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Is the Spread between E/P Ratio and Interest Rate Informative for Future Movement of Indian Stock Market?

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Empirical evidence for the developed economies suggests that the information on the spread between E/P ratio at the stock market and a measure of interest rate is sometimes useful in predicting stock market movements. In case of emerging markets like India, the issue has, however, not received adequate attention. The present paper employs several statistical and econometric tools (viz., correlation analysis, regression analysis, Granger's causality test and measures of out-of-sample forecast performance) for rigorously assessing the usefulness of spread in explaining stock market return in India. An attempt has also been made to examine the possibility of formulating profitable business/trading strategy using spread for varying degrees of transaction cost. Empirical results reveal that though spread seems to have reasonably strong causal influence on return and the causal model helps achieving forecasts slightly better than the random walk model, the usefulness of spread in formulating a profitable business strategy is not clear. The paper finds that the performances of different strategies vis-à-vis a simple buy-and-hold strategy would crucially depend on several factors like the choice of interest rate, choice of trading period and choice of threshold for determining 'extreme' values of spread. The paper also reveals that the profitability of a spread based trading strategy would crucially depend on the extent of transaction cost. In this context, however, it is interesting to note that a spread based strategy in many occasions yielded higher returns than that of the buy-and-hold strategy, especially when transaction cost was low.

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1. Introduction

The issue of whether the spread between Earning/Price (E/P) ratio (also known as earnings yield) and interest rate contains useful information about the movement of stock market is a matter of empirical investigation in recent years (Rolph and Shen, 1999). As the information on both E/P ratio and the prevailing market rate of interest are publicly available, apparently the spread between two variables as defined above could not be an important indicator of market movements in an efficient market. Empirical literature, however, does not provide conclusive answer to the validity of market efficiency (Basu, 1977; Campbell et al, 1997; Lo, 1996; Shiller, 1993)[1] . In practice, generally movements of a few influential variables are closely monitored by market practitioners for assessing the market condition with a view to predict the future direction of stock prices. Along with different indicators, market practitioners often use different measures of spread to analyze and predict market movements. A number of business publications[2] in developed countries also give importance to spread in their discussions of overall market conditions and outlooks. Though a number of research papers attempted to explain/predict future stock return by considering some of the regressors among E/P ratio, yields, interest rate, earnings per share, etc., (Cutler et al, 1991; Lander et al, 1997; Mohanty, 1997; Pesaran and Timmermann, 1995; Qi, 1999; Qi and Maddala, 1999; Samanta and Rajpathak, 2001; Shiller and Campbell, 1993) the literature on direct evaluation of the usefulness of spread between E/P ratio and interest rate as an indicator for overall market outlook is at a nascent state[3] . We came across only two recent papers by Rolph and Shen (1999) and Shen (2000), demonstrating the information content of spread for explaining future overall equity market movements.

In this paper, an attempt is made to assess the usefulness of spread between E/P ratio and interest rate in the context of Indian stock market. For analyzing the relationship between spread and return, a number of analytical tools, viz., correlation analysis, regression analysis, Granger's causality test and measures of out-of-sample forecast performance have been employed. Thereafter, we explore the possibility of formulating profitable business/trading strategy using spread. The paper is organized into seven sections. In Section 2, a brief review of literature is presented. The basic premises of considering the spread as containing advance information about stock market movement are also discussed therein. The methodology and analytical tools used in the study are presented in Section 3. Section 4 deals with describing the basic database and

[1] Reviews of market efficiency research in Indian context are available in Barman (1996), Subba Reddy (1997) among others.

[2] A few examples of such publications are Wall Street Journal, Barrons, Business Week (See Rolph and Shen, 1999).

[3] A review of research on Indian stock market is available in Barua and Varma (1994).

the derivation of measures for return and spread series in the study. In Section 5, empirical results on the relationship between spread and return are presented and interpreted. Section 6 examines the profitability of a few business/trading strategies based on spread in Indian stock market. Finally, Section 7 summarizes the main findings with concluding observations.

2. A Brief Review of Literature

The primary thrust of this section is to present a possible explanation on why the spread may contain useful information about future return. In this context, it may be informed that the topic is an emerging issue and so far not much research work has been done on the subject. In this section, therefore, the issue is discussed based on what is available in the existing literature.

2.1 Why Spread May Contain Information About Future Return?

An intuitive explanation on why spread may contain information about future stock market return is discussed by Rolph and Shen (1999). The information content follows from the notion that relative to the interest rate (say, i_t) there is an equilibrium level of spread. Under the assumption that expected future growth rate of P/E ratio is positively related to the current spread $[(E/P)_t - i_t]$, a higher spread leads to higher expected growth for the P/E ratio, which in turn gives higher expected market return[4] . In other words, when the spread is higher than its equilibrium level, the P/E ratio is more likely to grow faster, thus reducing the E/P ratio and spread towards its equilibrium levels and vice-versa.

In a subsequent study, Shen (2000) has given another simple argument on why the spread between earning yield (i.e. E/P ratio) and interest rate may be looked at for making futuristic assessment of stock market return. In this view, there are two good reasons in focusing on spread for assessing the short-term outlook for stock prices. First, a low spread may be indicative of more expensiveness of stocks in relation to alternative investments such as treasury securities or money market funds. In such situation, investors may switch over from stocks to other assets, causing the stock prices either to fall or to decelerate. Similarly, high spread may trigger faster rise of stock prices and hence higher return. The second reason is that researchers have found that in predicting monthly stock market returns, a combination of the earnings yield and market interest rates usually performs better than either the earnings yield or interest rates alone. By considering spread, both E/P ratio and interest rates are taken care of, though in some restricted way.

[4] This follows from the following identity (Rolph and Shen, 1999) $E_t[R_{t+1}] = E_t[gP/E_{t+1}] + E_t[gE_{t+1}]$ where $E_t[.]$ represents mathematical expectation at time t, R_{t+1} is return from time t to t+1, gP/E_{t+1} and gE_{t+1} are growth in P/E and E respectively from time t to t+1.

