An initiative to explore an efficient stock market

Introduction

Beginning with Sharpe (1964) and Lintner (1965), economists have systematically studied the asset pricing theory or, precisely, the portfolio choice theory of a consumer. Sharpe (1964) and Lintner (1965) have introduced the Capital Asset Pricing Model (CAPM) to investigate the relationship between the expected return and the systematic risk. From the day CAPM was developed, it is being regarded as one of the primary models to price an equity or a bond portfolio. However, economists of later generation have developed Intertemporal Capital Asset Pricing Model (ICAPM) and Arbitrage Pricing Theory (APT) which are more sophisticated approach compared to the original CAPM. These models and also models for pricing options as developed by Black and Scholes effectively predict asset returns for given levels of risks which are useful information to an investor in the case of selecting his portfolio or a banker in the case of monitoring financial health of a company. Over last four decades, investors, bankers and market researchers had used such models to predict asset returns in a normal market condition. The normal market condition essentially means when equity prices are not driven by any sentiment or, in other term, stocks are not systematically overvalued or undervalued by the market players. In such circumstances, markets act like efficient markets. But, the anomaly arises when such conditions are not valid for a capital market.

Although theories for pricing of a bond or a stock or an option were considered by economists as an enormous breakthrough in the history of finance, inventors of them believed financial markets evolve with some special characteristics: market prices adjust to new information without delay and, as a result, no arbitrage opportunities exist that would allow investors to achieve above-average returns without accepting above-average risk. This hypothesis is associated with the view that price movements approximate those of a random walk. If new information develops randomly, then so will market prices, making the market unpredictable apart from its long-run uptrend. Under such backdrop, Geometric Brownian Motion (GBM) process, also sometimes called a lognormal growth process, had gained wide acceptance as a valid model for the growth in the price of a stock over time. Most pronounced economists in 1970s and 1980s had considered GBM process or its ancestor, efficient market hypothesis, the leading principle to understand the basic nature of a financial market so that they could be used as input in various asset-pricing models. CAPM or its any modified version depends on identifying a “market portfolio” that is mean-variance efficient. Practically such portfolio could be any index of an efficient capital market; thus it was grown as a tradition to consider any market index as a proxy of such portfolio. However, prior to use the model it was never inspected at what extent the market is efficient. Since financial markets are inefficient in today’s world, application of such models leads a significant flaw to the institution’s policies. This inference was supported by empirical studies by different scholars that had established in one hand, the tail of the return distribution is much heavier compared to the normal distribution and, on the other, existence of strong autocorrelation in the market returns.

What was described as an "anomaly" by the most pronounced economists of earlier decades, has been recognized as a "rule" through empirical studies by several scholars. Consequently, the question that has gained importance to the market practitioners or researchers is "whether the bond or stock or option pricing models invented by great economists in 1970s and 1980s would apt to provide additional information to investors?". The answer would necessary be negative for traders who look for the short-term gain by playing on the market sentiment. This is because the models cannot predict the direction and intensity of the market sentiment. The second category of investors looks for the long-term benefits by depending on the information on firm's financial health. In this case, the dilemma is quite subjective because we shall not find equity prices, as input of the models, that have not been driven by any sentiment. However, if price changes due to the irrational market behavior are quantified and isolated from the equity price (or return), the residual part is the portion of the equity price (or return) that is governed only by firm-specific factors. Such prices (or returns) would be corresponded a hypothetical efficient stock market and can be used as an effective input in the bond or stock or option pricing formula. The approach will widen the scope of asset-pricing models ranging from a strict efficient market to an inefficient market. The rest of the paper is organized as follows: Section 2 depicts the model. Section 3 provides empirical findings. The conclusions and policy implications are given in Section 4.

2. The Model

Behaviors of investors in the equity market are generally governed by the market sentiment. As an example, post-election uncertainty or uncertainty in policies of newly elected government may induce a panic among investors which subsequently may lead a major downfall in equity prices. Thus any upturn/downturn in equity prices might be a consequence of any of the hundreds unforeseen events such as frauds or war or draught or hike/fall in oil prices etc. These events are not predictable, however, playing on market sentiment they change the overall supply/demand and consequently disrupt the stability of the market. Another kind of factors that regulates the behavior of rational investors is firm-specific and does not depend on market behavior. The firm-specific factors eg. strike, rise/fall of sale etc. induce an upward or downward shift in the net asset value of the firm. Consequently, any rational investor would prefer to hold long position if the firm's net asset value would likely to boost and, conversely, he would prefer to hold short position if the firm's net asset value would likely to decrease. Accordingly, there would essentially be a shift in the demand for equity of that firm which lead to a change in the equity price. Thus equity price changes might be consequent either to alteration of the firm's financial strength or to any exogenous factor that plays on the market sentiment or, otherwise, any combined effect of the above two factors. These two factors are uncorrelated when any shift in the firm's net asset value is not governed by the market sentiment and vise-versa. Therefore, we can assume that equity (E) of a firm is a linear combination of effects of two factors F and M, where F is the factor specific to the firm and M is the factor relates to the market. Thus,

