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## AN EMPIRICAL STUDY ON ARBITRAGE PRICING THEORY IN INDIAN CAPITAL MARKETS

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### Abstract:-

A substitute and synchronal theory to the CAPM is one that includes multiple factors in explaining the movement of plus costs. The arbitrage pricing model (APT) on the other hand approaches rating from a special facet. it's seldom productive to analyse portfolio risks by assessing the weighted total of its parts. Equity portfolios square measure way more diverse and tremendously giant for separate element assessment, and therefore the correlation existing between the weather would build a calculation per se untrue. Rather, the portfolio's risk should be viewed as one product's innate risk. The APT represents portfolio risk by an element model that's linear, wherever returns square measure a total of risk issue returns. Factors might vary from macroeconomic to elementary market indices weighted by sensitivities to changes in every factor. These sensitivities square measure known as factor-specific beta coefficients or a lot of unremarkably, factor loadings. additionally, the firm-specific or individual come back is intercalary as a noise issue. This last part, as is that the case with all political economy models, is indispensable in explaining regardless of the original factors didn't embrace. In distinction with the CAPM, this can be not associate equilibrium model; it is not involved with the economical portfolio of the capitalist. Rather, the APT model calculates asset rating exploitation the various factors and assumes that within the case market rating deviates from the worth urged by the model, arbitrageurs can build use of the imbalance and veer pricing back to equilibrium levels. At its simplest kind, the arbitrage pricing model will have one issue solely, the market portfolio issue. this kind can provide similar results to the CAPM. The present study stress on the pertinence of APT in Indian Stock Markets because the surge in volatility associated growth within the Indian capital markets over the past few years makes it an interesting market to check and given the rising significance of the risk-return trade-off in such a market.

**Keywords:** Empirical Study , On Arbitrage Pricing Theory ,Indian Capital Markets.

### INTRODUCTION

Stephen Ross, who initiated APT in 1976, explained that an asset's price today should equal the sum of discounted future cash flows, where the expected return of the asset is a linear function of the various factors. According to this definition, risky asset return will satisfy the following equation:

$$E(r_i) = r_f + \beta_{i1}RP_1 + \beta_{i2}RP_2 + \dots + \beta_{in}RP_n$$

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

Where  $E(r_i)$  is the expected return of the asset,  $r_f$  is risk free rate,  $RP_n$  is risk premium of the factor  $n$ ,  $F_n$  is the factors,  $\beta_{in}$  is the sensitivity of the asset to factor  $n$ , also known as factor loading, and  $\beta_i$  is the asset's idiosyncratic risk.

Well-diversified portfolios are assumed in the model. This incorporates that  $\epsilon$  the disturbance factor be composed of sufficiently uncorrelated terms so that the disturbance term for a substantially large portfolio vanishes. The market portfolio will be well-diversified if no single asset accounts for a significant proportion of aggregate wealth. A further assumption is that there is perfect competition in the market, and that factors do not outnumber the assets in the portfolio. APT is tested for its validity in the Indian markets by examining the following hypothesis:

#### **HYPOTHESIS**

1.  $H_0$  = There is no relation between Macro economic factors and stock returns.

$H_a$  = There is a relation between Macro economic factors and stock returns.

In order to test the above hypothesis the following methodology has been adopted.

#### **SAMPLE**

The study has been carried out based on S&P CNX Nifty and Nifty Junior companies that were part of the index from April 2005 to June 2012. These companies are well traded and belong to diverse industry groups. While the afore mentioned indices consists of 100 stocks was reduced to 87 companies owing to the unavailability of data . The companies which are merged and acquired etc are also removed. The S&P CNX 500 has been taken as the market proxy being India's first broad-based benchmark. It represents more than 90 per cent of the total market capitalization and accounts for 72 industry indices. The required data for the stocks and indices was collected from CMIE database Prowess, the National Stock Exchange (NSE) website and the Yahoo! Finance website. For the risk-free rate, 91-day Treasury bill rates have been taken as a proxy. Other macro variables for which data was collected include, the INR-USD exchange rate, FII investments, Gold and Silver prices, IIP prices, Inflation rates, Brent Crude and Market Premium. These variables have been identified from literature as factors directly affecting returns. Each factor's impact on returns has been detailed. For the purpose of the study, monthly data has been used for all variables. This is because, daily data, though better for estimating risk-return relationships, is very noisy.

