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ASSESSING RESPONSE OF GROWTH FUNDS TO MACROECONOMIC INFORMATION AND MARKET INDEX

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Abstract

Returns on portfolios are expected to be influenced by macroeconomic factors. In this work, we employ the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) to analyze the ability of the portfolios of 50 growth funds in India to rationally evaluate economic news in terms of the risk premium pertaining to the factors. We test if the market portfolio itself suffices in explaining return on growth funds or if the economic factors also play a role in influencing returns. In the process, we conceptualize rolling regressions on a dynamic window basis to obtain efficient parameter estimates.

Keywords: CAPM, APT

JEL Classifications: C21, C22, C30, C88, G10

Introduction

That returns on stocks respond to announcements and movements in leading macroeconomic indicators cannot be denied and is well documented in the literature. However, some macroeconomic factors may exert greater influence than others. In line with finance theory such as Arbitrage Pricing Theory (APT), we identify the influences as probable sources of investment risk. We analyze if additional return is obtained when a portfolio of growth stocks is impacted by economic forces. While most economic series is derived directly from their time series, the anticipated component of inflation is extracted from an appropriate model.

Returns are influenced by expected cash flows which in turn depend on changes in expected inflation rate. Darrat and Tarun (1987) noted in the Indian context that inflation has a negative impact on stock returns. Arjun, Sanjay and Frank (1996) established that unexpected inflation contributed to the negative relationship with a significant negative coefficient. Tufte et.al. (1998) employed a vector error correction model suggesting that inflation deters stock market performance in India. Mukhopadhyay and Sarkar (2003) found inflation to be significant in explaining Indian stock returns. Vuyyuri et. al (2004) used Johansen cointegration test and

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identified a long run equilibrium relationship between industrial production, interest rate, exchange rate, inflation and stock returns in India with the conclusion that inflation rate Granger causes stock price movements in a unidirectional manner. However, Paritosh (2008) concluded the lack of any long run relation between stock prices and inflation considering WPI as a proxy for inflation. Poon, Wai-Ching and Tong, Gee-Kok (2009) used GARCH and EGARCH models to estimate the predictive power of inflation and other variables on stock returns and conditional volatility. Their results for India indicated significant positive effect of inflation on stock return volatility.

Increase in the supply of money increase stock prices. Higher the variation in money supply, lower the equity prices. Results indicated that money had both direct and indirect influence on stock returns. Analysis between Asian-Pacific stock returns and changes in US weekly money supply resulted in the lack of support for a direct causal relationship. In the Indian context, unidirectional causality from money growth to stock returns was established. Further, lagged money supply was found to be relevant in explaining returns.

Ross et.al (1986) conjectured that growth rates in industrial production affect stock returns through their impact on cash flows. Arjun, Sanjay and Frank (1996) found significant positive coefficients pertaining to lagged values of industrial production. Tufte et.al (1998), concluded that industrial production is the largest positive determinant of stock prices in India. While a weak causality was demonstrated from industrial production growth rate to both Sensex and Nifty individually, Vuyyuri et. al (2004) documented significant positive effect of stock returns on industrial productivity in India.

Oil prices play an important role in influencing stock returns. While studies indicate that some countries displayed a negative relation, in India, stock returns exhibited positive correlation with oil prices.

Decrease in term premium lowers returns. In the Indian scenario, long term interest rates established a powerful negative impact on returns. Tufte et.al (1998) found smaller, yet substantial effects from shocks to interest rates on stock index returns in India.

In this work, we consider the impact of anticipated and unanticipated inflation, money supply, industrial production rates, oil shocks and changes in term premium on the return on equity funds. Anticipated inflation is modeled as a seasonal multiplicative ARIMA model.

Data

The period of study is Oct 2004 – Jan 2011. The monthly returns of 50 large cap and diversified growth funds are calculated from the NAV’s of the respective funds. BSE Sensex is used as a proxy for market portfolio and the yield on the 91-day T-Bills is used as the risk free rate.

