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ARBITRAGE PRICING THEORY TESTED IN INDIAN STOCK MARKET

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ABSTRACT

In this paper Arbitrage pricing theory are tested in Indian stock market. Two steps used in this study are time series regression and multiple regression analysis (Stepwise estimation). This study supports the applicability of Arbitrage Pricing Theory in Indian Stock Market. There is more than one factor which influences the security returns, instead of one as indicated by CAPM. In different years, different factors influence rate of return of securities and portfolios. In 1998-99 S&P CNX Nifty, in 1999-00 all factors, in 2000-01 S&P CNX Nifty, in 2001-02 S&P CNX Nifty and IIP, in 2002-03 IIP, S&P CNX Nifty, GDP and PLR, in 2003-04 GDP, IIP and PLR, in 2004-05 S&P CNX Nifty, IIP and WPI, in 2005-06 WPI, PLR, S&P CNX Nifty and IIP, in 2006-07 S&P CNX Nifty and in 2007-08 S&P CNX Nifty and PLR are affecting on returns of securities listed in NSE. But for portfolios in 1998-99 S&P CNX Nifty, in 1999-00 S&P CNX Nifty, GDP, IIP and WPI, in 2000-01 S&P CNX Nifty, IIP and WPI, in 2001-02 all factors, in 2002-03 IIP, S&P CNX Nifty and GDP, in 2003-04 S&P CNX Nifty GDP, WPI and PLR, in 2004-05 no factors, in 2005-06 WPI, PLR, S&P CNX Nifty and IIP, in 2006-07 S&P CNX Nifty and PLR and in 2007-08 S&P CNX Nifty, GDP and PLR factors affect the stock price. These studies recommend the investors to analyze all factors for investing rather than one factor.

KEYWORDS

arbitrage pricing theory, stock market.

INTRODUCTION

Financial asset pricing models are usually divided over two fundamental issues. They are respectively what constitutes and how risk affects security returns. While the CAPM is a simple model that is based on sound reasoning, some of the assumptions that underlie the model are unrealistic. Some extensions of the basic CAPM were proposed that relaxed one or more of these assumptions. Instead of simply extending an existing theory, Ross (1976) addresses this concern by developing a completely different model: the Arbitrage Pricing Theory (APT). Unlike the CAPM, which is a model of financial market equilibrium, the APT starts with the premise that arbitrage opportunities should not be present in efficient financial markets. This assumption is much less restrictive than those required to derive the CAPM.

For instance, the CAPM model was structured on the belief that relevant risk measure is related to just one aspect of the macro economy such as security's return is a function of return on a market index. However, in attempting to accurately estimate expected return, variance and covariance for securities, multiple-factor model are potentially more useful than the CAPM. The health of the economy affects most companies. Thus change in expectations concerning the future of the economy will generally have profound effects on the returns of most securities. Given the belief that there is more than one factor, a goal of security analysis is to identify these factors in the economy and the sensitivities of security returns to movement in these factors. APT holds that the expected return of a financial asset can be modeled as a linear function of various macro-economic factors or theoretical market indices, where sensitivity to changes in each factor is represented by a factor-specific beta coefficient. The model-derived rate of return will then be used to price the asset correctly - the asset price should equal the expected end of period price discounted at the rate implied by model. If the price diverges, arbitrage should bring it back into line.

The theory does not specify how large the number is, nor does it identify the factors. It simply assumes that these n factors cause returns to vary together. There may be other, firm-specific reasons for returns to differ from their expected values, but these firm-specific deviations are not related across stocks. Since the firm-specific deviations are not related to one another, all return variation not related to the n common factors can be diversified away. Based on these assumptions, Ross shows that, in order to prevent arbitrage, an asset's expected return must be a linear function of its sensitivity to the n common factors. Thus the returns for any asset i are assumed to be generated as:

$$R_i = E(R_i) + \beta_{i1}F_1 + \beta_{i2}F_2 + \dots + \beta_{in}F_n + e_i$$

where:

$E(R_i)$ is the risky asset's expected return;

RP_k is the risk premium of the factor;

R_f is the risk free rate;

P_k is the macroeconomic factor;

β_{ik} is the sensitivity of the asset to factor k , also called factor loading; and

e_i is the risky asset's idiosyncratic random shock with mean zero.

A major turning point in empirical tests of the CAPM was the devastating Roll (1977) critique. Previous tests of the CAPM examine the relationship between equity returns and beta measured relative to a broad equity market index such as the S&P500. However, Roll demonstrates that the market, as defined in the theoretical CAPM, is not a single equity market, but an index of all wealth. The market index must include bonds, property, foreign assets, human capital and anything else, tangible or intangible that adds to the wealth of mankind. Roll points out that "the portfolio used by Black, Jensen and Scholes was certainly not the true portfolio". Moreover, Roll shows that unless these market portfolios were known with certainty then the CAPM never could be tested. Finally, Roll argues that tests of the CAPM are at best tests of the mean-variance efficiency of the portfolio that is taken as the market proxy. But within any sample, there will always be a portfolio that is mean-variance efficient; hence finding evidence against the efficiency of a given portfolio tells us nothing about whether or not the CAPM is correct. Vipul and Gianchandani (1997) investigate the relevance of Arbitrage Pricing Theory (APT) in the Indian context. Five macroeconomic variable namely wholesale price index, dollar- rupee conversion rate, call money rate, price of gold and BSE national index have been selected to represent factors. A two stage regression analysis indicates that the market 'value' national index (NI) and dollar rupee conversion rate (FEDA1) in determining the prices of the scrip in Multiple index Model (MIM). However, after second stage none of the risk premium is found to be significant, indicating that none of the variables is valued by the market as predicted by APT. Focusing on asset returns governed by a facture structure, the APT is a one-period model, in which preclusion of arbitrage over static portfolios of these assets leads to a linear relation between the expected return and its covariance with the factors. The APT, however, does not preclude arbitrage over dynamic portfolios. Consequently, applying the model to evaluate managed portfolios contradicts the no- arbitrage spirit of the

model. Huberman and Wang (2005) conclude that an empirical test of the APT entails a procedure to identify features of the underlying factor structure rather than merely a collection of mean-variance efficient factor portfolios that satisfies the linear relation.

