
. |*. |	. | . |	7	0.080	0.016	69.778	0.000
. |*. |	. | . |	8	0.077	0.045	70.216	0.000
. | . |	. | . |	9	0.066	0.054	70.547	0.000
. | . |	.*| . |	10	0.022	-0.165	70.584	0.000
. | . |	. | . |	11	-0.026	-0.004	70.635	0.000
.*| . |	. | . |	12	-0.073	-0.030	71.062	0.000
.*| . |	.*| . |	13	-0.143	-0.113	72.744	0.000
.*| . |	.*| . |	14	-0.179	-0.069	75.413	0.000
**| . |	. | . |	15	-0.211	-0.006	79.219	0.000
.*| . |	. | . |	16	-0.185	0.058	82.206	0.000

Table A.3.12 Regression Results of ARMA (1,0) Model of Call Money Rate

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	5.909913	0.732178	8.071692	0.0000
AR(1)	0.729861	0.088465	8.250240	0.0000
R^2 =**0.531493** Adjusted R^2 =0.523685 Prob(F-statistic) 0.000000				

Correlogram of residuals from ARMA (1,0) Model of Call money rate

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	-0.008	-0.008	0.0039	
. | . |	. | . |	2	0.050	0.050	0.1669	0.683
. | . |	. | . |	3	0.040	0.041	0.2749	0.872
**| . |	**| . |	4	-0.217	-0.220	3.5076	0.320
. |*. |	. |*. |	5	0.170	0.173	5.5282	0.237
. | . |	. | . |	6	-0.050	-0.036	5.7055	0.336
. | . |	. | . |	7	-0.043	-0.046	5.8386	0.442
. | . |	. | . |	8	0.019	-0.036	5.8648	0.556
. | . |	. |*. |	9	0.060	0.157	6.1372	0.632
. | . |	. | . |	10	0.013	-0.046	6.1491	0.725
. | . |	. | . |	11	-0.020	-0.038	6.1794	0.800
. | . |	. | . |	12	0.018	0.030	6.2065	0.859
.*| . |	. | . |	13	-0.077	-0.030	6.6849	0.878
.*| . |	.*| . |	14	-0.083	-0.146	7.2561	0.888
.*| . |	.*| . |	15	-0.107	-0.102	8.2177	0.878
.*| . |	. | . |	16	-0.086	-0.033	8.8519	0.885

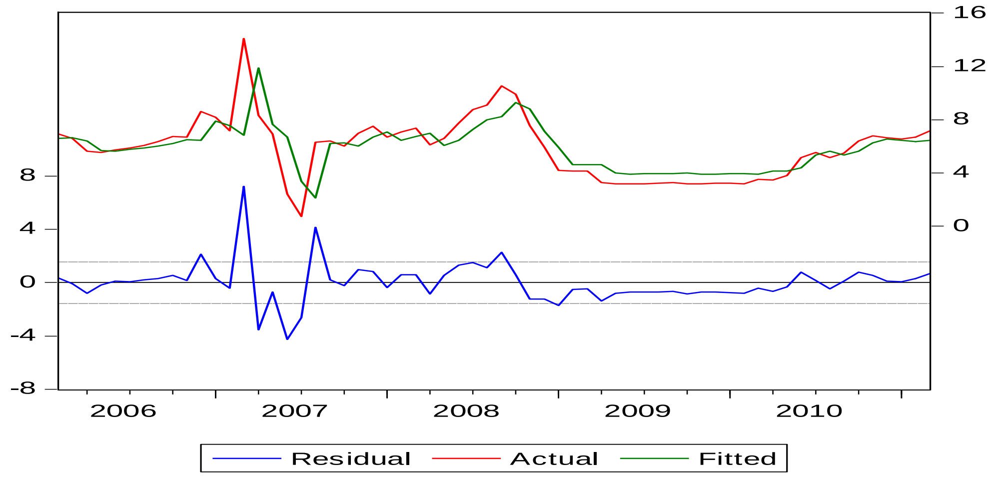

Figure A.3.21 Graph of Actual, fitted and residual values of Call Money Ratefrom ARMA (1,0) Model