Table 1. List of Growth Funds

BARODA PIONEER GROWTH-G	L & T OPPO. FUND CUM
BIRLA SL ADV. FUND - G	L&T GROWTH
BIRLA SL EQUITY FUND - G	LIC N MF EQUITY FUND -G
BIRLA SL FRONTLINE EQ. PLAN A - G	LIC N MF GROWTH FUND-G
BNP PARIBAS EQUITY - G	MORGAN STANLEY GROWTH FUND - G
CANARA ROBECO EQUITY DIV.	PRINCIPAL GROWTH
DSP BR OPPO. FUND	RELIANCE GROWTH
DSP BR TOP 100 EQUITY	RELIANCE VISION
DWS ALPHA EQUITY - G	SBI MAGNUM EQUITY - G
ESCORTS GROWTH PLAN - G	SBI MAGNUM MULTIPLIER PLUS
FRANK INDIA BLUECHIP G	SUNDARAM GROWTH
FRANK INDIA OPPO. FUND	SUNDARAM INDIA LEADERSHIP
FRANK INDIA PRIMA PLUS	SUNDARAM SELECT FOCUS
HDFC CAPITAL BUILDER	TATA EQUITY OPPO. G
HDFC EQUITY G	TATA EQUITY PE FUND G
HDFC GROWTH	TATA GROWTH
HDFC TOP 200-G	TATA PURE EQUITY
HSBC EQUITY	TAURUS BONANZA
HSBC INDIA OPPO.	TAURUS STARSHARE
ICICI PRU. TOP 100	TEMPLETON INDIA GROWTH
ICICI PRU. TOP 200	UTI EQUITY
ING CORE EQUITY - G	UTI MASTER PLUS
ING LC EQUITY - G	UTIMNC
KOTAK 50 - G	UTI TOP 100
KOTAK OPPO. - G	UTIUNIT SCHEME 1986 MS

Table 2. List of Macroeconomic Variables and Source

Macroeconomic Variables	*Source*
Money Supply - M1	RBI Bulletin – data on last reporting Friday of the month
Index of Industrial Production	MOSPI, Press Releases by Press Information Bureau GOI
Wholesale Price Index (WPI)	RBI
Wholesale Price Index Crude Oil Petroleum (CO)	RBI
10 year bond yield	CCIL
91-day T-Bill yield (3 month rate derived from YTM curve)	CCIL

Methodology

From the set of macroeconomic variables identified, we render the following transformation to obtain the monthly rates.

Table 3. Transformation to Macroeconomic Variables

Macroeconomic Variables	Transformation
Change in term premium (TP)	TP_t- TP_{t-1}, where Term Premium is calculated as 10 year bond yield - T-Bill yield (3 month rate derived from YTM curve)
Money Supply (M1)	$\ln(M1_t)$- $\ln(M1_{t-1})$
Wholesale Price Index Crude Oil Petroleum (CO)	$\ln(CO_t)$- $\ln(CO_{t-1})$
Anticipated Inflation (AI)	Modeled from realized inflation as a Seasonal Multiplicative ARIMA Model
Unanticipated Inflation (UI)	Realized inflation – Anticipated inflation, where realized inflation is $\ln(WP1_t)$- $\ln(WPI_{t-1})$
Index of Industrial Production (IIP)	$\ln(IIP_t)$- $\ln(IIP_{t-1})$

The anticipated component of inflation is modelled as follows:

Anticipated Inflation

While the CPI series is used to represent inflation in some countries, we find WPI series to be suitable for modeling inflation in India, since WPI affects the prices of equities. Augmented Dickey-Fuller (ADF) unit root test is employed to test for stationarity of the series. The ln difference of the WPI series is found to be stationary. While moving average models provide good fit to the series, seasonal variations depicted by the series can be better captured using seasonal models. Further, a multiplicative component that also factors seasonality results in a sound model with good forecasting abilities. For further details and results, refer to working paper on “Identification of benchmark share price index based on efficiency using DEA.”