The APT differs from the CAPM in that it is less restrictive in its assumptions. It assumes that each investor will hold a unique portfolio with its own particular array of betas, as opposed to the identical "market portfolio". In some ways, the CAPM can be considered a "special case" of the APT in that the securities market line represents a single-factor model of the asset price, where beta is exposed to changes in value of the market.

DATA

The core object of this study is to test the APT in Indian stock market. For this purpose, daily data of 291 companies are collected. The daily price is computed by taking average of highest and lowest price in a day. Daily changes in value are worked out for five macroeconomic factors GDP, PLR, WPI, IIP and NSE for period April 1998 to March 2008. The data are collected from RBI Bulletin, RBI Annual report and NSE website nseindia.com.

MACROECONOMIC VARIABLES

However, APT does not specify as to what these factors could be. The following macroeconomic variables are selected for the purpose of the study:

- The growth rate of gross domestic product (GDP).
- The level of interest rates on short-term treasury securities such as prime lending rate (PLR).
- The wholesale price index for inflation rate (WPI).
- The index of industrial production (IIP).
- The S&P CNX Nifty (NSE).

Gross domestic production and index of industrial production are associated with aggregate economic activity. It is often assumed that these factors have positive effect on return of securities. So, both factors are considered for testing the APT. Almost all studies on APT considered price as one of the factor. Therefore, it is assumed that increase in price level leads to fall in demand, which results the fall in stock prices i.e. stock price index levels are related negatively. Interest rates are also included in various studies related to APT. In this study prime lending rate are to be used. It is assumed that there is negative relation between interest rate and stock prices.

PORTFOLIO CREATION

In 1997-98, the values of return are arranged in descending order for making portfolios. A portfolio of five securities has been made with equal weight; subsequent portfolios are made with leaving the highest return security and adding the next lowest return security. In portfolios the numbers of securities are remained same for rest of time period. The returns of 286 portfolios are measured with averaging the returns of five securities under one year gap.

METHODOLOGY

Following steps and methods are applied for this study:

- **Average share price** of each company is obtained as:

$$\text{Share price} = \frac{P_H + P_L}{2}$$

where:

P_H = Highest market price during the day; and

P_L = Lowest market price during the day.

- The **daily return** of the S&P CNX Nifty and companies are calculated as:

$$R_t = \frac{(P_t - P_{t-1}) * 100}{P_{t-1}}$$

where:

R_t is the rate of return for the period t ; and

P_t and P_{t-1} are the price of two successive periods t and $t - 1$.

- Thus, time series regressions are used to estimate beta under different time gaps for different factors with securities and portfolios.

$$R_i = \alpha_i + \beta_i R_m + \epsilon_i$$

where:

R_i is the expected return on portfolio;

α_i is intercept on y - axis;

β_i is the slope of a straight line;

R_m is expected market return; and

ϵ_i is random error term with mean zero.

- **Partial correlation** measures the degree of association between two random variables, which the effect of a set of controlling random variables removed. The partial correlation between X and Y given a set of n controlling variables Z , written $pxy.z$, is the correlation between the residuals R_x and R_y resulting from the linear regression of x with z and of y with z . For solving the linear regression problem amounts to finding:

$$w_x^* = \underset{w}{\operatorname{argmin}} \left\{ \sum_{i=1}^N (x_i - (w, z_i))^2 \right\}$$

$$w_y^* = \underset{w}{\operatorname{argmin}} \left\{ \sum_{i=1}^N (y_i - (w, z_i))^2 \right\}$$

With N being the number of samples and (v, w) the scalar product between the vectors v and w . the residuals are then

$$r_{x,i} = x_i - (w_x^*, z_i)$$

$$r_{y,i} = y_i - (w_y^*, z_i)$$

And the partial correlation is:

$$\hat{p}_{xy.z} = \frac{N \sum_{i=1}^N r_{x,i} r_{y,i} - \sum_{i=1}^N r_{x,i} \sum_{i=1}^N r_{y,i}}{\sqrt{N \sum_{i=1}^N r_{x,i}^2 - (\sum_{i=1}^N r_{x,i})^2} \sqrt{N \sum_{i=1}^N r_{y,i}^2 - (\sum_{i=1}^N r_{y,i})^2}}$$

- **Independent t test** is tested whether mean differences of different factors are significant or not. To carry out the test, it calculates the statistic as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S} * \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

$$S = \sqrt{\frac{\sum (X_1 - \bar{X}_1)^2 + \sum (X_2 - \bar{X}_2)^2}{n_1 + n_2 - 2}}$$

where:

\bar{X}_1 is the mean of first sample;

\bar{X}_2 is the mean of second sample;

n_1 is the number of observations in the first sample;

n_2 is the number of observations in the second sample; and

S is the combined standard deviation.

- **Multiple regression** analysis is a statistical technique that can be used to analyze the relationship between a single dependent variable and several independent variables. The object of multiple regression analysis is to use the independent variable whose values are known to predict the single dependent value. The generalized equation is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \dots + \beta_n X_n + \varepsilon$$

where:

β_0 = a constant, the value of Y when all X values are zero;

β_1 = the slope of the regression surface; and

ε = an error term, normally distributed about a mean of 0.

- **Stepwise estimation** is used for selecting variables for inclusion in the regression model that starts by selecting the best predictor of the dependent variable. Additional independent variables are selected in terms of the incremental explanatory power. Independent variables are added as long as their partial correlation coefficients are statistically significant. Independent variables may also be dropped if their predictive power drops to a no significant level when another independent variable added to the model. This method is also helpful in identifying collinearity is an examination of the correlation matrix for the independent variables. The two most common measures for assessing both pair wise and multiple variables collinearity are tolerance and its inverse, the variance inflation factor. A direct measure of multicollinearity is tolerance, which is defined as the amount of variability of the selected independent variable not explained by the other independent variables. The tolerance value should be high, which means a small degree of multicollinearity. A second measure of multicollinearity is the variance inflation factor (VIF), which is calculated simply as the inverse of the tolerance value. Thus, instances of higher degrees of multicollinearity are reflected in lower tolerance values and higher VIF values.