$$E = \alpha F + (1-\alpha)M \qquad (1)$$

where α is the relative weightage to the factor F. Any change in equity price is observable from the market, however, influence of either F or M on the equity price cannot be separated directly. We can segregate the effect of F and M from the equity price under certain reasonable assumptions which are described below.

The factors F and M can be viewed as two assets which are formed a portfolio, E. Therefore, the return based on the firm's equity prices at time t, R_t^E, is a linear combination of the return on the asset F, R_t^F, and the return on the asset M, R_t^M:

$$R_t^E = \alpha R_t^F + (1-\alpha) R_t^M \tag{2}$$

Equation (2) can be represented in terms of betas:

$$\beta_E = \alpha \beta_F + (1-\alpha)\beta_M \tag{3}$$

where $\beta_I = \dfrac{\mathrm{Cov}(R^I, R^M)}{\mathrm{VaR}(R^M)}$ gives the market risk of the asset I (I=E/F/M). More explicitly, β_I explicates the relationship between the return on the asset I and the return on the market portfolio.

Case 1: The return on the asset F is uncorrelated with that of the asset M, β_F is essentially zero. Therefore, α can be solved as below:

$\alpha = 1 - \beta_E$ (as β_M is equal to one)

Using the value of α, the return on the asset F can be evaluated from equation (2) as below:

$$R_t^F = \frac{R_t^E - \beta_E R_t^M}{1-\beta_E} \tag{4}$$

Case 2: The return on the asset F is correlated with that of the asset M, β_F is nonzero. As any change in the net asset value of the firm would lead to a similar change in R_t^F, we can estimate β_F using historical data on firm's Net Asset Value (NAV) and the market index, S. Thus, β_F can be estimated using following formula:

$$\beta_F = \frac{\mathrm{Cov}(R^{NAV}, R^M)}{\mathrm{VaR}(R^M)}$$

where R_t^{NAV} is the return based on historical data on NAV. In this case, α can be solved using equation (3) as below:

$$\alpha = \frac{1-\beta_E}{1-\beta_F}$$

Using the value of α, the return on the asset F can be evaluated from equation (2) as below:

$$R_t^F = \frac{(1-\beta_F)R_t^E - (\beta_F-\beta_E)R_t^M}{(1-\beta_E)} \quad (5)$$

When the historical series on firm's Net Asset Value (NAV) is not available, alternatively we can estimate β_F by the iterative procedure described below.

Let us denote the approximation of β_F and R_t^F in the i th iteration as $\beta_F(i)$ and $R_t^F(i)$ respectively. The equation (5) gives i th approximation of R_t^F as follows:

$$R_t^F(i) = \frac{(1-\beta_F(i-1))R_t^E - (\beta_F(i-1)-\beta_E)R_t^M}{(1-\beta_E)} \quad (6)$$

Using the above equation the set of values of $R_t^F(i)$ can be calculated for t = 1,2,----,n. Accordingly, the i th approximation of β_F would be,

$$\beta_F(i) = \frac{\mathrm{Cov}(R^F(i), R^M)}{\mathrm{VaR}(R^M)} \quad (7)$$

The first approximation of β_F might be $\beta_F(1) = 0$. Using equation (6) and (7) it is possible to generate a series of appoximations for β_F. The process converges if $|\beta_F(i) - \beta_F(i-1)| < \varepsilon$. Accordingly, we can obtain a desired degree of accuracy by considering a smaller ε.

Case 1 and 2, described above, provide layouts for computing β_F and R_t^F in two distinct scenarios. Consequently, we can compute the part of the return based on the firm's equity prices governed only by the fundamental value and not affected by the market sentiment. Therefore, this part may equivalently be considered as the return on the equity in an efficient stock market and may reasonably be taken as inputs in the asset pricing models.