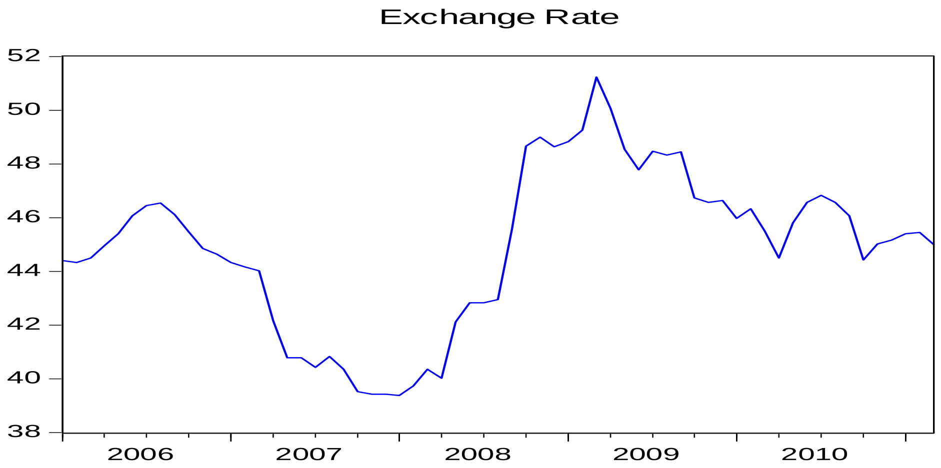

Figure A.3.22 Line graph of Exchange Rate (EXR)

Table A.3.13 Results of Augmented Dicky Fuller (ADF) Tests for Exchange rate

Constraints	MacKinnon (1996) one-sided p-values in Level	MacKinnon (1996) one-sided p-values in First Difference
Intercept	0.5552	0.0027
Intercept and Trend	0.8119	0.0151

* denotes significant at 1 per cent level.

Correlogram of Exchange rate in first difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |** |	. |** |	1	0.309	0.309	6.2160	0.013
. | . |	.*| . |	2	-0.031	-0.140	6.2802	0.043
. | . |	. | . |	3	-0.020	0.039	6.3075	0.098
. |*. |	. |*. |	4	0.179	0.192	8.5014	0.075
. |*** |	. |** |	5	0.368	0.284	17.920	0.003
. |** |	. | . |	6	0.230	0.073	21.670	0.001
.*| . |	**| . |	7	-0.192	-0.287	24.338	0.001
.*| . |	. | . |	8	-0.163	-0.038	26.279	0.001
. | . |	. | . |	9	0.024	-0.029	26.323	0.002
. | . |	.*| . |	10	0.033	-0.153	26.406	0.003
.*| . |	.*| . |	11	-0.098	-0.154	27.148	0.004
**| . |	.*| . |	12	-0.274	-0.119	33.087	0.001
***| . |	.*| . |	13	-0.360	-0.189	43.574	0.000
. | . |	. |*. |	14	-0.026	0.117	43.628	0.000
.*| . |	.*| . |	15	-0.092	-0.181	44.342	0.000
.*| . |	. |*. |	16	-0.077	0.175	44.858	0.000

Table A.3.14 Regression Results of ARIMA (0,1,1) Model of Exchange Rate

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	0.006944	0.149127	0.046562	0.9630
MA(1)	0.351601	0.120990	2.906022	0.0051
R^2 =0.111381 Adjusted R^2 =0.096571 Prob(F-statistic) 0.008029				

Correlogram of residuals from ARIMA (0,1,1) for Exchange rate

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.003	0.003	0.0006	
. | . |	. | . |	2	-0.016	-0.016	0.0178	0.894
. | . |	. | . |	3	-0.051	-0.051	0.1944	0.907
. |*. |	. |*. |	4	0.114	0.114	1.0767	0.783
. |** |	. |** |	5	0.261	0.262	5.8028	0.214
. |** |	. |** |	6	0.225	0.251	9.4026	0.094
**| . |	**| . |	7	-0.229	-0.220	13.190	0.040
.*| . |	.*| . |	8	-0.104	-0.134	13.987	0.051
. | . |	. | . |	9	0.044	-0.007	14.131	0.078
. | . |	.*| . |	10	0.039	-0.101	14.248	0.114
.*| . |	.*| . |	11	-0.071	-0.186	14.639	0.146
.*| . |	.*| . |	12	-0.138	-0.080	16.141	0.136
***| . |	**| . |	13	-0.356	-0.264	26.382	0.009
. |*. |	. |*. |	14	0.130	0.117	27.784	0.010
.*| . |	.*| . |	15	-0.147	-0.191	29.605	0.009
. | . |	. |*. |	16	0.051	0.164	29.826	0.013

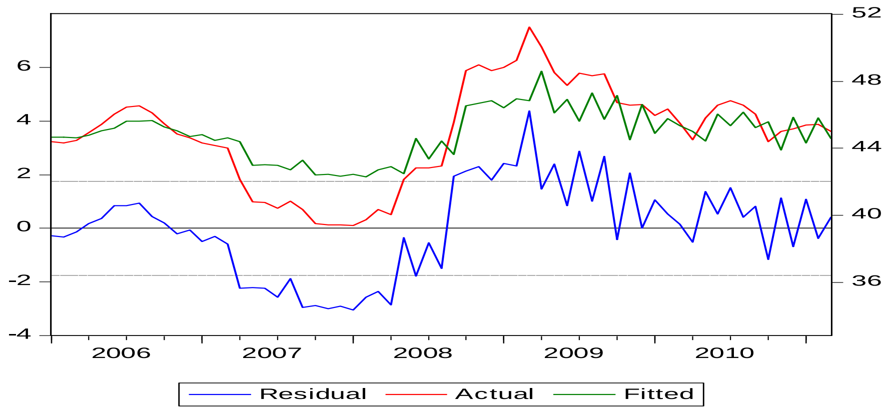

Figure A.3.23 Graph of Actual, fitted and residual values of Exchange Rate from ARIMA (0,1,1) Model