EMPIRICAL FINDINGS

Appendix-I presents the value of factors for different time periods. Multiple steps are involved in case of empirical testing on APT. In first step, daily changes in different factors are identified. Thereafter, time series regressions are run for each stock and portfolios to estimates the beta with various factors. In this case return on securities or portfolios are taken as dependent variable. After the time series regression, a second pass cross sectional regression is used to measure the relation between average rate of returns and factor betas from individual securities and portfolios.

Thus, the series regression runs 14335 times and 14300 times for estimating the beta related to different factors in case of securities and portfolios. After the time series regression, multiple regression analysis is used. In first step the partial correlation is calculated. Partial correlation coefficient is the correlation of an independent and dependent variable when the effects of other independent variables have been removed. Partial correlations are shown in appendix- II for securities and portfolios. Then stepwise estimation are used, it maximize the incremental explained factor at each step. In this estimation, p value is identified against the t statistic. P value of different factors are depicts in appendix-III for securities and portfolios from 1998-99 to 2007-08. It is helpful to determine the factor added in the equation. In each step, add the factor in equation which has highest partial correlation and whose t value is statistically significant.

It can be seen from appendix- IV and appendix- V that in each step R^2 and adjusted R^2 are increased with increasing number of factors in the equation. However standard error decreases and multicollinearity becomes minimum. In different years different factors influence the rate of return of securities and portfolios. These factors are shown in appendix- IV for securities. It can be seen from appendix- IV that S&P CNX Nifty has effect on all the years, index of industrial production has also effect on all the years except 2000-01, 2006-07 and 2007-08. However, prime lending rate affects return of securities in 1999-00, 2002-03, 2003-04, 2005-06 and 2007-08. Gross domestic production affected the returns only in 1999-00, 2002-03, and 2003-04.

Factors effect on portfolios are depicts in appendix- V which shows that in 2004-05 the returns of companies does not affected by any factors, remaining years influenced by S&P CNX Nifty . Hence, 1999-00, 2001-02, 2002-03, 2003-04 and 2007-08 are affected by gross domestic production. The effect of prime lending rate is visible after year 2002-03 (except in 2004-05). The wholesale price index influences the prices only in 2000-01, 2001-02, 2003-04 and 2005-06. Also, in 2000-01, 2001-02, 2002-03 and 2005-06 prices are affected by index of industrial production. However, factors seemed to be significant after completing different stages. It reveals that many factors influence the prices of securities and portfolios, so results interpret that Arbitrage pricing theory is suitable for Indian stock market.

CONCLUSION

A large amount of work has been done on Arbitrage pricing theory. Although most of the researchers favor this theory, some have rejected the applicability of this theory. It may be because of factors like less number of securities included, short time period selected, less number of risk factors selected etc. Present study overcomes all these limitation. For testing the Arbitrage pricing theory, five factors are chosen such as Gross Domestic Production, Index of industrial Production, Prime Lending Rate and Wholesale Price Index. This study supports the applicability of Arbitrage Pricing Theory in Indian Stock Market. There is more than one factor which influences the security returns.

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APPENDIX

APPENDIX-I: FACTOR AFFECTING STOCK PRICES

Years	GDP (Rs in Crores)	% Change in GDP	Per Day Change in GDP	IIP	% Change in IIP	Per Day Change in IIP	WPI	% Change in WPI	Per Day Change in WPI	PLR	% Change in PLR	Per Day Change in PLR
1997-98	1012816			139			133			14.00		
1998-99	1081834	6.814	0.0187	144	3.810	0.0104	141	5.949	0.0163	12.50	-10.714	-0.0294
1999-00	1151991	6.485	0.0178	156	8.172	0.0224	145	3.269	0.0090	12.25	-2.000	-0.0055
2000-01	1193922	3.640	0.0100	163	4.161	0.0114	156	7.158	0.0196	11.50	-6.122	-0.0168
2001-02	1267833	6.191	0.0170	167	2.643	0.0072	161	3.597	0.0099	11.50	0.000	0.0000
2002-03	1318321	3.982	0.0109	177	5.749	0.0157	167	3.410	0.0093	11.13	-3.261	-0.0089
2003-04	2226041	68.854	0.1886	189	7.022	0.0192	176	5.456	0.0149	10.63	-4.494	-0.0123
2004-05	2393671	7.530	0.0206	205	8.360	0.0229	222	25.924	0.0710	10.50	-1.176	-0.0032
2005-06	2612847	9.156	0.0251	222	8.154	0.0223	196	-11.693	-0.032	10.50	0.000	0.0000
2006-07	2804310	7.328	0.0201	247	11.558	0.0317	206	5.368	0.0147	12.38	17.857	0.0489
2007-08	3122862	11.359	0.0311	268	8.458	0.0232	216	4.755	0.0130	12.50	1.010	0.0028