The model is formulated as

$$(1 - B)(1 - B^8)Y_t = \mu + (1 - \theta_{11}B - \theta_{12}B^2)(1 - \theta_{21}B)(1 - \theta_{31}B^8)a_t$$

Y_t represents the original WPI series, θ represents the MA component and B stands for the backshift operator with $B^n = a_{t-n}$. The model is constructed using SAS.

We examine the relation between economic factors and returns on portfolios of growth funds. Portfolios of stocks are expected to respond quickly to market information while most economic time series are not expected to assimilate all the information about market factors at the same point of time when measured at frequent time points, due to the timing of measurement and averaging associated with the series. Consequently, stock market indices are expected to influence portfolio returns to a greater extent than macroeconomic variables.

CAPM

The CAPM model conceptualizes the following relation between the return on equity portfolios and their systematic component of risk (Modigliani e.al 1973):

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

where

$E(R_i)$ = expected return on portfolio i

R_f = risk-free rate

$E(R_m)$ = expected return on market portfolio

β_i = systematic risk measured as $\frac{\sigma_{R_i R_m}}{\sigma_{R_m}{}^2}$

The stochastic version of the model is of the form:

$R_{it} = R_{ft} + \beta_i(R_{mt} - R_{ft}) + \varepsilon_{it}$

Here R_{it} is the realized return series on portfolio i during the period t, R_{ft} is the riskless rate during the period t, R_{mt} is the realized return on the market portfolio and ε_{it} is the residual series. We employ two methods to find if there is a significant difference between the estimated coefficients in a regression framework and the risk premium.

Method 1 – Time Series and Cross Section Regressions

We adopt a two step procedure. In the first step, we perform the time series regression of the return on each portfolio of growth fund over the period Oct 04 – Jan 11 on the return on market portfolio Sensex and the parameter estimates are obtained.

$$R_{it} = \hat{\alpha}_{0i} + \hat{\beta}_i R_{mt} + \hat{u}_{it} \quad \text{... (1)}$$

The estimate of beta ($\hat{\beta}_i$) in the above regression is the same as the ratio of covariance of the portfolio returns to the variance of the market return. The betas are computed for all 50 growth funds.

The beta obtained for the individual portfolios in step one is introduced in step 2 as the independent variable in the cross section regression of average returns of each portfolio on betas during Oct04-Jan11.

$$\overline{R_i} = \hat{\gamma}_0 + \hat{\gamma}_1 \beta_i + \hat{u}_i \quad \text{... (2)}$$

If CAPM holds, then $\overline{R_i} = \overline{R_f} + \beta_i(\overline{R_m} - \overline{R_f}) + \overline{u_i}$

We estimate the coefficients of regression 2 and test if there is a significant difference between the estimated coefficient of intercept and the risk-free rate and between the slope coefficient and market risk premium. Specifically, we test if

a) $\hat{\gamma}_0 = \overline{R_f}$
b) $\hat{\gamma}_I = \overline{R_m} - \overline{R_f}$
c) $\overline{R_m} - \overline{R_f} > 0$

where $\overline{R_m}$ and $\overline{R_f}$ denote the average values.