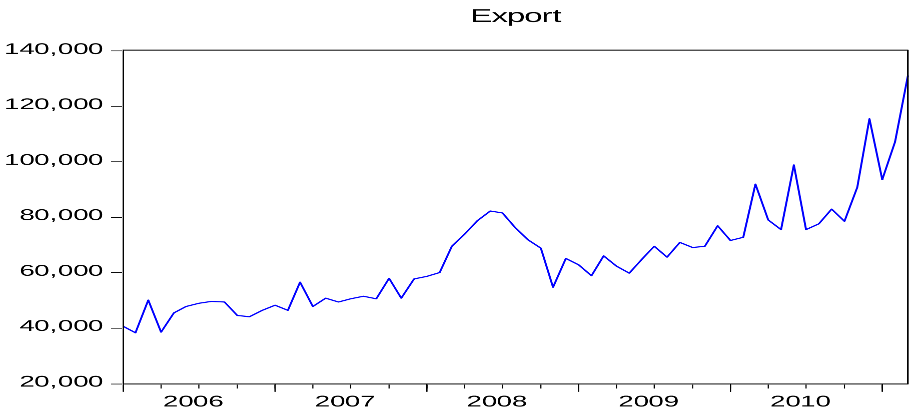

Figure A.3.24 Line graph of Export (EXP)

Table A.3.15 Regression Results of Quadratic Multiplicative model of Export

Variables	**Coefficient**	**Standard error**	**t – statistics**	**P –value**
Constant	43606.47	8804.097	4.952974	0.0000
Time	-14.17569	430.9066	-0.032897	0.9739
Time^2	10.06731	4.732346	2.127341	0.0376
AR(12)	0.019940	0.181059	0.110130	0.9127
R^2 = **0.750833** Adjusted R^2 =0.738164 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

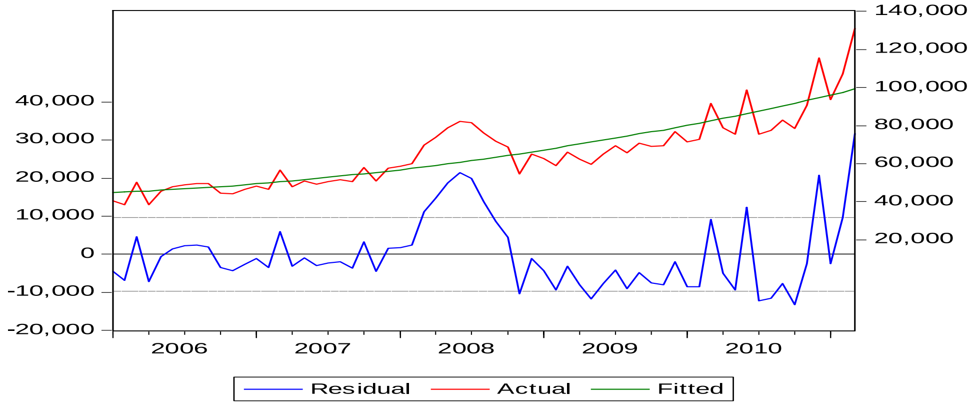

Figure A.3.25 Graph of Actual, fitted and residual values of Export from Quadratic Multiplicative Model

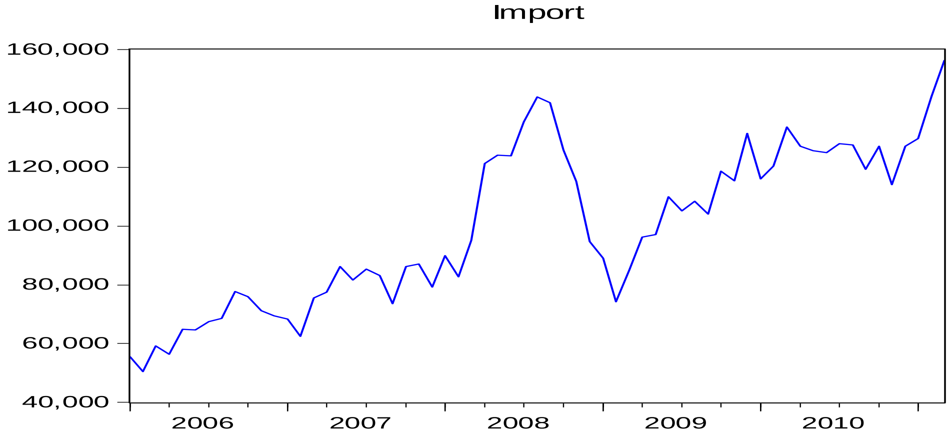

Figure A.3.26 Line graph of Import (IMP)