APPENDIX –II: ZERO-ORDER PARTIAL CORRELATION OF SECURITIES AND PORTFOLIOS

1							PARTIAL CORRELATION OF 286 PORTFOLIOS						
1998-99	NSE	GDP	IIP	WPI	PLR	RETURN	1998-99	NSE	GDP	IIP	WPI	PLR	RETURN
NSE	1.000						NSE	1.000					
GDP	-.019	1.000					GDP	.090	1.000				
IIP	.134*	-.345**	1.000				IIP	-.051	-.259**	1.000			
WPI	.003	-.135*	.208**	1.000			WPI	.015	-.135*	.181**	1.000		
PLR	-.012	-.095	.270**	.310**	1.000		PLR	.075	-.139*	.448**	.250**	1.000	
RETURN	-.329**	-.098	.101	-.003	-.055	1.000	RETURN	-.581**	-.029	-.056	-.010	-.117*	1.000
1999-00	NSE	GDP	IIP	WPI	PLR	RETURN	1999-00	NSE	GDP	IIP	WPI	PLR	RETURN
NSE	1.000						NSE	1.000					
GDP	-.206**	1.000					GDP	-.384**	1.000				
IIP	-.386**	-.703**	1.000				IIP	-.460**	-.474**	1.000			
WPI	.036	.905**	-.791**	1.000			WPI	-.056	.839**	-.624**	1.000		
PLR	-.026	-.793**	.786**	-.656**	1.000		PLR	-.011	-.617**	.656**	-.389**	1.000	
RETURN	-.758**	.469**	.230**	.173**	-.163**	1.000	RETURN	-.828**	.610**	.344**	.243**	-.160**	1.000
2000-01	NSE	GDP	IIP	WPI	PLR	RETURN	2000-01	NSE	GDP	IIP	WPI	PLR	RETURN
NSE	1.000						NSE	1.000					
GDP	.388**	1.000					GDP	.531**	1.000				
IIP	-.216**	-.978**	1.000				IIP	-.364**	-.981**	1.000			
WPI	-.111	-.956**	.993**	1.000			WPI	-.277**	-.960**	.995**	1.000		
PLR	.111	.957**	-.993**	-.999**	1.000		PLR	.274**	.960**	-.995**	-.999**	1.000	
RETURN	-1.000**	-.388**	.217**	.111	-.111	1.000	RETURN	-1.000**	-.531**	.365**	.277**	-.274**	1.000
2001-02	NSE	GDP	IIP	WPI	PLR	RETURN	2001-02	NSE	GDP	IIP	WPI	PLR	RETURN
NSE	1.000						NSE	1.000					
GDP	-.116*	1.000					GDP	-.192**	1.000				
IIP	-.141*	.000	1.000				IIP	-.099	.244**	1.000			
WPI	-.027	.008	-.002	1.000			WPI	-.255**	-.160**	.278**	1.000		
PLR	.003	-.121*	-.005	-.026	1.000		PLR	-.076	-.062	.152	.100	1.000	
RETURN	.621**	-.072	.184**	-.017	-.007	1.000	RETURN	.534**	-.185**	.058	-.279**	-.125*	1.000
2002-03	NSE	GDP	IIP	WPI	PLR	RETURN	2002-03	NSE	GDP	IIP	WPI	PLR	RETURN
NSE	1.000						NSE	1.000					
GDP	.202**	1.000					GDP	.057	1.000				
IIP	.519**	-.196**	1.000				IIP	.312**	-.339**	1.000			
WPI	.034	-.044	-.051	1.000			WPI	.017	.078	-.075	1.000		
PLR	-.110	.019	-.090	.486**	1.000		PLR	-.124*	.078	-.105	.422**	1.000	
RETURN	-.622**	-.228**	-.649**	-.004	-.020	1.000	RETURN	-.366**	-.112	-.559**	.046	-.014	1.000
2003-04	NSE	GDP	IIP	WPI	PLR	RETURN	2003-04	NSE	GDP	IIP	WPI	PLR	RETURN
NSE	1.000						NSE	1.000					
GDP	.670**	1.000					GDP	.760**	1.000				
IIP	.451**	.417**	1.000				IIP	.433**	.347**	1.000			
WPI	.003	-.026	.234**	1.000			WPI	-.002	-.033	.375**	1.000		
PLR	.002	.000	.332**	.402**	1.000		PLR	-.013	.006	.342**	.304**	1.000	
RETURN	-.385**	-.459**	-.296**	.062	.089	1.000	RETURN	-.163**	-.199**	-.056	.123*	.101	1.000
2004-05	NSE	GDP	IIP	WPI	PLR	RETURN	2004-05	NSE	GDP	IIP	WPI	PLR	RETURN
NSE	1.000						NSE	1.000					
GDP	-.118*	1.000					GDP	-.129*	1.000				
IIP	.270**	-.610**	1.000				IIP	.193**	-.692**	1.000			
WPI	-.028	.597**	-.757**	1.000			WPI	.078	.600**	-.750**	1.000		
PLR	-.010	-.341**	.493**	-.773**	1.000		PLR	-.082	-.448**	.596**	-.814**	1.000	
RETURN	-.862**	.143	-.282**	.019	.002	1.000	RETURN	-.861**	.210**	-.216**	-.068	.028	1.000
2005-06	NSE	GDP	IIP	WPI	PLR	RETURN	2005-06	NSE	GDP	IIP	WPI	PLR	RETURN
NSE	1.000						NSE	1.000					
GDP	-.797**	1.000					GDP	-.821**	1.000				
IIP	-.422**	.002	1.000				IIP	-.483**	-.009	1.000			
WPI	.796**	-1.000**	-.001	1.000			WPI	.822**	-1.000**	.007	1.000		
PLR	-.796**	1.000**	.001	-1.000**	1.000		PLR	-.823**	1.000**	-.006	-1.000**	1.000	
RETURN	.854**	-.991**	-.091	.991**	-.991**	1.000	RETURN	.879**	-.991**	-.096	.991**	-.991**	1.000
2006-07	NSE	GDP	IIP	WPI	PLR	RETURN	2006-07	NSE	GDP	IIP	WPI	PLR	RETURN
NSE	1.000						NSE	1.000					
GDP	.009	1.000					GDP	.089	1.000				
IIP	-.006	.462**	1.000				IIP	-.025	.484**	1.000			
WPI	-.046	-.379**	-.661**	1.000			WPI	-.133*	-.443**	-.572**	1.000		
PLR	.052	.167**	-.289**	.165**	1.000		PLR	.156**	.278**	-.191**	-.067	1.000	
RETURN	.251**	-.017	.044	.026	-.005	1.000	RETURN	.181**	-.074	-.117*	.095	.157**	1.000
2007-08	NSE	GDP	IIP	WPI	PLR	RETURN	2007-08	NSE	GDP	IIP	WPI	PLR	RETURN
NSE	1.000						NSE	1.000					
GDP	.984**	1.000					GDP	.987**	1.000				
IIP	.030	-.149*	1.000				IIP	-.013	-.175**	1.000			
WPI	-.121*	-.296**	.988**	1.000			WPI	-.175**	-.333**	.987**	1.000		
PLR	-.118*	-.260**	.796**	.813**	1.000		PLR	-.191**	-.321**	.814**	.835**	1.000	
RETURN	-1.000**	-.984**	-.030	.120*	.117*	1.000	RETURN	-1.000**	-.987**	.013	.175**	.190**	1.000