3. Empirical Findings

Prior to exercise any asset pricing model for predicting equity returns, it is worthwhile to examine whether the capital market is informationally efficient. If the market is efficient then market prices adjust to new information without delay. As an example, in an efficient stock market, announcement of quarterly performance results of a company

leads to a move the equity prices immediately. Therefore, any positive (or negative) growth in the quarterly profit of a company would likely to boost (or reduce) its equity prices in the same day of the announcement of quarterly performance results. Our goal in the present section is to examine whether such assertion holds for the Indian equity market. We have considered samples of major Indian companies and computed one-day returns based on daily closing prices in National Stock Exchange of India for some specific dates. Those dates include the dates of announcement of financial result of the companies for two consecutive quarters, April-June and July-September in the year 2005. The results have been specified in the following tables.

Table 1: Decline in the net profit in the quarter Apr-Jun 2005 and one-day returns for selected dates for selected major Indian companies

	Bharat Petroleum	**Hindistan Petroleum**	**Canara Bank**	**Mico**	**Andhra Bank**	**Kotak Mohindra Bank**	**CNX Nifty**
Percentage fall in net quarterly profit	343.7% (#)	305.4%(#)	44%	2%	43.3%	11%	-
Date	**One day return**						
19-Jul-2005	0.5	0.6	-1.3	0.4	3.9	1.3	0.1
20-Jul-2005	0.0	-1.6	-0.1	1.7	1.1	2.1	0.2
21-Jul-2005	0.2	0.1	-1.6	2.8	-2.2	0.9	-0.5
22-Jul-2005	1.9	0.5	**4.0***	-0.2	3.2	1.3	1.6
25-Jul-2005	0.6	0.0	0.5	-2.4	2.1	0.8	1.1
26-Jul-2005	0.2	-0.3	-1.6	2.8	**5.4***	**0.4***	0.5
27-Jul-2005	1.6	0.5	0.3	**1.7***	-4.9	0.0	0.7
29-Jul-2005	**1.7***	-3.3	4.2	-1.4	0.8	-0.9	-0.3
01-Aug-2005	1.5	**1.7***	2.8	0.7	-3.5	0.0	0.2
02-Aug-2005	4.0	4.1	-2.1	-0.2	1.2	1.4	1.5
03-Aug-2005	-0.1	-1.3	-2.7	1.0	-0.5	2.1	0.1
04-Aug-2005	-3.5	0.2	-2.1	-0.7	-0.5	3.6	0.5

***** Corresponds the date of declaration of quarterly financial results

# Indicates a loss in the quarter April-June 2005

Table 2: Growth in the net profit in the quarter Jul-Sep 2005 and one-day returns for selected dates for selected major Indian companies

	Infosys	Allahabad Bank	IDBI	ACC	Hdfc Bank	ICICI Bank	CNX Nifty
Percentage rise in net quarterly profit	13.9%	1.69%	22%	159%	31.5%	31.2%	-
Date	**One day return**						
07-Oct-2005	-1.4	-1.3	-1.5	-1.5	-0.5	-0.9	-0.2
10-Oct-2005	1.9	0.0	-1.5	-1.8	1.4	0.3	-0.3
11-Oct-2005	**2.3***	2.1	2.4	1.3	0.2	1.3	0.9
13-Oct-2005	-2.3	-2.8	-1.3	-1.6	-1.7	**-2.4***	-2.0
14-Oct-2005	-0.8	-1.4	-2.8	**-5.5***	-2.8	-3.8	-2.1
17-Oct-2005	-0.4	**-2.8***	-1.9	0.8	**-0.8***	-1.2	0.0
18-Oct-2005	-2.4	-0.6	-3.5	0.6	0.5	-0.7	-0.7
19-Oct-2005	-1.1	-6.7	-6.6	0.4	-1.5	0.2	-2.3
20-Oct-2005	1.4	-0.7	**-6.9***	-0.3	-0.6	-0.1	-0.7
21-Oct-2005	0.6	0.3	-3.2	-0.5	0.6	1.9	2.0
24-Oct-2005	-1.7	0.1	-2.0	0.6	-1.9	-1.8	-2.0
25-Oct-2005	0.4	3.1	-1.5	0.5	-0.8	1.3	1.0