In a slightly different context, Clare et al (1994) and Brooks and Persand (2001) also offered similar argument. These studies investigated the role of the ratio of income yield on long-term government bonds to the dividend yield on equities (called as Gilt-Equity Yield Ratio) in determining whether to invest in equities or whether to invest in gilts. The basic premise in putting importance on gilt-equity yield ratio is that the said ratio has a long-run equilibrium level, deviations from which are taken as a signal that equity prices are at an unsustainable level – if the ratio becomes relatively high[5] , equities are viewed as being expensive relative to bonds. The expectation, then, is that for a given level of bond yield, equity yield must rise, which will occur via fall in equity prices (Brooks and Persand, 2001). Similarly, if gilt-equity yield ratio is well below its long-term trend, by the same argument, prices of stocks are expected to rise. In their empirical analysis, Clare et al. (1994) investigated the usefulness of the gilt-equity yield ratio in determining when investment should be made in equities and when in gilts. They evaluated a number of trading rules incorporating the said ratio and found empirical evidence in favour of higher average returns and lower standard deviations in case of rules as compared to a buy-and-hold equity strategy[6] . Brooks and Persand (2001) also examined the usefulness of the gilt-equity yield ratio in making investment decisions in three countries, viz., the United Kingdom (UK), the United States (US) and Germany. They employed a regime-switching model for each country for forecasting gilt-equity yield ratio with a view to making investment decision. They found that for the UK market, such model-based forecasts of the ratio are helpful in making investment decisions with strongly superior risk-return characteristics compared with a buy-and-hold strategy. For the US and German markets, the forecast based strategy was slightly better than the buy-and-hold strategy.

2.2 Review of Select Studies

Instead of going into in details in each view/theory of stock market movement, only a few studies using at least spread or any of the two basic components of spread (i.e. E/P ratio and interest rate) are discussed here.

Basu (1977) examined the performance of various portfolios on the basis of their P/E ratios for 1957-71 and found that return on company stocks with low P/E ratios was significantly higher that the return on companies with relatively high P/E ratios (Keith, 1998, Page 209). Pesaran and Timmermann (1995) also used both E/P ratio and interest rates along with several other influential variables for explaining stock market movements. Lander et al (1997) also documented strong evidence that both earnings yield and interest rates matter for short-run stock market performance. They used linear combination of E/P ratio and bond yields to predict returns on S & P 500 index in a regression framework.

In a recent study, Qi (1999) outlined a recursive modeling procedure to examine the predictability of S & P 500 index returns using linear regression (LR) framework and neural network (NN), a nonlinear framework. The explanatory variables considered by him are dividend yield, E/P ratio, 1-month Treasury Bills rate, 12-month Treasury bond rate, inflation rate, growth rate in industrial output and money growth. He found that the NN model outperforms LR-framework in terms of both within-sample fit as well as out-of-sample forecast accuracy. He also found that with three categories of transaction cost scenario, viz., zero cost, low cost and high cost, a switching portfolio based on recursive NN forecasts earns higher risk-adjusted returns than that of the switching strategy based on the forecasts from recursive LR-framework. Interestingly, however, both the LR-based and NN-based switching portfolios, outperform the buy-and-hold market index portfolio.

In another recent study, Qi and Madalla (1999) found empirical evidence of the influence of various economic and financial variables, viz., yields, interest rate, inflation rate, growth in industrial output, etc., on future excess return in both LR and NN frameworks.

Recently, in the Indian context, Mohanty (1997) examined the relationship of P/E ratio and earnings per share (EPS) with stock price. Using annual data he concluded that one could make excess return by forecasting the directions of movement of EPS based on publicly available information. In the Indian context, the importance of the P/E ratio in explaining and forecasting market movements was also highlighted by Gupta et al (1998). Use of spread variable in explaining Indian stock market return is available in Samanta and Rajpathak (2001). Though, they have not investigated detail relationship between spread and return, they constructed a composite indicator by combining partial information contents of spread in addition to E/P ratio, yields and a few other economic and financial variables, for forecasting/tracking future stock market returns. The results presented in the study are quite encouraging in a sense that the composite indicator beat random-walk model in predicting future stock market return.

3. Plan of the Empirical Investigation - Methodologies and Analytical Tools

For assessing the information content of spread about future stock market return, following analytical tools and methodologies are employed in the present study.

[5] Note that when the ratio is relatively high (low) from its long-run equilibrium, the spread, in usual sense, is also relatively high (low) from respective long-run equilibrium.

[6] However, their trading rule analysis is based on 11 quarterly out-of-sample observations which occur during the 1990s, at a time when the gilt-equity yield ratio was consistently above its historical average (Brooks and Persand, 2001).

3.1 Correlation/Cross-Correlation Analysis

A preliminary assessment of the strength in relationship between return and past values of 'spread' may be assessed through appropriate correlation analysis. For this purpose, one can calculate cross-correlation coefficients between spread and returns for different orders/lags (i.e. correlation coefficient between spread and future return) and can test for their statistical significance. The cross-correlation of order k between spread and return (denoted by ρ_k) is simply the correlation coefficient between SP_{t-k} and R_t, k being any integer [7]. If ρ_k's for some positive k, are significantly different from zero, one may expect that past values of spread would have some impact on present/future return.

3.2 Regression Analysis

The explanatory power of 'spread' in capturing the movement of stock price return could also be assessed in a regression framework. For this purpose, return series could be regressed on past information on 'spread' variable. Following Rolph and Shen (1999), the form of the regression equation may be kept simple as below;

$$R_t = \alpha_0 + \sum_{j=1}^{p} \alpha_j SP_{t-j} + e_t \qquad \text{......... (1)}$$

where p is a suitably chosen positive integer; R_t and SP_t are as defined above, α_j's, j=0,1,2, ... ,p are unknown parameters and e_t is the usual disturbance term.

Equation (1) includes only the lags of SP_t as regressors. As a main purpose is to assess the usefulness of 'spread' in explaining return but not of identifying a model for forecasting return, no other variable is considered as regressor. Some of the widely used statistics, like $\bar{R}^2$ (i.e. adjusted-R^2), Durbin-Watson (D-W) statistics and Ljung-Box Q-Statistics (denoted by Q-Statistics) will be used for assessing the strength of the relationship [8] presented in equation (1).