** AND * DEPICT SIGNIFICANT AT 1 PERCENT LEVEL. AND 5 PERCENT LEVEL RESPECTIVELY.

APPENDIX –III: P- VALUE AGAINST T TEST FOR SELECTING FACTORS IN EQUATION

P Value in Case Of Securities				P Value in Case Of Portfolios			
1998-99	Beta Coefficient	t- value	p- value	1998-99	Beta Coefficient	t- value	p- value
NSE	-0.2228	-6.5400	0.0000	NSE	-0.6703	-11.9065	0.0000
GDP	-0.0053	-1.0867	0.2780	GDP	0.0002	0.0288	0.9770
IIP	0.0176	2.6350	0.0088	IIP	-0.0165	-1.2266	0.2210
WPI	-0.0022	-0.1933	0.8468	WPI	0.0081	0.4614	0.6449
PLR	-0.0339	-1.8067	0.0718	PLR	-0.0259	-0.8619	0.3895
1999-00				1999-00			
NSE	-0.0985	0.0012	0.0012	NSE	-0.1434	-4.3505	0.0000
GDP	0.2852	0.0000	0.0000	GDP	0.2320	18.5463	0.0000
IIP	0.0856	0.0000	0.0000	IIP	0.1155	15.3894	0.0000
WPI	-0.1068	0.0000	0.0000	WPI	-0.0598	-6.4273	0.0000
PLR	0.0108	0.0000	0.0000	PLR	0.0006	0.2787	0.7806
2000-01				2000-01			
NSE	-0.5931	-150.8139	0.0000	NSE	-0.6029	-434.6828	0.0000
GDP	-0.0015	-0.2626	0.7930	GDP	0.0112	3.6080	0.0004
IIP	0.0167	2.6628	0.0082	IIP	0.1270	4.4788	0.0000
WPI	-0.0007	-0.0835	0.9335	WPI	0.0152	2.4479	0.0150
PLR	0.0693	2.4781	0.0138	PLR	-0.0014	-0.1401	0.8887
2001-02				2001-02			
NSE	2.2019	15.3145	0.0000	NSE	1.4736	8.7772	0.0000
GDP	0.0012	0.0923	0.9265	GDP	-0.0634	-3.9299	0.0001
IIP	0.0000	6.4799	0.0000	IIP	0.0000	4.5686	0.0000
WPI	0.0007	0.0303	0.9758	WPI	-0.1719	-4.7697	0.0000
PLR	0.0000	-0.1657	0.8685	PLR	0.0000	-2.3727	0.0183
2002-03				2002-03			
NSE	-0.8962	-6.1342	0.0000	NSE	-0.4895	-3.5567	0.0004
GDP	-0.1608	-6.9436	0.0000	GDP	-0.1492	-6.3807	0.0000
IIP	-0.5751	-12.2776	0.0000	IIP	-0.5186	-12.1497	0.0000
WPI	0.0058	0.3673	0.7137	WPI	0.0192	1.4518	0.1477
PLR	-0.0225	-2.4566	0.0146	PLR	-0.0191	-2.1420	0.0331
2003-04				2003-04			
NSE	-0.0096	-1.2750	0.2033	NSE	-0.0002	-0.0173	0.9862
GDP	-0.0229	-4.7183	0.0000	GDP	-0.0144	-1.8974	0.0588
IIP	-0.0103	-2.7674	0.0060	IIP	-0.0046	-0.9649	0.3354
WPI	0.0006	0.7584	0.4488	WPI	0.0016	1.7952	0.0737
PLR	0.0037	2.2557	0.0248	PLR	0.0028	1.4215	0.1563
2004-05				2004-05			
NSE	-0.3314	-26.4824	0.0000	NSE	-0.2975	-26.1068	0.0000
GDP	0.0213	1.4319	0.1532	GDP	0.0605	3.7692	0.0002
IIP	-0.0280	-2.8315	0.0049	IIP	-0.0119	-1.0997	0.2724
WPI	-0.2790	-3.0178	0.0028	WPI	-0.3330	-4.0554	0.0001
PLR	-0.0183	-1.5561	0.1207	PLR	-0.0369	-2.9063	0.0039
2005-06				2005-06			
NSE	0.0401	15.2928	0.0000	NSE	0.0453	11.7131	0.0000
GDP	-0.0001	-0.0247	0.9803	GDP	0.0001	0.0248	0.9802
IIP	0.0000	-5.2984	0.0000	IIP	0.0000	-3.2236	0.0014
WPI	-0.0290	-4.6135	0.0000	WPI	-0.0273	-4.7435	0.0000
PLR	0.0000	-6.4462	0.0000	PLR	0.0000	-6.3026	0.0000
2006-07				2006-07			
NSE	4.0340	4.6099	0.0000	NSE	1.9597	3.0083	0.0029
GDP	-0.0221	-0.6642	0.5071	GDP	-0.0488	-1.4476	0.1488
IIP	0.9740	1.7523	0.0807	IIP	0.1630	0.3602	0.7190
WPI	0.5100	1.5356	0.1257	WPI	0.4256	1.3550	0.1765
PLR	0.1233	0.1995	0.8420	PLR	1.6144	2.5936	0.0100
2007-08				2007-08			
NSE	-0.7689	-888.1519	0.0000	NSE	-0.7662	-660.8048	0.0000
GDP	-0.1840	-5.1217	0.0000	GDP	-0.2180	-5.8106	0.0000
IIP	0.0080	1.7368	0.0835	IIP	0.0003	0.0441	0.9648
WPI	-0.0016	-1.7129	0.0878	WPI	0.0001	0.0401	0.9680
PLR	-0.0024	-2.2731	0.0238	PLR	-0.0053	-4.4345	0.0000