Table A.3.16 Regression Results of Quadratic model of Import

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	29467.38	9054.361	3.254496	0.0019
Time	2103.162	473.5243	4.441508	0.0000
$Time^2$	-9.827887	5.446137	-1.804561	0.0762
AR(12)	-0.123285	0.124564	-0.989732	0.3263
R^2 = **0.732700** Adjusted R^2 =0.719109 Prob(F-statistic) 0.000000				

* denotes significant at 1 per cent level.

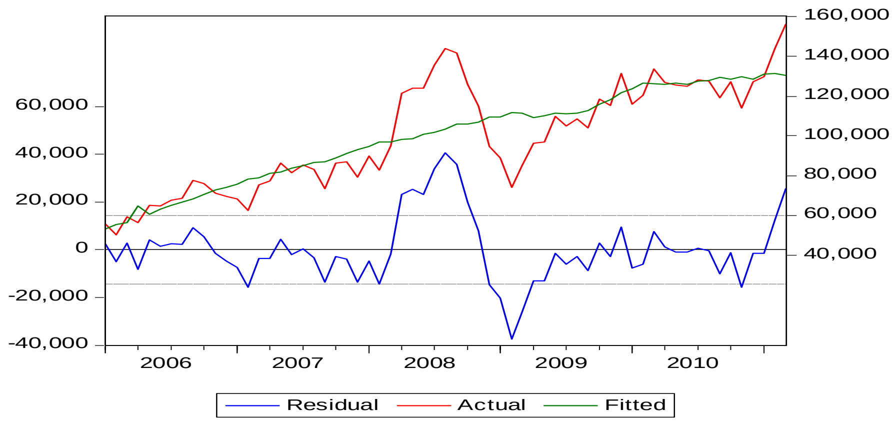

Figure A.3.27 Graph of Actual, fitted and residual values of Import from Quadratic Multiplicative Model

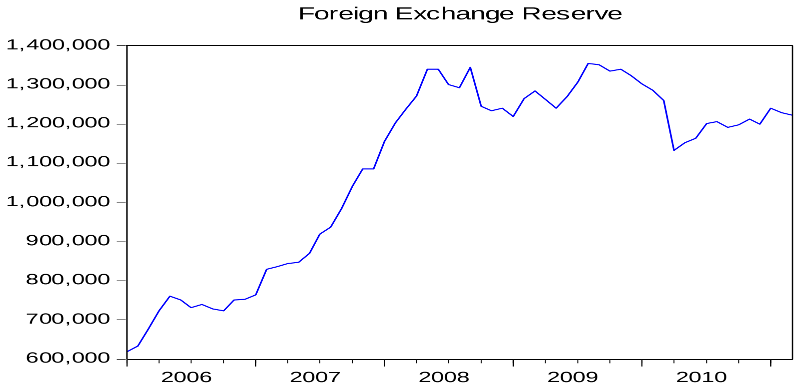

Figure A.3.27 Line graph of Foreign Exchange Reserve (FORX)

Table A.3.17 Results of Augmented Dicky Fuller (ADF) Tests for Foreign Exchange Reserve

Constraints	MacKinnon (1996) one-sided p-values in Level	MacKinnon (1996) one-sided p-values in First Difference
Intercept	0.3470	0.0456
Intercept and Trend	0.9453	0.0179

* denotes significant at 1 per cent level.

Correlogram of Foreign Exchange Reserve in first difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
***| . |	***| . |	1	-0.424	-0.424	11.522	0.001
.*| . |	***| . |	2	-0.139	-0.388	12.772	0.002
. |*. |	.*| . |	3	0.112	-0.193	13.598	0.004
. | . |	.*| . |	4	0.011	-0.099	13.606	0.009
.*| . |	**| . |	5	-0.131	-0.211	14.791	0.011
. |*. |	. | . |	6	0.144	-0.037	16.229	0.013
. | . |	. | . |	7	-0.009	-0.003	16.235	0.023
. | . |	. | . |	8	-0.009	0.070	16.241	0.039
.*| . |	.*| . |	9	-0.176	-0.204	18.530	0.030
. | . |	**| . |	10	0.039	-0.286	18.643	0.045
. |*. |	. | . |	11	0.204	-0.004	21.844	0.026
.*| . |	. | . |	12	-0.087	0.037	22.437	0.033
.*| . |	.*| . |	13	-0.118	-0.098	23.559	0.035
. | . |	**| . |	14	0.021	-0.266	23.596	0.051
. |*. |	.*| . |	15	0.107	-0.073	24.555	0.056
.*| . |	.*| . |	16	-0.131	-0.115	26.016	0.054