[7] Note that when k is positive, r_k measures the strength in relationship between return and past value of spread and when k is negative, r_k measures the strength in relationship between spread and past value of return. Similarly, for k=0, r_k measures the strength in relationship between spread and return contemporaneously.

[8] Note that while adjusted-R2 helps in assessing the strength in relationship, other two statistics, namely D-W statistics and Q-statistics are useful for testing the significance of the auto-correlations of the residual. Significance of some autocorrelations (of different lags) may reduce the reliability of estimated coefficients/model. While D-W statistics is useful for testing the significance of first-order auto-correlation, Q-statistics is used to test the joint significance of first-few (say, 1 to m) auto-correlations of the residuals. Ideally, if first autocorrelation (i.e. first-order autocorrelation) is close to zero, D-W statistics would be close to 2. On the other hand, under the null hypothesis of all first m auto-correlations are zero, the Q-statistics based on first m auto-correlation follows a Chi-Square distribution with m degrees of freedom except in case of ARIMA model when the degrees of freedom has to be adjusted for number of model parameters (Doan, 1990, Chapter 1).

3.3 Granger's Causality Test

For a formal assessment of the influence/usefulness of 'spread', Granger's causality test may be performed using an extended regression equation.

$$R_t = \alpha_0 + \sum_{j=1}^{p} \alpha_j SP_{t-j} + \sum_{k=1}^{q} b_k R_{t-k} + e_t \qquad \text{......... (2)}$$

As in case of equation (1), relationship presented in equation (2) may also be assessed in terms of $\bar{R}^2$ D-W statistics and Q-Statistics. In addition, if all α_j's in equation (2) are statistically zero, the null hypothesis of no causality from spread to return is accepted. Usual F-statistics may be used for performing the causality test.

3.4 Assessing Forecast Performance

The regression diagnostics discussed above pertain to the within-sample characteristics of the data. The usefulness of 'spread' may also be assessed in terms of improvement in degree of accuracy in out-of-sample forecast of return by using spread. Therefore, it would be interesting to exploit the relationship between 'spread' and stock market return for forecasting return out-of-sample. For this purpose, through recursive/rolling regression [9], forecasting exercise will be repeated several times and based on the forecast accuracy (or error in out-of-sample forecasts) in every repetition, an overall measure of forecast accuracy, say the widely used Mean Error (ME), Mean Absolute Error (MAE) and Root-Mean-Square-Error (RMSE), will be derived for different competing forecasting models, viz., (i) random walk (RW) model; (ii) regression model as in equation (1); (iii) and causal model as in equation (2). Here RW model is considered as a benchmark model to represent the behaviour of the stock market/prices under the weak-form of efficient market hypothesis (EMH). If the magnitude of forecast errors in cases of (ii) and (iii) are lower than that of case (i), one can conclude that spread helps in improving accuracy of out-of-sample forecast of stock price return.

3.5 Methodology for Exploring the Possibility of Profitable Business Strategy

The methodologies discussed above are useful for assessing the ability of spread in explaining/forecasting future stock market return. A natural question that also may arise here is whether the spread is helpful in formulating a profitable business/trading strategy. It is well known that making better forecasts of return does not necessarily guarantee profitability. Sometimes, despite good degree

[9] Section 5.3 of the paper discusses the adopted procedure in detail.

of accuracy in forecast of return, business strategy may not be profitable if return is adjusted for transaction costs and/or other related economic factors. Moreover, time and size of business may also be important for profitability. Thus, it is necessary to examine whether spread helps in evolving profitable business strategy. For this purpose it would be interesting to design some business strategies using spread (sometimes along with other related economic indicators/factors, if needed) and to examine whether the strategy gives better-adjusted return (adjusted for transaction costs, etc.) than some benchmark strategy (say, simple buy-and-hold trading strategy).

A careful look at the way spreads are cited by the practitioners suggests that the extreme values in spread are informative for stock returns, a point that is missed out in regression or other analyses discussed above (Rolph and Shen, 1999). To evaluate the impact/usefulness of spreads, the business strategy, therefore, may be based on extreme values of spread. If at least a business strategy triggered by these extreme values gives better net return (i.e. making adjustment for transaction cost) as compared to benchmark strategy, then only the claim of usefulness of spread in real business would be established. Accordingly, a few spread-based trading strategies are assessed vis-à-vis a buy-and-hold strategy – the benchmark strategy used in this paper.

3.5.1 Strategy 1: A Spread-Based Switching Trading Strategy

In this strategy (Rolph and Shen, 1999), it is assumed that an extreme low value of spread relative to its historical range is an indication of unusual vulnerability of overall stock market condition. Thus an extreme low value is considered as a signal to exit the stock market temporarily. For judging the extremeness of the spread, one may derive the statistical distribution of spread based on historical data and a specific percentile/decile of the distribution may be considered as the threshold for exiting the stock market. When observed spread is under the chosen threshold, one may consider the spread as low and the investment may be switched over from stock market to money/other markets or vice versa. In other cases, spread may be considered as not low enough and investment may be continued/made in stock market.

The strategy may be implemented easily starting from the calculation of the threshold value from the past observations. In any time point if the observed spread is non-low (i.e. not under the threshold), portfolio is invested in the stock index till the end of next time point (i.e. during next month/week or as the case may be depending upon the frequency of data). If at the end of the next time point, spread is still above threshold, the portfolio will be invested in stock market. Otherwise, the portfolio will be switched over to alternative market (i.e., government securities market, money market, etc., as the case may be). Similarly, if starting spread is below threshold, the portfolio would initially be invested in T.Bills/money market and proceeds for next time point. At each time point, all dividends and yields will also be invested along with original portfolio. After each transaction, portfolio value may be adjusted for transaction costs. Particularly, when portfolio is switched over from one market to another, transaction costs may appear in the picture. However, if the transaction costs is negligible, one may ignore it and need not adjust the portfolio for it. This way the strategy may be used for quite some time (until the end of desired time point) and one may easily calculate the overall return obtained during the period and compare this return with that of the benchmark strategy.