#### **MACRO ECONOMIC VARIABLES IDENTIFIED**

It is well documented in literature (Lintner (1975), Modigliani and Cohn (1979), Chen, et al. (1986), Fama (1981), Chen (1991), Antoniou et al. (1998), Kaoutoulas and Kryzanowski (1998), Ferson and Harvey (1991, 1993, 1999) that that macroeconomic variables influence the asset returns in developed markets. Accordingly based on the past studies the following economic variables are considered to proxy the unspecified factors in APT. The following variables are identified which are as follows

1. FII investment in Indian market
  2. Whole sale Price index
  3. Index of Industrial Production
  4. Gold Prices
  5. silver Prices
  6. Brent Crude Oil Price in dollars
  7. Exchange rates
- Market premium

#### **METHODOLOGY**

The present study was conducted based on Fama Macbeth (1973) model. In the portfolio formation period we estimated the beta for each stock by regressing the time series of the stocks' excess returns on the time series of the index excess returns, where excess returns are obtained by subtracting the risk free rate from the returns. Based on these beta estimates, we sorted the stocks into 10 equally weighted portfolios. Portfolio 1 contains the stocks with the highest betas and portfolio 10 comprises the stocks with the lowest beta. Portfolio betas were calculated as weighted averages of the betas of the stocks in the portfolio. In the testing period cross-sectional regressions were carried out

for each month. The monthly portfolio returns are regressed on the portfolio betas. The number of observations in the cross-sectional regressions is equal to the number of portfolios. The coefficients estimated in the cross-sectional regressions were averaged; hypothesis tests (t test) are based on these averages.

We have formulated ten portfolios basing on the data to examine APT. For the market index and each of the 10 portfolios, monthly returns are computed through the natural logarithm of price relatives. Similarly price relatives are calculated for all the macro economic variables (except interest rates). The following multiple regression model was estimated to statistically test the significance of the various risk factors represented by the macro economic variables:

$$R_{it} = R_{ft} + \beta_1 I_{1t} + \beta_2 I_{2t} + \beta_3 I_{3t} + \dots + \beta_n I_{nt} + e_{it}$$

Where

$R_{it}$  is the return on portfolio  $i$  at time  $t$

$R_{ft}$  is the return on the risk-free asset at time  $t$

$I_1, I_2, I_3, \dots, I_n$  are the various macro variables influencing systematic risk

#### TOOLS FOR ANALYSIS

Fama McBeth methodology for portfolio construction and multiple regression, t-test was adopted for analysis were used.

#### RESULTS

TABLE 1 REGRESSION STATISTICS FOR PORTFOLIO 1

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	0.244927	0.142892	1.714069
Net_FII_INR(Mn)	-313.647	185.062	-1.69482
WPI	-0.76205	0.70997	-1.07335
IIP	-0.15901	0.081378	-1.95396
GOLD	-0.0322	0.138878	-0.23186
SILVER	0.00089	0.084652	0.010511
Brent	0.088997	0.058615	1.518346
INR-USD	0.188796	0.220498	0.856225
Rm-Rf(%)	0.870287	0.052287	16.64452

**TABLE 2 REGRESSION STATISTICS FOR PORTFOLIO 2**

	Coefficients	Standard Error	t Stat
Intercept	0.244927	0.142892	1.714069
net_FII_INR(Mn)	-313.647	185.062	-1.69482
WPI	-0.76205	0.70997	-1.07335
Iip	-0.15901	0.081378	-1.95396
GOLD	-0.0322	0.138878	-0.23186
SILVER	0.00089	0.084652	0.010511
Brent	0.088997	0.058615	1.518346
INR-USD	0.188796	0.220498	0.856225
Rm-Rf(%)	0.870287	0.052287	16.64452

**TABLE 3 REGRESSION STATISTICS FOR PORTFOLIO 3**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	0.054711	0.133811	0.408868
net_FII_INR(Mn)	-67.9817	173.3015	-0.39227
WPI	-0.22378	0.664852	-0.33659
Iip	-0.05871	0.076206	-0.77039
GOLD	-0.34253	0.130052	-2.63377
SILVER	0.16363	0.079272	2.064157
Brent	-0.03349	0.05489	-0.61017
INR-USD	0.084936	0.206486	0.411343
Rm-Rf(%)	0.799126	0.048964	16.3207