Table A.3.18 Regression Results of from ARIMA (1,1,1) for Foreign exchange reserve

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	7710.956	7574.744	1.017982	0.3129
AR(1)	0.752826	0.273171	2.755877	0.0078
MA(1)	-0.601179	0.335008	-1.794522	0.0779
R^2 = 0.069546 Adjusted R^2 =0.037462 Prob(F-statistic) 0.123637				

* denotes significant at 1 per

Correlogram of residuals from ARIMA (1,1,1) for Foreign exchange reserve

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.016	0.016	0.0167	
.*| . |	.*| . |	2	-0.079	-0.079	0.4220	
. |*. |	. |*. |	3	0.104	0.107	1.1394	0.286
. | . |	. | . |	4	0.036	0.025	1.2252	0.542
. | . |	. | . |	5	-0.057	-0.043	1.4514	0.694
. |*. |	. |*. |	6	0.117	0.115	2.4003	0.663
. | . |	. | . |	7	-0.009	-0.030	2.4060	0.791
.*| . |	.*| . |	8	-0.115	-0.090	3.3566	0.763
**| . |	**| . |	9	-0.208	-0.233	6.5520	0.477
. | . |	. | . |	10	0.028	0.015	6.6090	0.579
. |*. |	. |*. |	11	0.188	0.208	9.3259	0.408
.*| . |	. | . |	12	-0.073	-0.043	9.7462	0.463
.*| . |	.*| . |	13	-0.153	-0.144	11.622	0.393
. | . |	. | . |	14	-0.006	-0.058	11.625	0.476
. |*. |	. |*. |	15	0.090	0.161	12.305	0.503
. | . |	. | . |	16	-0.025	0.008	12.357	0.578

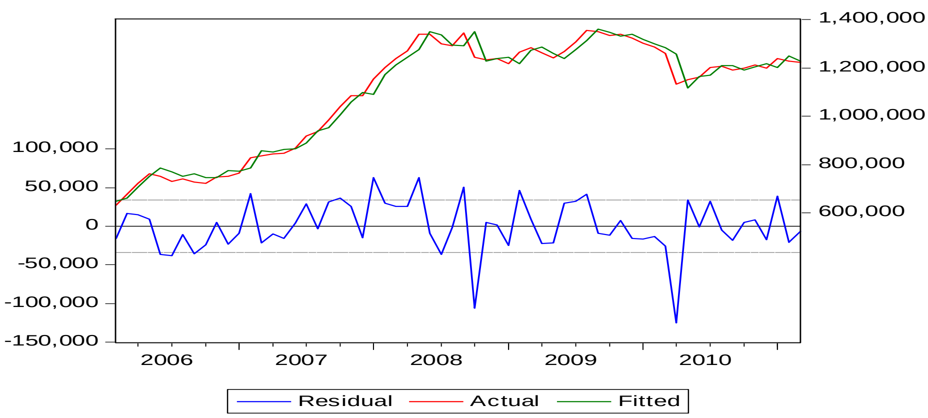

Figure A.3.28 Graph of Actual, fitted and residual values of Foreign exchange reserve from ARIMA (1,1,1)

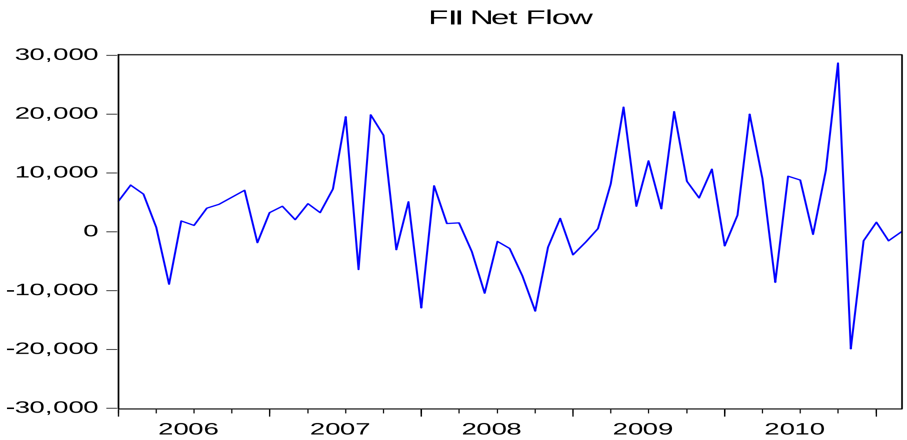

Figure A.3.29 Line graph of FII Net flow (FII)