Method 2 - Time Series and Cross Section Regressions on A Rolling Window Basis

We adopt a variant of the Fama, Macbeth (1973) technique. Instead of dividing the data into various sub periods, we adopt a rolling window regression approach so that the parameter estimates are robust in this dynamic process. We use the data covering 60% of the time period for estimating beta using the equation 1 in method 1 and use the estimated beta as the explanatory variable in the regression of the return of the 50 portfolios during the next month on the portfolio betas (regression equation 2). We obtain the estimates of $\hat{\gamma}_0$ and $\hat{\gamma}_1$. This procedure is repeated to cover the remaining 40% data on a rolling window basis by dropping the first month data in the 60% data set and including the returns for the month prior to the current first month of the 40% data set. Using this method, we estimate 30 values of $\hat{\gamma}_0$ and $\hat{\gamma}_1$ for the entire 40% data covering Aug 08 – Jan 11. The dynamic estimates in conjunction with the data on portfolio returns rather than that of individual securities can render the estimates more reliable. Any error in the measurement of the factor sensitivities leading to possible bias in the estimates $\hat{\gamma}_0$ and $\hat{\gamma}_1$can be reduced by using portfolios of stocks, such as the growth funds, with each fund containing sufficient number of stocks. We test whether the estimated coefficient $\hat{\gamma}_0$exceeds Rf and if the coefficient $\hat{\gamma}_1$ exceeds the market risk premium. We use the t-statistic

$$t(\hat{\gamma}_i) = \frac{\overline{\hat{\gamma}_i}}{s(\hat{\gamma}_i)/\sqrt{n}}$$

where $s(\hat{\gamma}_i)$ is the standard deviation of $\hat{\gamma}_i$ and n is the number of observations used to estimate the average value of $\hat{\gamma}_i$ and is also the same as the number of months in the period Aug08-Jan11. We calculate $t(\overline{\hat{\gamma}_i} - \overline{R}_f)$ using the denominator $s(\hat{\gamma}_i)/\sqrt{n}$as a close approximation (Chen, Roll, Ross 1986).

APT

Method 1

We hypothesize the following factor model for portfolio returns:

R = $\alpha + b_{TP}TP + b_{M1}M1 + b_{CO}CO + b_{AI}AI + b_{UI}UI + b_{IIP}IIP + b_{RM}RM + u$

The b's represent the factor loadings on the macroeconomic variables, RM represents the market portfolio Sensex and R stands for the return on portfolio. Again, we adopt a two step procedure, to study the impact of the macroeconomic factors on the portfolio returns.

In step 1, we regress the return on each growth fund on the six macroeconomic variables identified and the return on the market index during Oct 04 – Jan 11. The factor sensitivities for each factor is extracted for each fund. We find that only the coefficients associated with CO, AI, UI and RM are significant in the above regression.

The following provides the parameter estimates of the regression of one portfolio returns (HSBC India Opportunities fund)during the entire time period on the six macroeconomic variables and the market portfolio. We see that TP, M1 and IIP do not pronounce a substantial impact on portfolio returns.

Table 4. Regression of Returns Of HSBC India Opportunities Fund on Macroeconomic Variables and Market Index

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.007232	0.004758	1.51984	0.133188
TP	-0.7508	0.817584	-0.91832	0.361698
M1	-0.03446	0.036295	-0.94946	0.34575
CO	0.062625	0.032501	1.926856	0.058177
AI	-1.35461	0.681692	-1.98713	0.050938
UI	-1.04234	0.575286	-1.81187	0.074422
IIP	-0.03027	0.05663	-0.53444	0.594778
RM	0.903979	0.038904	23.23603	4.61E-34

We find that the signs for these variables are not consistent across all portfolios.

However, in the regressions for all portfolios, the exposure associated with market was consistently positive in sign and the most significant influential factor. The macroeconomic factors still seemed to exert some influence as discovered by APT and that the pricing impact by these variables cannot be ignored.

In step 2, we perform the regression of the average return on portfolios on the factor loadings of only those macroeconomic variables that are found to significantly influence portfolio returns in step 1. We fit the equation

$$\overline{R_i} = \hat{\gamma}_0 + \hat{\gamma}_1\beta_{COi} + \hat{\gamma}_2\beta_{AIi} + \hat{\gamma}_3\beta_{UIi} + \hat{\gamma}_4\beta_{RMi} + \hat{u}_i$$

The parameters $\hat{\gamma}_{1,}\hat{\gamma}_{2,}\hat{\gamma}_3$ and $\hat{\gamma}_4$ are compared against the respective risk premiums.