**TABLE 4 REGRESSION STATISTICS FOR PORTFOLIO 4**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	0.065844	0.147521	0.446333
net_FII_INR(Mn)	-84.5873	191.0578	-0.44273
WPI	-0.18729	0.732972	-0.25552
Iip	-0.03099	0.084014	-0.36891
GOLD	-0.19161	0.143377	-1.33637
SILVER	0.056378	0.087394	0.645094
Brent	0.056963	0.060514	0.941327
INR-USD	-0.01528	0.227642	-0.06714
Rm-Rf(%)	0.826312	0.053981	15.30754

**TABLE 5 REGRESSION STATISTICS FOR PORTFOLIO 5**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	0.156408	0.134453	1.163286
net_FII_INR(Mn)	-198.583	174.133	-1.14041
WPI	1.302283	0.668042	1.949402
iip	-0.02792	0.076572	-0.36462
GOLD	-0.22247	0.130676	-1.70248
SILVER	0.049222	0.079653	0.617955
Brent	-0.06869	0.055153	-1.24546
INR-USD	0.154297	0.207476	0.743687
Rm-Rf(%)	0.946918	0.049199	19.24674

**TABLE 6 REGRESSION STATISTICS FOR PORTFOLIO 6**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	0.152018	0.162494	0.93553
net_FII_INR(Mn)	-198.317	210.4493	-0.94235
WPI	0.582013	0.807365	0.720879
iip	-0.10976	0.092541	-1.18602
GOLD	-0.12957	0.157929	-0.82044
SILVER	0.063824	0.096265	0.663004
Brent	-0.06609	0.066656	-0.99151
INR-USD	-0.04052	0.250747	-0.16158
Rm-Rf(%)	0.883067	0.05946	14.85156

**TABLE 7 REGRESSION STATISTICS FOR PORTFOLIO 7**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	0.12563	0.143472	0.875641
net_FII_INR(Mn)	-161.353	185.8135	-0.86836
WPI	-0.21042	0.712853	-0.29519
iip	-0.06734	0.081708	-0.82415
GOLD	0.032268	0.139442	0.231411
SILVER	-0.04895	0.084996	-0.57588
Brent	0.025202	0.058853	0.428215
INR -USD	-0.18753	0.221393	-0.84705
Rm-Rf(%)	1.071656	0.052499	20.41288

**TABLE 8 REGRESSION STATISTICS FOR PORTFOLIO 8**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	-0.01949	0.156266	-0.1247
net_FII_INR(Mn)	21.14449	202.3826	0.104478
WPI	0.854008	0.776418	1.099933
iip	-0.00084	0.088994	-0.00941
GOLD	-0.12069	0.151876	-0.79469
SILVER	0.027096	0.092575	0.292698
Brent	-0.03459	0.064101	-0.53959
INR-USD	-0.12363	0.241135	-0.51268
Rm-Rf(%)	1.11891	0.05718	19.56808

**TABLE 9 REGRESSION STATISTICS FOR PORTFOLIO 9**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	0.190426	0.156451	1.217163
net_FII_INR(Mn)	-245.73	202.6222	-1.21275
WPI	0.014449	0.777337	0.018587
iip	-0.05404	0.089099	-0.60655
GOLD	0.104335	0.152055	0.686163
SILVER	-0.06169	0.092684	-0.66555
Brent	-0.04451	0.064177	-0.69353
INR-USD	-0.27285	0.241421	-1.13019

**TABLE 10 REGRESSION STATISTICS FOR PORTFOLIO 10**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	0.183963	0.163705	1.123748
net_FII_INR(Mn)	-228.256	212.017	-1.07659
WPI	-1.17279	0.813379	-1.44187
iip	-0.13479	0.093231	-1.44573
GOLD	-0.2814	0.159106	-1.76864
SILVER	0.050727	0.096982	0.523056
Brent	-0.03895	0.067152	-0.58008
INR-USD	0.230902	0.252614	0.914048
Rm-Rf(%)	1.020098	0.059902	17.02933



TABLE 11 REGRESSION STATISTICS FOR PORTFOLIOS

	Multiple R	R Square	Adjusted R Square	Standard Error	Observations
PF1	0.905287	0.819545	0.801036	0.035425	87
PF2	0.916188	0.8394	0.822928	0.035987	87
PF3	0.918885	0.84435	0.828386	0.0337	87
PF4	0.910297	0.828642	0.811066	0.037153	87
PF5	0.934059	0.872467	0.859387	0.033862	87
PF6	0.898678	0.807622	0.78789	0.040924	87
PF7	0.943567	0.890319	0.87907	0.036133	87
PF8	0.9387	0.881157	0.868968	0.039355	87
PF9	0.917533	0.841867	0.825648	0.039402	87
PF10	0.919856	0.846135	0.830354	0.041228	87