Table A.3.19 Results of Augmented Dicky Fuller (ADF) Tests for Exchange rate

Constraints	MacKinnon (1996) one-sided p-values in Level
Intercept	0.0287
Intercept and Trend	.1051

** denotes significant at 5 per cent level

Correlogram of FII in level

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.060	0.060	0.2403	0.624
. | . |	. | . |	2	0.055	0.051	0.4413	0.802
. |** |	. |** |	3	0.258	0.253	4.9772	0.173
. |*. |	. | . |	4	0.081	0.056	5.4318	0.246
. | . |	. | . |	5	0.061	0.035	5.6961	0.337
. |*. |	. | . |	6	0.075	0.002	6.1019	0.412
. | . |	. | . |	7	0.065	0.027	6.4138	0.492
.*| . |	**| . |	8	-0.182	-0.232	8.8717	0.353
.*| . |	.*| . |	9	-0.081	-0.110	9.3719	0.404
. | . |	. | . |	10	0.047	0.037	9.5454	0.481
.*| . |	.*| . |	11	-0.194	-0.113	12.497	0.327
.*| . |	.*| . |	12	-0.177	-0.125	14.999	0.241
.*| . |	. | . |	13	-0.086	-0.064	15.604	0.271
**| . |	.*| . |	14	-0.216	-0.127	19.507	0.146
.*| . |	. | . |	15	-0.115	-0.001	20.632	0.149
**| . |	**| . |	16	-0.229	-0.218	25.216	0.066

Table A.3.20 Regression Results of ARMA (0,1) Model of FII

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	3345.557	1215.883	2.751546	0.0078
MA(1)	0.060487	0.128975	0.468985	0.6408
R^2 = 0.003652 Adjusted R^2 = -0.012953 Prob(F-statistic) 0.640780				

Correlogram of Residuals for FII from ARMA (0,1) model

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.001	0.001	0.0001	
. | . |	. | . |	2	0.041	0.041	0.1105	0.740
. |** |	. |** |	3	0.252	0.252	4.4444	0.108
. | . |	. | . |	4	0.064	0.068	4.7265	0.193
. | . |	. | . |	5	0.055	0.039	4.9374	0.294
. | . |	. | . |	6	0.067	0.001	5.2609	0.385
. | . |	. | . |	7	0.072	0.040	5.6353	0.465
.*| . |	**| . |	8	-0.181	-0.224	8.0852	0.325
.*| . |	.*| . |	9	-0.075	-0.125	8.5078	0.385
. | . |	. | . |	10	0.062	0.037	8.8052	0.455
.*| . |	.*| . |	11	-0.188	-0.103	11.574	0.315
.*| . |	.*| . |	12	-0.162	-0.127	13.691	0.251
.*| . |	. | . |	13	-0.066	-0.063	14.043	0.298
**| . |	.*| . |	14	-0.207	-0.131	17.634	0.172
.*| . |	. | . |	15	-0.090	0.004	18.330	0.192
**| . |	**| . |	16	-0.222	-0.218	22.619	0.093

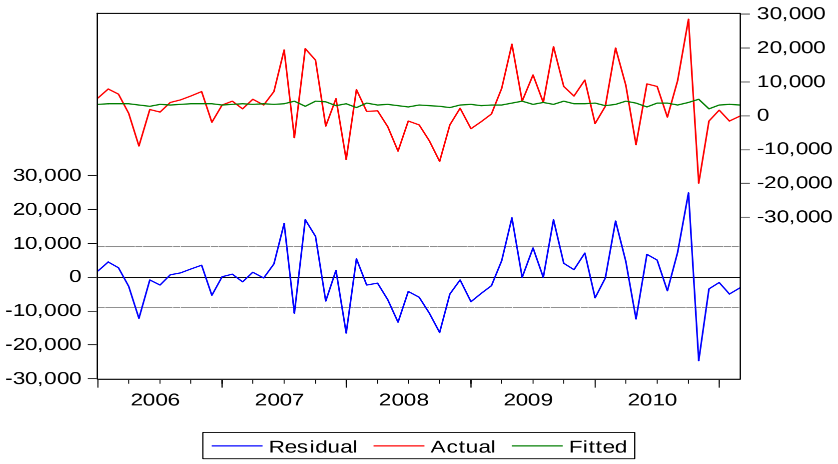

Figure A.3.30 Graph of Actual, fitted and residual values of FII from ARMA (0,1) Model