Method 2

We use the information during Oct04 – Jul 08 constituting 60% of the observations. In step 1 we regress the returns on portfolio on the six macroeconomic variables and market portfolio during this period to estimate the factor sensitivities. In step 2 we regress the return on portfolios in Aug08 on the betas obtained in step 1 for the 50 portfolios for those macroeconomic factors that are found to be significant in at least one regression in step 1. Only CO, AI, UI and RM qualify in the process. We obtain the respective estimates of $\hat{\gamma}_{0,}\hat{\gamma}_{1,}\hat{\gamma}_{2,}\hat{\gamma}_3$ and $\hat{\gamma}_4$. We continue the process on a rolling window basis and estimate the regressions in step 1 and step 2 till we get the parameter estimates for all months from Aug08 – Jan11. We have developed a macro in excel for fitting the regression equations.

We adopt the t-statistic to test if $E(\hat{\gamma}_{0,}) = \overline{R_f}$ and test the following hypothesis:

$$E(\hat{\gamma}_1) = \overline{R_{CO}} - \overline{R_F}$$

$$E(\hat{\gamma}_2) = \overline{R_{AI}} - \overline{R_F}$$

$$E(\hat{\gamma}_3) = \overline{R_{UI}} - \overline{R_F}$$

$$E(\hat{\gamma}_4) = \overline{R_M} - \overline{R_F}$$

Results and Discussions

CAPM-Method 1

The estimate of $\hat{\gamma}_0$ and that of $\hat{\gamma}_1$ have the same sign as that of $\overline{R_f}$ and market risk premium respectively. The actual value of $\overline{R_f}$ is higher than that of $\hat{\gamma}_0$ and $\overline{R_M}$ - $\overline{R_f}$ is lower than the estimate of $\hat{\gamma}_1$.

Table 5. Parameter Estimates during Oct 04 – Jan 11

$\hat{\gamma}_0$	$\hat{\gamma}_1$	$\overline{R_f}$	$\overline{R_M}$ - $\overline{R_f}$
0.019 (3.413)	-0.0028 (-0.487)	0.0585	-0.0429

The values in the brackets provide the t-stat for the coefficients. We infer that the intercept, though significant, is not equal to the risk-free rate in the period. $\hat{\gamma}_1$ on the other hand does not play a significant role in influencing portfolio returns.

CAPM-Method 2

The average values of the parameters of the regression in step 2 are presented below.

Table 6. Average and T Values of Estimates of Step 2 Regression

$\overline{\hat{\gamma}_0}$	$\overline{\hat{\gamma}_1}$	$t(\overline{\hat{\gamma}_0})$	$t(\overline{\hat{\gamma}_1})$
0.01976	-0.0099	-2.9437	1.7483

While the signs of the estimates coincide with that postulated in theory, the t-stats. indicate that the expected value of $\overline{\hat{\gamma}_0}$ during Aug08-Jan11 is not equal to that of the average risk-free rate in that period and that the expected value of $\overline{\hat{\gamma}_1}$ is more than the theoretical market risk premium.

APT-Method 1

The intercept and the parameter estimates for the sensitivities associated with crude oil prices, anticipated, unanticipated inflation and market risk premium during Oct04-Jan11 are displayed in the table below:

Table 7. Estimates of Economic Factor Sensitivities

$\hat{\gamma}_0$	$\hat{\gamma}_1$	$\hat{\gamma}_2$	$\hat{\gamma}_3$	$\hat{\gamma}_4$
0.0189 (3.7732)	0.0019 (0.1407)	0.0036 (3.8232)	-0.0021 (-1.6203)	-0.0015 (-0.2784)

While the regression estimate of risk premium associated with anticipated inflation exerts influence on portfolio returns, its estimate is greater than $\overline{R_{AI}}$ - $\overline{R_f}$. $\hat{\gamma}_0$ and the estimates of the premium on unanticipated inflation and market risk have the same sign as postulated in theory while the signs on the estimated premiums on crude oil prices and anticipated inflation do not conform with their theoretical values.