3.5.2 Strategy 2: A Forecast-Based Trading Strategy Using Causal Models

In this strategy, return is forecasted using estimated causal models involving spread (i.e., estimates of models given in equation 2). If expected stock market return is positive, portfolio is invested or is held in the stock market. Otherwise, portfolio is switched-over or held in other market (say, money market or the market in which the chosen interest rate is applicable). As in the earlier case, after each transaction, the value of the portfolio may be adjusted for transaction costs if needed.

4. Database and Related Issues

Prior to 1990s, the capital market in India was segmented across cities. However, since the early 1990s, some fundamental changes have taken place at the Indian capital market. These include the emergence of the Securities and Exchange Board of India (SEBI) as the statutory regulator of the Indian capital market, the birth of the National Stock Exchange (NSE), the computerized screen based trading at both the BSE and the NSE linking the capital markets of different cities in India, increase in trading hour, dematerialization of shares and introduction of derivatives. Most of these changes have been introduced during the first half of the 90's. In this study, the focus is on the second half of the 90's.

In the present study, both weekly and monthly data are used. The basic variable covered in weekly database pertain to weekly average stock price index, E/P ratio of the index portfolio and a representative interest rate from the week ended January 6, 1996 to the week ended December 30, 2000. The monthly database also covers these basic variables for the months from January 1996 to December 2000. The data on return and spread are derived from these basic variables. Various aspects of basic and derived data are discussed below.

4.1 Data on Stock Price Index, E/P Ratio and Interest Rate

As regards stock price index, it is preferable to choose a market representative index. In India, a number of stock price indices are available. Notable among them are BSE 30 share price index (Sensitive Index or Sensex), Economic Times 30 Index, Financial Express 30 Index, NSE-50, BSE national index consisting of 100 shares (BSE-100), Economic Times 100, Financial Express 100, BSE-200, Business Line 250, CRISIL 500 index and several other regional exchange indexes[10]. In an interesting study, Balasubramanian and Narasimhan (1999) made an attempt to assess to what extent various indices reflect the market performance. For this purpose, they assumed that (i) the BSE Sensex represents other similar indexes like Economic Times 30 index and Financial Times 30 index, (ii) The BSE National index represents Economic 100 index, Financial Express 100 Index, NSE-50 and several other regional exchange indexes which consists of 100 shares, and (iii) the BSE-200 represents some of the new indexes like Business Line 250 index and CRISIL 500 index. Accordingly, they analysed in detail, various aspects of BSE Sensex, BSE-100 and BSE-200. Their empirical results suggest that there is no significant difference between these three indices. They also demonstrated that the behaviour of stocks in the Indian market, measured in terms of monthly returns, differ significantly and it was possible to segment the market into different groups. In such a situation, the similarity in behaviour of various indices point towards the fact that the existing indices merely reflect a few high market capitalised stocks but not the overall market. In absence of any market representative index, one is compelled to choose one among existing indices. As earlier research has established that these series exhibit similar behaviour, it is expected that empirical results will not differ qualitatively on choice of any one among them. In this study, closing value of BSE National index (i.e. BSE-100 index) is considered for calculating stock market return without entering into any debate on its ability to represent Indian stock market. The data on E/P ratio pertain to BSE-100 index portfolio.

The BSE-100 Index, formerly known as the BSE National Index, is a market value weighted index of 100 stocks. The BSE started publishing the index from January 3, 1989. The index was initially intended to reflect stock price movements on a national scale. Initially, the 100 stocks in the index were selected from the five major stock exchanges in India (viz., Mumbai, Calcutta, Delhi, Ahmedabad and Madras). However, the birth of NSE and its successful adoption of screen based trading forced BSE to adopt from an open outcry system to screen based trading. Advancement in trading technologies quickly diminished the price differences among the Indian stock exchanges. Consequently, effective 14 October 1996, the BSE redesigned the index and renamed it as the BSE 100 Index.

The selection of an appropriate interest rate plays a vital role, so far as the usefulness of the spread is concerned. The task, however, is not an easy one and the choice typically involves a spectrum of rates with varying term structure. Both the long-term and the short-term interest rates may have practical relevance in this context. Rolph and Shen (1999) have discussed the issue in detail, citing the merits and demerits of each of them and argued that short-term interest

[10] Apart from these indices, the Reserve Bank of India (RBI) also had its own Security Price Index. But recently, RBI has discontinued to publish this index.

rates may be more relevant in evaluating the usefulness of 'spread'. Their empirical results also affirm this position.

Without going into the debate, in this paper, we have used short-term rates for deriving spread. In the Indian context, possible proxies for short-term interest rate would be 'call money rate', 'yields on certain Treasury Bills', 'Deposit Rate', 'Bank Rate', etc. Among these, two rates, viz., the Bank Rate and the call money rate are generally used (Roy et al, 2000). The present study also has used the call money rate and the Bank Rate as indicators of short-term interest rate.

4.2 Derivation of Stock Market Return and Spread

In this study, one-period stock market return (i.e. return is weekly for weekly data, monthly for monthly data, and so on) at time point t, say R_t, is simply defined as

$$R_t = \log(P_t) - \log(P_{t-1}); \text{ where } P_t \text{ is a stock price index.} \qquad \text{........ (3)}$$

Another form of return would be

$$R_t = \frac{[P_t - P_{t-1}]}{P_{t-1}}; \text{ where } P_t \text{ is a stock price index.} \qquad \text{........ (4)}$$

In both equation (3) and equation (4), R_t would be adjusted for dividend yield and other cash flows during time point (t-1) to t. However, these simple returns (based on only price changes - without considering yields, etc.) are widely used in the empirical literature, mainly for simplicity and/or coping with data limitations. In Indian context, many studies (Madhusoodanan, 1998; Mohanty and Kamaiah, 2000; Samanta and Rajpathak, 2001) have used equation (3) for compilation of return series. Confining to the simple return calculation (i.e. without considering dividends, etc.), equation (4) is more useful for accounting purpose/business settlement. However, from analytical point of view, equation (3) is more preferable as it possess some interesting properties[11]. Noting these points, the present study analyses the relationship of spread with the return that is calculated using equation (3). However, while assessing the profitability of a trading strategy, the returns from equation (3) are used.