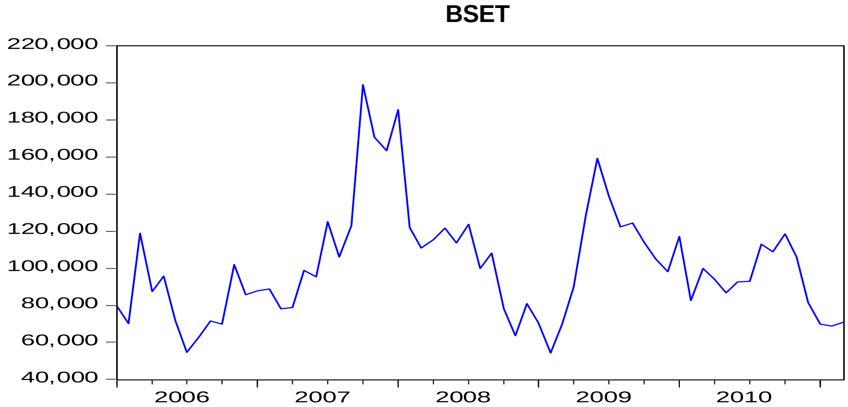

Figure A.3.31 Line graph of BSET

Table A.3.21 Results of Augmented Dicky Fuller (ADF) Tests for BSET

Constraints	MacKinnon (1996) one-sided p-values in Level	MacKinnon (1996) one-sided p-values in First difference
Intercept	0.1153	0.3480
Intercept and Trend	0.0028	0.0028

** denotes significant at 5 per cent level

Correlogram of BSET in level

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.*| . |	.*| . |	1	-0.181	-0.181	2.1223	0.145
. | . |	. | . |	2	-0.015	-0.049	2.1366	0.344
. |*. |	. |*. |	3	0.165	0.158	3.9586	0.266
**| . |	**| . |	4	-0.284	-0.240	9.4670	0.050
.*| . |	.*| . |	5	-0.096	-0.196	10.103	0.072
. |*. |	. | . |	6	0.108	0.037	10.925	0.091
.*| . |	.*| . |	7	-0.193	-0.111	13.625	0.058
. |*. |	. | . |	8	0.135	0.056	14.955	0.060
. | . |	.*| . |	9	-0.039	-0.119	15.070	0.089
.*| . |	.*| . |	10	-0.128	-0.124	16.314	0.091
. |*. |	. |*. |	11	0.175	0.075	18.708	0.067
. | . |	. | . |	12	-0.044	0.009	18.863	0.092
.*| . |	.*| . |	13	-0.154	-0.163	20.771	0.078
. |*. |	. | . |	14	0.181	0.001	23.487	0.053
**| . |	**| . |	15	-0.267	-0.224	29.525	0.014
. | . |	.*| . |	16	-0.022	-0.075	29.568	0.020

Table A.3.22 Regression Results of ARIMA (2,1,2) Model of BSET

Variables	Coefficient	Standard error	t – statistics	P –value
Constant	-427.5458	1637.956	-0.261024	0.7951
AR(1)	0.251583	0.147874	1.701341	0.0947
AR(2)	0.270760	0.142450	1.900737	0.0628
AR(3)	-0.024620	0.138697	-0.177512	0.8598
MA(1)	-0.545022	0.219868	-2.478862	0.0164
MA(2)	-0.791148	0.163915	-4.826562	0.0000
R^2 = 0.325151 Adjusted R^2 =0.261486 Prob(F-statistic) 0.000000				

Correlogram of residuals from ARIMA (3,1,2) Model of BSET

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
**| . |	**| . |	1	-0.210	-0.210	2.7468	
. |*. |	. | . |	2	0.106	0.065	3.4577	
. |*. |	. |** |	3	0.187	0.232	5.6950	
.*| . |	.*| . |	4	-0.189	-0.125	8.0325	
.*| . |	**| . |	5	-0.085	-0.215	8.5105	
. |*. |	. | . |	6	0.111	0.064	9.3473	0.002
.*| . |	. | . |	7	-0.191	-0.054	11.860	0.003
. | . |	. | . |	8	0.073	0.028	12.237	0.007
. | . |	. | . |	9	-0.019	-0.054	12.262	0.016
.*| . |	.*| . |	10	-0.151	-0.142	13.944	0.016
. |*. |	. |*. |	11	0.138	0.077	15.362	0.018
. | . |	. | . |	12	-0.035	0.040	15.458	0.031
.*| . |	.*| . |	13	-0.184	-0.188	18.107	0.020
. |*. |	. | . |	14	0.177	0.005	20.620	0.014
**| . |	**| . |	15	-0.277	-0.214	26.912	0.003
. | . |	. | . |	16	-0.013	-0.038	26.927	0.005