APT-Method 2

The following table provides the average values of risk-free rate, CO, AI, UI and market index returns during Aug08 – Jan11.

Table 8. Average Values of RF, CO, AI and Market Index Returns

$\overline{R_f}$	0.050675
$\overline{R_{CO}}$	0.00121
$\overline{R_{AI}}$	0.00423
$\overline{R_{UI}}$	-2.3×10^{-5}
$\overline{R_M}$	0.008142

The average values of the parameters of the regression in step 2 are presented below. s(γ) stands for the standard error.

Table 9. Average Values of Parameter Estimates, Standard Errors and T Values of Step 2 Regression

$\overline{\hat{\gamma}_0}$	$\overline{\hat{\gamma}_1}$	$\overline{\hat{\gamma}_2}$	$\overline{\hat{\gamma}_3}$	$\overline{\hat{\gamma}_4}$
0.0179	0.0132	0.0018	0.0017	0.0049
$s(\overline{\hat{\gamma}_0})$	$s(\overline{\hat{\gamma}_1})$	$s(\overline{\hat{\gamma}_2})$	$s(\overline{\hat{\gamma}_3})$	$s(\overline{\hat{\gamma}_4})$
0.05642	0.0948	0.00875	0.00599	0.1105
$t(\overline{\hat{\gamma}_0})$	$t(\overline{\hat{\gamma}_1})$	$t(\overline{\hat{\gamma}_2})$	$t(\overline{\hat{\gamma}_3})$	$t(\overline{\hat{\gamma}_4})$
-3.1766	3.6207	30.23	47.8614	2.3537

Except for the intercept, the estimates are of different sign in comparison to the risk premium.

We can conclude that $E(\hat{\gamma}_{0,}) \neq \overline{R_f}$ and that the parameter estimates are all higher than the corresponding risk premiums predicted by theory. Thus, $E(\hat{\gamma}_1) > \overline{R_{CO}} - \overline{R_F}$, $E(\hat{\gamma}_2) > \overline{R_{AI}} - \overline{R_F}$, $E(\hat{\gamma}_3) > \overline{R_{UI}} - \overline{R_F}$ and $E(\hat{\gamma}_4) > \overline{R_M} - \overline{R_F}$.

Under time-series regressions, the t-statistic of RM averaged 26.5 over 50 portfolios during Oct04-Jan11 under CAPM and averaged 26 over 50 portfolios under APT framework even upon introduction of macroeconomic factors. That market portfolio influences time series variability in equity fund returns cannot be denied. On the contrary, the t-statistic for the parameter associated with the market risk premium in the cross-section regression was only -0.487 under CAPM and -0.278 in the APT formulation. The estimated factor loadings of market index do not explain the cross-sectional differences in the returns on the portfolios of equity funds.

Conclusions

Under CAPM, if the market index is efficient, the macroeconomic factors should not really be necessary to improve pricing ability. We find that in addition to market index, crude oil prices, anticipated and unanticipated inflation also explain portfolio returns. Economic news gets reflected in returns on growth funds and may contribute to factors that improve the estimate of the market index perhaps by bringing out the information missing in the market factor or in the form of correlations with possible measurement errors in market exposure estimates.

We find that the parameter estimates of the sensitivities of macroeconomic factors are priced more than the theoretical risk premiums on crude oil prices, anticipated, unanticipated components of inflation and returns on market portfolio. While the market index explains time series variability in portfolio returns, its influence in cross-section regressions and asset pricing is not much pronounced. The signs in the coefficients of the parameter estimates obtained under CAPM coincide with the theoretical predictions. Except for the estimate on Rf and the premiums on unanticipated inflation and market index during Aug08-Jan11, the signs of the estimates of other economic factors fail to comply with theory. Across both CAPM and APT approaches, we find that the return per unit of risk premium is higher than that suggested by theory.

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