APPENDIX –IV: FACTORS ENTERED INTO THE REGRESSION EQUATION FOR SECURITIES

		Unstandardized Coefficients		Standardized Coefficients	t	p value	Correlations			Collinearity Statistics		R	R Square	Adjusted R Square	Std. Error of the Estimate
		B	Std. Error	Beta Coefficient			Zero-order	Partial	Part	Tolerance	VIF				
1998-99															
1 st step	NSE	-0.208	0.034	-0.329	-6.087	0.000	-0.329	-0.329	-0.329	1.000	1.000	0.329	0.108	0.105	0.981
2 nd step	NSE	-0.220	0.034	-0.349	-6.463	0.000	-0.329	-0.348	-0.346	0.982	1.018	0.360	0.130	0.124	0.970
	IIP	0.017	0.006	0.148	2.737	0.007	0.101	0.155	0.146	0.982	1.018				
1999-00															
1 st step	NSE	-0.770	0.038	-0.758	-20.260	0.000	-0.758	-0.758	-0.758	1.000	1.000	0.758	0.575	0.573	1.307
2 nd step	NSE	-0.701	0.034	-0.691	-20.710	0.000	-0.758	-0.766	-0.676	0.958	1.044	0.823	0.677	0.675	1.141
	GDP	0.051	0.005	0.327	9.820	0.000	0.469	0.491	0.321	0.958	1.044				
3 rd step	NSE	-0.188	0.035	-0.185	-5.319	0.000	-0.758	-0.293	-0.117	0.401	2.493	0.924	0.854	0.852	0.769
	GDP	0.167	0.007	1.073	23.825	0.000	0.469	0.808	0.524	0.238	4.194				
	IIP	0.122	0.006	0.913	19.104	0.000	0.230	0.740	0.420	0.212	4.721				
4 th step	NSE	-0.104	0.031	-0.103	-3.324	0.001	-0.758	-0.188	-0.063	0.375	2.669	0.944	0.892	0.891	0.662
	GDP	0.238	0.009	1.531	25.961	0.000	0.469	0.831	0.492	0.103	9.695				
	IIP	0.111	0.006	0.830	19.781	0.000	0.230	0.752	0.375	0.204	4.903				
	WPI	-0.073	0.007	-0.552	-10.307	0.000	0.173	-0.511	-0.195	0.125	8.001				
5 th step	NSE	-0.099	0.030	-0.097	-3.270	0.001	-0.758	-0.186	-0.059	0.374	2.673	0.949	0.901	0.900	0.634
	GDP	0.285	0.013	1.838	22.684	0.000	0.469	0.795	0.412	0.050	19.936				
	IIP	0.086	0.007	0.640	11.872	0.000	0.230	0.565	0.215	0.113	8.820				
	WPI	-0.107	0.009	-0.810	-11.436	0.000	0.173	-0.551	-0.208	0.066	15.247				
	PLR	0.011	0.002	0.259	5.284	0.000	-0.163	0.292	0.096	0.137	7.296				
2000-01															
1 st step	NSE	-0.598	0.000	-1.000	-3333.8	0.000	-1.000	-1.000	-1.000	1.000	1.000	1.000	1.000	1.000	1.045
2001-02															
1 st step	NSE	2.064	0.150	0.621	13.803	0.000	0.621	0.621	0.621	1.000	1.000	0.621	0.385	0.383	5.249
2 nd step	NSE	2.200	0.142	0.661	15.492	0.000	0.621	0.665	0.654	0.980	1.020	0.679	0.462	0.458	4.928
	IIP	0.000	0.000	0.278	6.512	0.000	0.184	0.351	0.275	0.980	1.020				
2002-03															
1 st step	IIP	-0.661	0.045	-0.649	-14.744	0.000	-0.649	-0.649	-0.649	1.000	1.000	0.649	0.421	0.419	3.063
2 nd step	IIP	-0.455	0.047	-0.446	-9.623	0.000	-0.649	-0.487	-0.381	0.730	1.369	0.730	0.532	0.529	2.757
	NSE	-1.229	0.146	-0.391	-8.427	0.000	-0.622	-0.439	-0.334	0.730	1.369				
3 rd step	IIP	-0.574	0.047	-0.563	-12.226	0.000	-0.649	-0.579	-0.449	0.636	1.573	0.774	0.600	0.596	2.531
	NSE	-0.857	0.145	-0.273	-5.912	0.000	-0.622	-0.325	-0.217	0.634	1.576				
	GDP	-0.164	0.023	-0.284	-7.060	0.000	-0.228	-0.379	-0.259	0.835	1.197				
4 th step	IIP	-0.577	0.046	-0.566	-12.409	0.000	-0.649	-0.585	-0.451	0.636	1.574	0.780	0.609	0.603	2.531
	NSE	-0.888	0.144	-0.282	-6.162	0.000	-0.622	-0.337	-0.224	0.630	1.587				
	GDP	-0.162	0.023	-0.280	-7.046	0.000	-0.228	-0.379	-0.256	0.834	1.199				
	PLR	-0.021	0.008	-0.096	-2.625	0.009	-0.020	-0.151	-0.095	0.986	1.015				
2003-04															
1 st step	GDP	-0.032	0.004	-0.459	-8.969	0.000	-0.459	-0.459	-0.459	1.000	1.000	0.5	0.2	0.2	0.3
2 nd step	GDP	-0.029	0.004	-0.406	-7.265	0.000	-0.459	-0.386	-0.369	0.826	1.210	0.5	0.2	0.2	0.268
	IIP	-0.008	0.003	-0.126	-2.261	0.024	-0.296	-0.129	-0.115	0.826	1.210				
3 rd step	GDP	-0.027	0.004	-0.380	-6.795	0.000	-0.459	-0.365	-0.341	0.804	1.243	0.5	0.2	0.2	0.265
	IIP	-0.011	0.004	-0.187	-3.155	0.002	-0.296	-0.179	-0.158	0.715	1.398				
	PLR	0.004	0.002	0.151	2.807	0.005	0.089	0.160	0.141	0.866	1.155				
2004-05															
1 st step	NSE	-0.347	0.012	-0.862	-29.596	0.000	-0.862	-0.862	-0.862	1.000	1.000	0.9	0.7	0.7	1.890
2 nd step	NSE	-0.341	0.012	-0.847	-28.118	0.000	-0.862	-0.850	-0.816	0.927	1.079	0.9	0.7	0.7	1.884
	IIP	-0.010	0.006	-0.053	-1.745	0.082	-0.282	-0.100	-0.051	0.927	1.079				
3 rd step	NSE	-0.332	0.013	-0.826	-26.511	0.000	-0.862	-0.836	-0.763	0.853	1.172	0.9	0.8	0.7	1.868
	IIP	-0.029	0.009	-0.145	-3.040	0.003	-0.282	-0.172	-0.087	0.364	2.745				
	WPI	-0.158	0.064	-0.114	-2.486	0.013	0.019	-0.142	-0.072	0.393	2.547				
2005-06															
1 st step	WPI	0.030	0.000	0.991	127.714	0.000	0.991	0.991	0.991	1.000	1.000	1.0	1.0	1.0	0.981
2 nd step	WPI	-0.032	0.011	-1.049	-2.819	0.005	0.991	-0.160	-0.021	0.000	2518.268	1.0	1.0	1.0	0.937
	PLR	0.000	0.000	-2.040	-5.483	0.000	-0.991	-0.300	-0.041	0.000	2518.268				
3 rd step	WPI	-0.029	0.006	-0.954	-4.529	0.000	0.991	-0.252	-0.019	0.000	2519.047	1.0	1.0	1.0	0.531
	PLR	0.000	0.000	-1.805	-8.561	0.000	-0.991	-0.441	-0.036	0.000	2523.099				
	NSE	0.050	0.002	0.176	25.387	0.000	0.854	0.825	0.107	0.366	2.731				
4 th step	WPI	-0.029	0.006	-0.949	-4.703	0.000	0.991	-0.261	-0.019	0.000	2519.104	1.0	1.0	1.0	0.509
	PLR	0.000	0.000	-1.828	-9.043	0.000	-0.991	-0.462	-0.036	0.000	2524.168				
	NSE	0.040	0.003	0.142	15.336	0.000	0.854	0.662	0.062	0.189	5.297				
	IIP	0.000	0.000	-0.030	-5.307	0.000	-0.091	-0.292	-0.021	0.516	1.940				
2006-07															
1 st step	NSE	3.941	0.872	0.251	4.522	0.000	0.251	0.251	0.251	1.000	1.000	0.3	0.1	0.1	13.073
2007-08															
1 st step	NSE	-0.767	0.000	-1.000	-4699.155	0.000	-1.000	-1.000	-1.000	1.000	1.000	1.0	1.0	1.0	0.433
2 nd step	NSE	-0.767	0.000	-1.000	-4796.375	0.000	-1.000	-1.000	-0.993	0.986	1.014	1.0	1.0	1.0	0.421
	PLR	-0.002	0.001	-0.001	-4.173	0.000	0.117	-0.238	-0.001	0.986	1.014				