The information on 'spread' variable is derived by subtracting interest rate from E/P ratio associated with BSE-100 stock price index. Depending upon the proxy of interest rate, following two measures of spread are used in this study;

$$SP\_B_t = EbyP_t - BR_t$$
$$SP\_C_t = EbyP_t - Call_t \qquad \text{......... (5)}$$

where SP_B_t and SP_C_t are measures of spread at time t; $EbyP_t$, BR_t and $Call_t$ are E/P ratio, bank rate and call money rate respectively at time point t.

[11] For instance, in case of equation (3), K-period return is simply the addition of k consecutive one-period returns. Moreover, log-transformation also may reduce a bit of volatility/heteroscadasticity and/or may help to get normal distribution.

4.3 Data on Transaction Costs

As seen earlier, for assessing the profitability of different trading/business strategies, accurate estimates of transaction cost in different markets are needed. The task of estimating transaction cost, however, is complex, mainly due to (i) non-availability of published information and, (ii) varying nature (non-uniformity) of transaction cost depending upon the category of market player (such as, institutional investors, individual investors, mutual funds, etc.). As can be seen from the estimates of Raju (2000) transaction cost in Indian stock market may vary from 0.1 % to 1.3 % for different categories of investors (Table 1). Another set of estimates, as used by Mitra (2000), shows that transaction cost at the Indian stock market may vary from 0.1 % to 1.8 % (Table 2). In case of alternative markets (viz., money market, etc.), transaction cost within a similar range is assumed.

As profitability may be sensitive to transaction cost, a business strategy, which is profitable to a segment of investors, may not generate any profit to other category of investors. Keeping all these points in mind, for assessing different business strategies, we used three possible transaction costs, viz., 0 %, 0.5 % and 1 %.

Table 1: Average Transaction Costs (in %)

Sr. No.	Type of Investor	August 1999	July 2000
(A)	**Mutual Funds**		
1	Trading and Safekeeping in dematerialised form	0.35	0.31
2	Trading (buy) and safekeeping in physical form (including stamp duty)	1.27	1.11
	Trading (sale) and delivery in physical form	0.77	0.61
3	Trading (buy) in physical and safekeeping in dematerialised form (including stamp duty)	0.85	0.77
(B)	**Financial Institututions**		
1	Trading and Safekeeping in dematerialised form	0.35	0.32
2	Trading (buy) and safekeeping in physical form (including stamp duty)	1.26	1.20
	Trading (sale) and delivery in physical form	0.76	0.70
3	Trading (buy) in physical and safekeeping in dematerialised form (including stamp duty)	0.85	0.82
(C)	**Retail Investors**		
1	Trading physical segment	0.80	0.75
2	Trading in dematerialised segment (includes safekeeping and transaction charges for July 2000 study only)	0.63	0.65
3	Trading for non-delivery	0.16	0.085
4	Buying in the physical segment (including stamp duty)	1.30	1.25

Source: Raju (2000)

Table 2: Cost Per Transaction

Type of Investor	Transaction Cost (in Per Cent)
Institutional Investors and Brokers	0.15
Small Investors Trading Frequently	0.70
Small Investors Dealing on Delivery Basis	1.80

Source: Mitra (2000).

5. Empirical Results on Investigating Relationship Between Spread and Return

To start with, in Table 3, we present the estimated ρ_k for k=1,2, …., 26 using weekly data. From Table 3, it appears that the magnitude of correlation coefficient between SP_B_{t-k} and R_t (i.e., ρ_k) is low for k=1 to 7, and is reasonably high for k = 8. The maximum correlation coefficient (in magnitude) is observed for k=11 followed by k=13, 19 and 20. In case of SP_C_{t-k}, estimated ρ_k is low for all k except for k=19, 20 and 21.

Table 3: Estimated ρ_k's for Different k - Using Weekly Data
(*Data Period: Week Ending January 6, 1996 to Week Ending December 30, 2000***)**

K	Estimated ρ_k Associated with#		K	Estimated ρ_k Associated With#	
(*in weeks*)	SP_B	SP_C	(*in weeks*)	SP_B	SP_C
1	0.0214	0.0375	**14**	0.1152	0.0254
2	0.0329	0.0137	**15**	0.1087	0.0075
3	0.0525	0 0215	**16**	0.1049	0.0142
4	0.0521	-0.0162	**17**	0.1147	0.0418
5	0.0506	-0.0436	**18**	0.1146	0.1043
6	0.0669	-0.0482	**19**	0.1222	0.1486
7	0.0827	-0.0040	**20**	0.1239	0.1498
8	0.1042	-0.0322	**21**	0.1130	0.1214
9	0.1188	-0.0259	**22**	0.1102	0.0926
10	0.1201	-0.0168	**23**	0.1070	0.0606
11	0.1298	0.0134	**24**	0.1035	0.0448
12	0.1235	0.0248	**25**	0.1062	0.0600
13	0.1255	0.0441	**26**	0.1128	0.1065

Note: '#' ρ_k indicates correlation coefficient between SP_{t-k} and R_t where $SP_t = SP\_B_t$ or SP_C_t.

Estimates of ρ_k's, k=1,2, ….,12, using monthly data (Table 4) show that the relationship between SP_B_{t-k} and R_t is reasonably strong for k above 2, particularly for k =3, 5 and 7. In case of SP_C_{t-k}, however, corresponding relationship is likely to be important only for lags k=5, 6 and 7. It is interesting to note that the results based on monthly data are more or less consistent with the same based on weekly data.

Table 4: Estimated ρ_k's for Different k - Using Monthly Data
(*Data Period: January 1996 to December 2000*)

K (*in months*)	Estimated ρ_k Associated with# SP_B	SP_C	K (*in months*)	Estimated ρ_k Associated With# SP_B	SP_C
1	0.0502	-0.0400	**7**	0.2578	0.2577
2	0.1534	-0.0234	**8**	0.2030	0.1507
3	0.2453	-0.0426	**9**	0.1660	0.1289
4	0.2222	0.0888	**10**	0.0864	-0.0565
5	0.2436	0.2636	**11**	0.0500	-0.0032
6	0.2259	0.1992	**12**	0.0241	-0.0968

Note: '#' ρ_k indicates correlation coefficient between SP_{t-k} and R_t where $SP_t = SP\_B_t$ or SP_C_t.