## DISCUSSION

It may be noticed that APT to be a suitable descriptor of asset prices or excess portfolio returns in the Indian capital markets. While APT specifies no particular factors to be considered for such an application of the model, the results obtained validate the influence that major macroeconomic variables have on the dependent variable, market risk premium is the significant explanatory variable. It is inferred that the APT model includes several market risk factors beyond market risk premium to explain the determinants of stock returns. The selection of market risk factors included in the selected APT model are interest rate, market index, oil price, and exchange rate. The betas estimated gives us the percentage change in stock prices for a 1 % increase in the market index, interest rate, oil price, gas price and exchange rate. For all the portfolios the intercept term is not found to be significant indicative of the sufficiency of the explanatory variables in describing the portfolio returns. In all the regressions we find that only the market risk premium is statistically significant and the adjusted R2 is quite high in all the cases. Only in the case of portfolio 1 and portfolio 3 gold and silver prices were found to be significant beyond market risk premium. In all the cases there is a positive relationship for the market risk premium's slope coefficient confirming the risk - return tradeoff i.e., higher the risk higher will be the expected return. This indicates that low beta portfolios are weakly influenced by prices of precious metals but other economic variables play little role in explaining security returns in India. Wherever we find that variable gold is statistically significant we also notice that the sign of the slope coefficient is negative. This indicates that there is an opposite relationship between stock returns and gold price changes and this means that as an asset class gold has diversifiable potential. When market risk premium is taken as dependent variable only Rupee-Dollar exchange rate was found to be significant and all other factors are found to be insignificant.

We have repeated the results omitting the Silver (gold) prices as these variables are having considerable correlations however, the inferences remained unchanged with only market risk premium being significant. It is becoming clear from the analysis that market is the only important factor in determining the return an asset is expected to earn which the equilibrium model CAPM advocates. By augmenting the independent variables to include factors that seem to have some impact on stock returns like FII investments, dollar-rupee exchange rate or other macro economic factors like IIP, Inflation or commodity prices like Gold crude oil seem to be of temporary importance. Hence we reject the null hypothesis and accept the alternate hypothesis.

### MAJOR FINDINGS

1. It is observed that silver is highly correlated with Gold and Oil prices and further gold and oil prices are also highly correlated.
2. It is found that market premium is significant explanatory variable and Gold has minimal impact on security returns and the rest of the factors have no significant impact on stock returns.
3. It is found that when market risk premium is taken as dependent variable only Rupee dollar exchange rate was found to be significant and all other factors are found to be insignificant.

### CONCLUSION

APT, like the CAPM, asserts a linear relationship between expected returns and their covariance with other random variables, interpreted as systematic risk that cannot be diversified. If evaluated on the basis of number of explicit assumptions required, APT is more parsimonious than CAPM. Nonetheless, APT, as a model, is based on the following assumptions:

1. Investors are risk-averse individuals and have homogenous expectations.
2. Markets are efficient so that there are no opportunities for arbitrage (Law of one price: Two assets with the same payoff in all states have the same price). Also, capital markets are perfect.
3. The number of assets is close to infinite.
4. There are a limited number of risk factors that determine realized security returns. Conceptually, the risk factors are broad economic forces, to which all securities are, to differing degrees, sensitive.

#### These factors are:

- a. Broad, not firm-specific.
- b. The market pays a premium to those who expose themselves to these risk factors.
- c. The value of the risk factor is a random variable.

Thus, APT appears to have a number of benefits as it is not as restrictive as the CAPM in its requirements about individual portfolios and also allows multiple sources of risk. While CAPM assumes that all news in the economy can be lumped together implying equal impact of all news on the stock, APT argues that the stocks would react differently depending on the kind of news. But APT has its flaws, as it is difficult, if not impossible, to implement practically owing to difficulties associated with creating a riskless portfolio comprising exclusively risky assets as required for arbitrage. Moreover, both APT and CAPM exhibit a similar vulnerability in looking for a benchmark for the purpose of comparing the ex post performance and ex-ante returns on real and financial investments. Thus, APT has also received mixed empirical support as, on the one hand, it is an improved version of CAPM and, on the other, it is more difficult to understand and much harder to use.

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