APPENDIX –V: FACTORS ENTERED INTO THE REGRESSION EQUATION FOR PORTFOLIOS

		Unstandardized Coefficients		Standardized Coefficients	t	p value	Correlations			Collinearity Statistics		R	R Square	Adjusted R Square	Std. Error of the Estimate
		B	Std. Error	Beta Coefficient			Zero-order	Partial	Part	Tolerance	VIF				
1998-99															
1 st step	NSE	-0.670	0.056	-0.581	-12.030	0.000	-0.581	-0.581	-0.581	1.000	1.000	0.581	0.338	0.335	0.648
1999-00															
1 st step	NSE	-0.897	0.036	-0.828	-24.850	0.000	-0.828	-0.828	-0.828	1.000	1.000	0.828	0.685	0.684	0.523
2 nd step	NSE	-0.755	0.032	-0.696	-23.307	0.000	-0.828	-0.811	-0.643	0.852	1.173	0.886	0.785	0.783	0.433
	GDP	0.070	0.006	0.342	11.465	0.000	0.610	0.563	0.316	0.852	1.173				
3 rd step	NSE	-0.232	0.035	-0.214	-6.534	0.000	-0.828	-0.363	-0.121	0.319	3.132	0.951	0.904	0.903	0.290
	GDP	0.170	0.007	0.831	25.190	0.000	0.610	0.832	0.466	0.314	3.184				
4 th step	IIP	0.122	0.007	0.639	18.638	0.000	0.344	0.743	0.345	0.290	3.444				
	NSE	-0.144	0.033	-0.133	-4.416	0.000	-0.828	-0.255	-0.072	0.292	3.429	0.962	0.925	0.924	0.256
	GDP	0.230	0.009	1.120	25.982	0.000	0.610	0.840	0.423	0.143	7.003				
WPI	0.117	0.006	0.612	20.163	0.000	0.344	0.769	0.328	0.288	3.478					
	-0.058	0.006	-0.322	-9.074	0.000	0.243	-0.476	-0.148	0.210	4.762					
2000-01															
1 st step	NSE	-0.598	0.000	-1.000	-3360.495	0.000	-1.000	-1.000	-1.000	1.000	1.000	1.000	1.000	1.000	0.520
2 nd step	NSE	-0.598	0.000	-1.000	-3145.308	0.000	-1.000	-1.000	-0.931	0.867	1.153	1.000	1.000	1.000	0.517
	IIP	0.000	0.000	0.001	1.994	0.047	0.365	0.118	0.001	0.867	1.153				
3 rd step	NSE	-0.597	0.001	-0.998	-1118.350	0.000	-1.000	-1.000	-0.328	0.108	9.264	1.000	1.000	1.000	0.512
	IIP	0.006	0.002	0.023	2.663	0.008	0.365	0.157	0.001	0.001	880.201				
	WPI	-0.014	0.005	-0.022	-2.592	0.010	0.277	-0.153	-0.001	0.001	826.651				
2001-02															
1 st step	NSE	1.769	0.166	0.534	10.631	0.000	0.534	0.534	0.534	1.000	1.000	0.534	0.285	0.282	2.284
2 nd step	NSE	1.640	0.170	0.495	9.662	0.000	0.534	0.498	0.478	0.935	1.069	0.554	0.307	0.302	2.253
	WPI	-0.104	0.035	-0.153	-2.985	0.003	-0.279	-0.175	-0.148	0.935	1.069				
3 rd step	NSE	1.538	0.174	0.464	8.859	0.000	0.534	0.467	0.435	0.879	1.137	0.566	0.321	0.313	2.234
	WPI	-0.122	0.035	-0.181	-3.470	0.001	-0.279	-0.202	-0.170	0.890	1.124				
	GDP	-0.038	0.016	-0.124	-2.425	0.016	-0.185	-0.143	-0.119	0.916	1.091				
4 th step	NSE	1.503	0.169	0.453	8.907	0.000	0.534	0.469	0.425	0.877	1.140	0.601	0.361	0.352	2.170
	WPI	-0.173	0.036	-0.255	-4.764	0.000	-0.279	-0.273	-0.227	0.793	1.261				
	GDP	-0.059	0.016	-0.192	-3.667	0.000	-0.185	-0.214	-0.175	0.831	1.204				
	IIP	0.000	0.000	0.220	4.218	0.000	0.058	0.244	0.201	0.836	1.197				
5 th step	NSE	1.474	0.168	0.444	8.777	0.000	0.534	0.465	0.415	0.873	1.146	0.611	0.374	0.363	2.152
	WPI	-0.172	0.036	-0.253	-4.770	0.000	-0.279	-0.274	-0.226	0.793	1.261				
	GDP	-0.063	0.016	-0.205	-3.930	0.000	-0.185	-0.229	-0.186	0.821	1.218				
	IIP	0.000	0.000	0.239	4.569	0.000	0.058	0.263	0.216	0.816	1.226				
	PLR	0.000	0.000	-0.115	-2.373	0.018	-0.125	-0.140	-0.112	0.960	1.042				
2002-03															
1 st step	IIP	-0.471	0.041	-0.559	-11.351	0.000	-0.559	-0.559	-0.559	1.000	1.0000	0.559	0.312	0.310	1.24742