Thus from correlation analysis, it is seen that the relationship between past values of spread and present value of stock market return is possibly strong only in longer lag, say for about 3-months or above (i.e. corresponding to 11 to 13 weeks or more). For exploring the strength in relationship between return and spread, a number of simple regression and causal-regression models are estimated and the empirical findings are interpreted. In this context, it may be noted that for estimating different regression equations (simple or causal models), lag selection is an important task. But the task is very difficult, particularly when one is dealing with highly volatile data at monthly/weekly frequency (Nag and Samanta, 1994). A widely used strategy in the context is the general-to-specific-type modeling /stepwise regression approach[12] (Davidson, et al, 1978; Doan, 1990; Nag and Samanta, 1994; Samanta, 2000). For this purpose, we first fix an upper limit/ceiling to the maximum lag and select only the important lags within the chosen limit. In all subsequent regression/causal models, upper ceiling for maximum lag was fixed at 26-weeks for weekly data and 12 for monthly data.

5.1 Empirical Results on Regression Analysis

Initially return series was regressed on constant and own past values. Relevant empirical results (presented in Table 5) show that the underlying relationship in case of weekly data is similar[13] with that for monthly data, though in former case $\bar{R}^2$ is relatively low. In both cases, D-W statistics is very close to 2 (being 1.95 or more) and the Q-statistics is also insignificant at 5 % level of significance

[12] In this strategy, we start with a general model using all lags within a specified upper limit. Thereafter, we may drop some unimportant lags. Sometimes, however, certain insignificant lags are retained mainly to improve the values of some of diagnostic statistics, viz., coefficient of determination (i.e., $\bar{R}^2$), D-W statistics and Q-statistics. Naturally, a bit of subjectivity is involved in the selection of lags here, but that is a common practice when one is dealing with high frequency data.

[13] In terms of $\bar{R}^2$, D-W statistics and Q-statistics

(as corresponding p-value is much more than 0.05), indicating absence of any significant autocorrelation of the residual series.

Table 5: Regression of R_t on Own Past Values

Dependent Variable	Explanatory Variable	Lags	Coefficients	t-ratio	$\bar{R}^2$	D-W Statistics	Q-Statistics (Degrees of freedom)
Using Weekly Data							
R_t	Constant	0	-0.0001	-0.05	0.09	1.95	29.13
	R_t	1	0.1466	2.28			(45)
		2	0.1654	2.52			
		4	-0.1351	-2.09			p-value
		9	0.1269	1.97			= 0.9679
		22	0.1397	2.15			
		26	0.1379	2.12			
Using Monthly Data							
R_t	Constant	0	0.0101	0.88	0.11	1.97	12.95
	R_t	1	0.2087	1.56			(21)
		3	-0.2930	-2.14			
		8	-0.2499	-1.64			p-value =0.9103

Now, we proceed to check the robustness of the results obtained from correlation analysis. For this purpose, R_t series is regressed on constant and past values of spread. Different fitted equations and associated estimates of $\bar{R}^2$, D-W statistics and Q-statistics for weekly data are given in Table 6. Similar results for monthly data are presented in Table 7.

In case of weekly data, as can be seen from Table 6, SP_B_t has relatively stronger relationship with future return than that associated with SP_C_t. Empirical results indicate higher $\bar{R}^2$ and better D-W statistics when R_t is regressed on constant and past values of SP_B_t instead of regressing R_t on constant and past values of SP_C_t. The Q-statistics in later case is also worse than that in former case. As a matter of fact, Q-statistics in case of SP_C_t is statistically significant at 5 % level of significance (as corresponding p-value does not exceed 0.05), indicating presence of residual autocorrelation.

In case of monthly data, the empirical results (Table 7) are almost same qualitatively as that of weekly data, though $\bar{R}^2$**,** D-W statistics and Q-statistics are better for monthly data. Interestingly, Q-statistics in case of SP_C_t for monthly data turns out to be statistically insignificant.

Table 6: Regression of R_t on Spread - Using Weekly Data

Dependent Variable	Explanatory Variable	Lags	Coefficients	t-ratio	$\overline{R}^2$	D-W Statistics	Q-Statistics (Degrees of freedom)
Using SP_B as Proxy for Spread							
R_t	Constant	0	0.0062	1.39	0.04	1.69	56.40
	SP_B_t	1	-0.0031	-1.07			(45)
		7	-0.0143	-1.71			
		8	0.0130	1.43			p-value
		11	0.0123	2.20			= 0.1187
		16	-0.0086	-2.19			
		26	0.0026	1.32			
Using SP_C as Proxy for Spread							
R_t	Constant	0	0.0024	0.90	0.02	1.62	68.41
	SP_C_t	19	0.0009	1.94			(45)
		26	0.0005	1.00			p-value = 0.0138

Table 7: Regression of R_t on Spread - Using Monthly Data

Dependent Variable	Explanatory Variable	Lags	Coefficients	t-ratio	$\overline{R}^2$	D-W Statistics	Q-Statistics (Degrees of freedom)
Using SP_B as Proxy for Spread							
R_t	Constant	0	0.0198	1.10	0.13	1.83	14.55
	SP_B_t	1	-0.0253	-2.44			(21)
		3	0.0532	2.64			
		4	-0.0232	-1.51			p-value = 0.8446
Using SP_C as Proxy for Spread							
R_t	Constant	0	0.0124	1.06	0.06	1.66	19.98
	SP_C_t	5	0.0044	2.10			(21)
							p-value = 0.5222

5.2 Empirical Results on Causality Tests

For exploring the possibility of causal influence of spread on return, we fitted a causal model like equation (2), where lag values of both dependent variable (i.e. R_t) and independent variable (i.e. SP_B_t or SP_C_t) are used as regressors.