* Corresponds the date of declaration of quarterly financial results

The table 1 includes a sample of six major Indian companies which had experienced a substantial decline in the net profit during the quarter April-June 2005. However, immediately after the announcement of the financial results of those companies, one-day return based on the firm's equity prices has been observed as positive. Ironically, equity prices had boosted even after an inferior financial performance of a company. Practically, such prices moved in the direction of the market index which had experienced a upward trend in-between 20th July 2005 to 3rd August 2005. Similarly, the table 2 represents a sample of six major Indian companies which had experienced a substantial increase in the net profit during the quarter July-September 2005. However, immediately after the announcement of the financial results of those companies, one-day return based on the firm's equity prices has been observed as negative. Therefore, equity prices had declined even after a superior financial performance of a company. Virtually, such prices moved in the direction of the market index which had experienced a downward trend in-between 7th October 2005 to 25th October 2005. Such events are mere common phenomena in the Indian equity market to establish that announcement of a firm's quarterly performance results has insignificant effects on equity prices and equity prices move where market sentiments resolute. Therefore, market sentiments are dominant factor to any major publicly announced information on the firm's financial health. These insights lead to the conclusion that the Indian equity market is inefficient. Although markets are inefficient, we can compute the component of the return based on the firm's equity prices that is governed only by the fundamental value and not effected by any irrational market movement. On account of smoothing out 'irregular component' or 'noise' from the return series we employ three days moving average on the return based on equity prices of each

company as well as on the return on Nifty Index specified in the table 2. Consequently, modified returns based on the firm's equity prices are computed using equation (4) and are illustrated in the following table.

Table 3: Modified Returns based on equity prices and the Correlation Coefficient between firm-specific returns and market returns

	Infosys	Allahabad Bank	IDBI	ACC	Hdfc Bank	ICICI Bank
Date	**Modified one day return**					
10-Oct-2005	0.8	0.0	-0.3	-0.7	0.3	0.1
11-Oct-2005	1.0	0.6	0.2	-0.4	0.2	0.3
13-Oct-2005	0.7	1.2	0.1	-1.3	-0.8	-0.3
14-Oct-2005	0.0	0.1	-1.1	-1.3	-0.9	-0.8
17-Oct-2005	-0.4	0.0	-2.1	-0.8	-0.5	-0.7
18-Oct-2005	-0.4	-1.6	-3.4	1.2	0.0	0.7
19-Oct-2005	0.4	-0.5	-4.9	1.0	0.2	1.3
20-Oct-2005	0.6	-1.8	-5.4	0.1	-0.3	1.1
21-Oct-2005	0.3	0.3	-3.9	0.1	-0.5	0.3
24-Oct-2005	-0.5	0.6	-2.4	0.0	-0.9	0.1
Series	**Correlation with the return on Nifty Index**					
Original Return Series	0.59	0.65	0.37	0.36	0.69	0.78
Modified Return Series	0.10	0.12	0.02	0.04	0.08	0.12

It can easily be verified that the modified return series' specified in the table 3 are less volatile compared to the original return series in the table 2. The additional volatility in equity returns in table 2 compared with returns in table 3 is due to that former has moved in the direction where market sentiments resolute whereas the later is free from the effect of market sentiments. The phenomena can be well understood from the fact that the correlations of the return series specified in the table 3 with the market index are near to zero whereas the original return series' possess a very high correlation with the market index. Thus, returns specified in the table 3 are governed only by their fundamentals. If a hypothetical stock market is constructed using those modified returns based on the firm's equity prices, then such market must be an efficient market. Returns (or prices) of that hypothetical stock market may be used as inputs in various asset-pricing theories.

4. Conclusion

Financial markets are inefficient in the today's world. This assertion would be well established when we find equity prices move in the direction of the market sentiment. Especially in the economy with emerging markets, it can be found that the market sentiment is a major driving force behind equity price movements and, most of the times, it is dominant factor than any major publicly announced information on the firm's financial health. Our empirical study for India has established that announcement of a firm's quarterly performance results has insignificant effects on equity prices and equity prices move where market sentiments resolute. In such circumstances, a bond or stock or option pricing models developed by pronounced economists of earlier generation are

basically normative approaches. Those theories presume equity prices are determined by their fundamentals and market sentiment has a transitory role to play. In this perspective, the model developed in the present paper has the following basic insights: Price changes due to the irrational market behavior can be quantified and isolated from the equity price movements (or returns). The residual part is the portion of the equity price (or returns) that is governed only by firm-specific factors. Therefore, if a hypothetical stock market is constructed using that residual part then such market must be an efficient market. In that market, irrational market movements cannot induce investor to overvalue or undervalue a stock and the equity price (or return) is governed only by its fundamental value. Such hypothetical stock market might be useful to market practitioners as equity prices (or returns) in that market can be used as inputs in the bond or stock or option pricing formula. The approach will widen the scope of asset-pricing models ranging from a strict efficient market to an inefficient market.

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