2 nd step	IIP	-0.415	0.042	-0.492	-9.781	0.000	-0.559	-0.503	-0.468	0.903	1.1079	0.594	0.353	0.348	1.21197
	NSE	-0.609	0.144	-0.213	-4.226	0.000	-0.366	-0.244	-0.202	0.903	1.1079				
3 rd step	IIP	-0.519	0.043	-0.615	-12.110	0.000	-0.559	-0.585	-0.542	0.775	1.2909	0.660	0.436	0.430	1.13370
	NSE	-0.447	0.137	-0.156	-3.265	0.001	-0.366	-0.191	-0.146	0.872	1.1462				
	GDP	-0.151	0.023	-0.311	-6.436	0.000	-0.112	-0.358	-0.288	0.855	1.1690				
2003-04															
1 st step	NSE	-0.312	0.111	-0.861	-28.497	0.000	-0.861	-0.861	-0.861	1.000	1.0000	0.861	0.741	0.740	0.91140
2 nd step	NSE	-0.307	0.111	-0.848	-28.337	0.000	-0.861	-0.860	-0.841	0.983	1.0169	0.867	0.751	0.749	0.89514
	GDP	0.040	0.012	0.101	3.378	0.001	0.210	0.197	0.100	0.983	1.0169				
3 rd step	NSE	-0.301	0.111	-0.832	-27.566	0.000	-0.861	-0.854	-0.809	0.946	1.0575	0.870	0.757	0.755	0.88528
	GDP	0.064	0.015	0.164	4.360	0.000	0.210	0.251	0.128	0.609	1.6417				
	WPI	-0.131	0.048	-0.101	-2.709	0.007	-0.068	-0.159	-0.079	0.616	1.6243				
4 th step	NSE	-0.302	0.111	-0.833	-27.964	0.000	-0.861	-0.858	-0.810	0.945	1.0577	0.874	0.764	0.761	0.87376
	GDP	0.068	0.015	0.173	4.640	0.000	0.210	0.267	0.134	0.605	1.6527				
	WPI	-0.291	0.073	-0.225	-3.999	0.000	-0.068	-0.232	-0.116	0.264	3.7864				
	PLR	-0.037	0.013	-0.146	-2.913	0.004	0.028	-0.171	-0.084	0.334	2.9917				
2005-06															
1 st step	WPI	0.030	0.000	0.991	122.090	0.000	0.991	0.991	0.991	1.000	1.0000	0.991	0.981	0.981	0.45503
2 nd step	WPI	-0.043	0.011	-1.400	-3.849	0.000	0.991	-0.223	-0.029	0.000	2309.3580	0.992	0.984	0.984	0.42456
	PLR	0.000	0.000	-2.392	-6.574	0.000	-0.991	-0.364	-0.050	0.000	2309.3580				
3 rd step	WPI	-0.027	0.006	-0.877	-4.624	0.000	0.991	-0.265	-0.018	0.000	2332.4444	0.998	0.996	0.996	0.22021
	PLR	0.000	0.000	-1.710	-8.984	0.000	-0.991	-0.472	-0.035	0.000	2348.5348				
	NSE	0.056	0.002	0.193	27.747	0.000	0.879	0.856	0.109	0.320	3.1280				
4 th step	WPI	-0.027	0.006	-0.896	-4.800	0.000	0.991	-0.275	-0.019	0.000	2334.7149	0.998	0.996	0.996	0.21659
	PLR	0.000	0.000	-1.759	-9.367	0.000	-0.991	-0.488	-0.036	0.000	2364.0846				
	NSE	0.045	0.004	0.156	11.734	0.000	0.879	0.573	0.045	0.085	11.8179				
	IIP	0.000	0.000	-0.024	-3.242	0.001	-0.096	-0.190	-0.013	0.263	3.7965				
2006-07															
1 st step	NSE	1.996	0.645	0.181	3.095	0.002	0.181	0.181	0.181	1.000	1.0000	0.181	0.033	0.029	5.373
2 nd step	NSE	1.768	0.648	0.160	2.728	0.007	0.181	0.160	0.158	0.976	1.0250	0.223	0.050	0.043	5.335
	PLR	1.243	0.554	0.132	2.243	0.026	0.157	0.132	0.130	0.976	1.0250				
2007-08															
1 st step	NSE	-0.766	0.000	-1.000	-4875.659	0.000	-1.000	-1.000	-1.000	1.000	1.0000	1.000	1.000	1.000	0.226
2 nd step	NSE	-0.769	0.001	-1.003	-802.473	0.000	-1.000	-1.000	-0.163	0.026	37.9362	1.000	1.000	1.000	0.224
	GDP	0.000	0.000	0.003	2.639	0.009	-0.987	0.155	0.001	0.026	37.9362				
3 rd step	NSE	-0.762	0.002	-0.995	-473.923	0.000	-1.000	-0.999	-0.093	0.009	115.4445	1.000	1.000	1.000	0.216
	GDP	-0.001	0.000	-0.005	-2.516	0.012	-0.987	-0.148	0.000	0.008	124.0156				
	PLR	-0.006	0.001	-0.002	-4.839	0.000	0.190	-0.277	-0.001	0.295	3.3922				

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