Different causal models are estimated by employing 'general-to-specific-type' strategy again. The estimated equations for weekly data and corresponding empirical results on causality tests are given in Table 8 and Table 9 respectively. Similar results for monthly data are presented in Table 10 and Table 11.

It may be seen from Table 8 that the causal models for weekly data are generally better than the regression equations using only past values of return (as given in Table 5) or only past values of spread (given in Table 6) in terms of $\overline{R}^2$, D-W statistics and Q-statistics. Empirical results on causality tests using weekly data reveal that the widely used F-statistics (Table 9) is significant at 5 per cent level (as corresponding p-values are lower that 0.05) for both SP_B_t and SP_C_t, indicating that weekly information on both SP_B_t and SP_C_t has causal influence on weekly return.

Table 8: Estimated Causal Models - Using Weekly Data

Dependent Variable	Explanatory Variable	Lags	Coefficients	t-ratio	$\overline{R}^2$	D-W Statistics	Q-Statistics (Degrees of freedom)
Using SP_B as Proxy for Spread							
R_t	Constant	0	0.0056	1.37	0.11	1.99	34.92
	R_t	1	0.1328	2.03			(45)
		2	0.1376	2.06			
		3	-0.1076	-1.59			p-value
		4	-0.1928	-2.81			= 0.8605
		22	0.1548	2.42			
		26	0.1366	2.11			
	SP_B_t	2	-0.0068	-2.43			
		9	0.0086	3.19			
Using SP_C as Proxy for Spread							
R_t	Constant	0	0.0017	0.67	0.11	1.96	27.86
	R_t	1	0.1278	2.00			(45)
		2	0.1620	2.50			
		4	-0.1490	-2.32			
		9	0.1294	2.03			p-value
		22	0.1679	2.58			= 0.9790
		26	0.1488	2.31			
	SP_C_t	19	0.0010	2.07			
		26	0.0005	1.08			

Table 9: Results on Causality Tests - Using Weekly Data

Dependent Variable	Explanatory Variable	Lags#	Testing Hypothesis: Coefficients of SP_B/SP_C are Collectively Zero	
			F-Statistics (Degrees of Freedom)	P-Value
Using SP_B as proxy for spread				
R_t	Constant	0	5.6375	0.0041
	R_t	1,2,3,4,22,26	(2,225)	
	SP_B_t	2,9		
Using SP_C as proxy for spread				
R_t	Constant	0	4.2728	0.0399
	R_t	1,2,4,9,22,26	(1,225)	
	SP_C_t	19,26		

Note: '#' Estimated Coefficients and corresponding t-ratios for different lags are given in Table 8.

For monthly data also, causal models are better (Table 10) than simple regression models (presented in Table 5 and Table 7). The causality tests also detected causal influence of spread on return (see Table 11), though the influence in case of SP_C_t is likely to be mild (as the corresponding F-statistics is insignificant at 5 % level, but significant at 6 % level).

Table 10: Estimated Causal Models - Using Monthly Data

Dependent Variable	Explanatory Variable	Lags	Coefficients	t-ratio	$\bar{R}^2$	D-W Statistics	Q-Statistics (Degrees of freedom)
Using SP_B as Proxy for Spread							
R_t	Constant	0	0.0270	1.39	0.21	1.97	12.69
	R_t	3	-0.3818	-2.59			(21)
		8	-0.2454	-1.60			
	SP_B_t	1	-0.0245	-2.38			p-value
		3	0.0193	1.72			= 0.9191
		7	0.0092	1.28			
Using SP_C as Proxy for Spread							
R_t	Constant	0	0.0132	1.14	0.14	1.99	14.52
	R_t	1	0.1730	1.31			(21)
		3	-0.3114	-2.34			
	SP_C_t	7	0.0041	1.97			p-value =0.8462

Table 11: Results on Causality Tests - Using Monthly Data

Dependent Variable	Explanatory Variable	Lags#	Testing Hypothesis: Coefficients of SP_B/SP_C are Collectively Zero	
			F-Statistics (Degrees of Freedom)	P-Value
Using SP_B as proxy for spread				
R_t	Constant	0	3.4471	0.0243
	R_t	3, 8	(3,45)	
	SP_B_t	1, 3,7		
Using SP_C as Proxy for Spread				
R_t	Constant	0	3.8849	0.0544
	R_t	1,3	(1,49)	
	SP_C_t	7		

Note: "#' Estimated Coefficients and corresponding t-ratio for different lags are given in Table 10.

5.3 Empirical Assessment of Forecast Performance

For assessing the forecast performance, out-of-sample forecasts of return series were generated for (i) last 26 observations in case of weekly data and (ii) last 12 observations for monthly data through rolling regression technique as discussed below.

For weekly data, initially each regression/causal model (Table 6 and Table 8) was re-estimated using first 226 observations and out-of-sample forecast was generated for the return series at time point 227. Thereafter, the coefficients of the underlying models were re-estimated using first 227 observations and out-of-sample forecast was generated for time point 228. This way the forecasting exercise was repeated 26 times, each repetition generating a one-week ahead forecast of return series. Now comparing the forecasts of return with actual, three measure of forecast error, namely 'Mean Error (ME)', 'Mean Absolute Error (MAE)' and 'Root-Mean-Square Error (RMSE)' were calculated. Similar error measures were also derived for the random walk model. The relevant results are reported in Table 12.

In case of monthly data, one-month ahead forecasts of return were generated for last 12 observations (i.e. from 49-th to 60-th observations) similarly. Then, like in case of weekly data, different measures of forecast accuracy, viz., ME, MAE and RMSE, associated with different models (i.e. random walk and regression/causal models) were estimated and presented in Table 13.