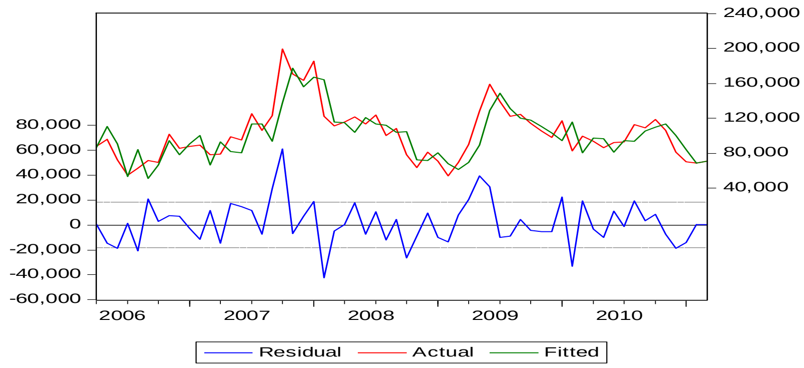

Figure A.3.32 Graph of Actual, fitted and residual values of BSET from ARIMA (3,1,2) Model

Appendix -4

Name of Companies

Aditya Birla Nuvo Ltd

Aegis Logistics

Ago Tech Foods

Alok Industries

Ambuja Cements

Amtek Auto Ltd

Andhra Pradesh Paper Mills

Apar Industries

Appolo Hospitals

Appolo Tyres

Aravind Mills

Ashok Leyland

Associate Cement Companies Ltd

Astrazeneca Pharma

Atlas Cop co

Bajaj Hindustan

Bajaj Holding And Investments Ltd

Balakrishna Industries

Balarampur Chini Mills

Ballarpur Industries

Bank of Maharashtra.

Bharti Airtel

Bharth Forge

BHEL

BASF

Berger Paints.

Bharti Shipyard

Blue Star
Bombay Burma Trading Corporation
Bombay Dyeing And Manufacturing Company Ltd
Britannia Industries
Bhushan Steel
Caprihans India Ltd
Castrol India Ltd
Ceat Tyres India Ltd
Century Textiles
Chemplast Sanmar
Cipla Ltd
Classic Diamond India Ltd
CMC Ltd
Colgate Palmolive India Ltd
Coromandel International
Crompton Greaves
Deccan Chronicle
Deepak Fertilizers And Petrochemicals Ltd
Dr. Reddies Lab
Dynamatic Technology
Eicher Motors
Eid Parry
EIH Ltd
Elentas Beck India Ltd
Elgi Equipments
Emami Ltd
Esab India
Escorts Ltd
Essar Shipping and Ports
Fag Bearings India Ltd

Federal Mogul Goetz

Federal Bank Ltd

Fkonco

Force Motors

Garware Plastics And Polyester Ltd

Geojit BNP Paribas Ltd

GIC Housing Finance

Glaxo Smithkline Pharmaceuticals

Godrej Industries

Goodyear India Ltd

Goa Carbon Black

Govind Rubber

Grasim Industries

Greaves Cotton

GTL Ltd

Gujarat Narmada

Gulf Oil Corporation

HBL Power Systems

HCL Technologies

HDFC Ltd

Heidelberg Cements

Hero Honda

Hindustan Motors Ltd

Hindustan Petroleum

India Cements

Indian Hotel Industries Ltd

Indian Organics Ltd

Indian Telephone Industries

Indian Tobacco Company Ltd

Industrial Development Bank of India

INEOS ABS India Ltd

Infosys

J K Lakshmi Cements

JBF Industries

Jindal Drilling Industries

Jubiliant Life Sciences

Jyothi structures

Kirlosker Brothers

Kirlosker Pneumatic Company

KSB Pumbs

Larsen and Toubro Ltd

Madras Cements

Mahanagar Telecom Nigam Ltd

Maharashtra Seamless

Mahindra and Mahindra Ltd

Maruti Suzuki

Mukund Iron Ltd

Nalwa Sons

Natco Pharma

National Thermal Power Corporation

Nestle India Ltd

NIIT Ltd

OCL India Ltd

Oil and Natural Gas Commission

Orient Paper And Industries

Oriental Hotels

Pfizer Ltd

Philips Carbon Black

Philips India Ltd

Premier Autos

Proctor And Gamble

Ranbaxy Laboratories

Raymond Woolen Mills Ltd

Reliance Communications

Reliance Industrial Infrastructure Ltd

Reliance Industries Ltd

Reliance MediaWorks

Sarda Energy And Minerals

Sesa Goa

Siemens Ltd

SKF India Ltd

SML Isuzu

SPML Infra

SREI Infrastructure Finance

State Bank of India Ltd

Steel Authority of India

Sterlite Industries

Sun Pharmaceuticals

Supreme Industries

Supreme Petrochemicals

Swaraj Engines

Tata Chemicals Ltd

Tata Consultancy Services

TRF

VIP Industries

VST Industries

Walchandnager Industries

Wipro

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