Table 12: Out-of-Sample Forecast Errors - Using Weekly Data

Model	Measure of Forecast Error		
	ME	MAE	RMSE
Random Walk	-0.0072	0.0338	0.0417
Regression Model (As in Equation 1)			
Using SP_B as Proxy for Spread	-0.0078	0.0354	0.0430
Using SP_C as Proxy for Spread	-0.0029	0.0339	0.0409
Causal Model (As in Equation 2)			
Using SP_B as Proxy for Spread	-0.0053	0.0301	0.0399
Using SP_C as Proxy for Spread	0.0026	0.0309	0.0373

Table 13: Out-of-Sample Forecast Errors - Using Monthly Data

Model	Measure of Forecast Error		
	ME	MAE	RMSE
Random Walk	-0.0105	0.1048	0.1250
Regression Model (As in Equation 1)			
Using SP_B as Proxy for Spread	-0.0100	0.1013	0.1166
Using SP_C as Proxy for Spread	-0.0008	0.1073	0.1259
Causal Model (As in Equation 2)			
Using SP_B as Proxy for Spread	-0.0102	0.0928	0.1062
Using SP_C as Proxy for Spread	-0.0029	0.0979	0.1093

From Table 12 and Table 13, it is seen that generally causal models (using spread) outperform both random walk model and regression models (using only past values of spread as regressors as given in equation 1), in generating out-of-sample forecast of stock market return.

6. Empirical Results on Exploring the Profitability Trading Strategies

In this section we compare profitability of two alternative trading strategies (discussed in Section 3.5) with the buy-and-hold strategy. As the results on relationship between return and past values of spread based on weekly and the monthly data are broadly similar, this section examines the aspect of profitability with the help of weekly data only.

For Strategy 1, we consider four cut-off points (threshold) based on the 5th, 10th, 15th, and the 20th percentiles of the distribution of spread.[14] Using Table 1 and Table 2, the implications of the profitability of these strategies were examined for three sets of transaction costs, viz., 0.0%, 0.5% and 1.0%. Further, as the profitability could vary from time to time, the implications for three sets of trading periods – the duration of each being 104 weeks[15] (i.e., two years) – after the first 50th, 100th and 150th weeks are examined.

[14] Rolph and Shen (1999) considered the 10th and the 20th percentiles for a similar exercise. However, as the results in both the cases were qualitatively similar, they reported only the results corresponding to the 10th percentile.

It is assumed that initially trading commences with an investment of Rs.100. Table 14 reports the value of the portfolio at the end of the trading period for different measures of spread, threshold, trading period and trading strategies. It may be noted that if the final value of the portfolio is less than Rs.100, the

Table 14: Portfolio Value after 104-weeks of Trading Following Different Trading Strategies - Based on Weekly Data
(Amount Invested at the Starting Week of Trading Period = 100 Rupees)

Starting Week of Trading	Proxy for Spread	Trading Strategy					
		Strategy 1 (Using Percentile Point of Spread)				Strategy 2	Buy-and-Hold#
		5-th	10-th	15-th	20-th		
(A) Transaction Cost (in %) = 0							
50	**SP_B**	103.46	103.46	103.46	103.46	114.97	103.46
	SP_C	102.26	102.26	102.26	102.26	117.14	
100	**SP_B**	145.67	145.67	145.67	145.67	211.99	145.67
	SP_C	143.99	152.21	145.80	150.43	208.99	
150	**SP_B**	152.39	152.39	152.39	157.63	273.40	152.39
	SP_C	161.61	186.48	161.76	131.37	210.79	
(B) Transaction Cost (in %) = 0.5							
50	**SP_B**	103.46	103.46	103.46	103.46	97.44	103.46
	SP_C	101.24	101.24	101.24	101.24	98.29	
100	**SP_B**	145.67	145.67	145.67	145.67	180.57	145.67
	SP_C	142.55	147.70	141.48	143.08	172.75	
150	**SP_B**	152.39	152.39	152.39	154.50	236.41	152.39
	SP_C	158.40	175.59	152.32	116.48	175.98	
(C) Transaction Cost (in %) = 1							
50	**SP_B**	103.46	103.46	103.46	103.46	82.52	103.46
	SP_C	100.23	100.23	100.23	100.23	82.40	
100	**SP_B**	145.67	145.67	145.67	145.67	153.69	145.67
	SP_C	141.12	143.30	137.27	136.05	142.65	
150	**SP_B**	152.39	152.39	152.39	151.42	204.28	152.39
	SP_C	155.24	165.29	143.38	103.22	146.80	

Note: Portfolio Value Under Buy-and-Hold Strategy Will Not Vary Over Transaction Costs

[15] The entire analysis was also carried out for a trading period of duration 52 weeks. However, the results were found to be broadly similar.

associated trading strategy incurs a loss. The practical relevance of spread would be established if the final value of the portfolio under any spread-based strategy exceeds that corresponding to the buy-and-hold strategy.

The results on comparison of spread-based strategies, as revealed in Table 14, are not robust across definitions of spread or across strategies. While increase in transaction cost clearly reduces profitability vis-à-vis the buy-and-hold strategy, the extent of profitability seems to depend on the starting point of trading period. However, it is interesting to note that spread-based strategies in many occasions yielded higher returns than that of the buy-and-hold strategy, especially when transaction cost was low.

7. Summary and Conclusion

On theoretical plane, whether the spread between E/P ratio and interest rate is helpful for predicting future return/movement of stock price index is a debatable issue. However, in practice, spread is frequently used by market practitioners. So far empirical evidence for the developed economies suggests that the information on spread could be useful. In case of emerging markets including India, the issue has not received adequate attention.

The present study employed various statistical and econometric tools for rigorously assessing the usefulness of spread in explaining stock market return. Empirical results, at this stage, however, are not conclusive. Though spread seems to have reasonably strong causal influence on return and the causal model helps achieving forecasts better than the random walk model, the usefulness of spread in formulating a profitable business strategy is not clear. Empirical work in the paper reveals that the performances of different strategies vis-à-vis a simple buy-and-hold strategy, crucially depend on several factors like the choice of interest rate, choice of trading period and choice of threshold for determining 'extreme' values of spread. Our study also reveals that the profitability of a spread based trading strategy would crucially depend on the extent of transaction cost. In this context, however, it is interesting to note that spread based strategies in many occasions yielded higher returns that of the buy-and-hold strategy, especially when transaction cost was low.

The empirical results presented here are tentative and further research is needed to address the issue. Particularly, there is a need to put concerted efforts to construct alternative measures of 'spread' based on different interest rates and compare their usefulness empirically in explaining and predicting future movement of stock market return in India.

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