Short-term Interest Rates and Expected Stock Returns: Evidence from Sri Lanka

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Abstract

This study examines the ability of interest rates, as measured by Treasury bill yields, to track expected monthly, quarterly and annual returns in the Sri Lankan stock market during the 1990-97 period. Different from the findings in most prior studies on foreign markets, the results indicate a positive relation between interest rates and expected returns. Interest rates reliably track expected returns and the effect becomes larger and stronger with longer maturity Treasury bill yields, particularly in monthly and quarterly return horizons. The explanatory power also tends to increase with return horizon, except in annual returns. Treasury bill yields explain up to 4%, 11%, and 7% of monthly, quarterly, and annual expected returns respectively. The 12-month Treasury bill yield is found to have the most power to track monthly and quarterly expected returns. However, the behaviour of the Sri Lankan stock market suggests that the apparent strong statistical relationship is potentially spurious.

I. Introduction

The relationship between stock prices and macro-economic variables has attracted a great deal of interest among researchers. Many studies focus on the predictability of expected returns by factors such as the economic growth, industrial production, interest rates, inflation, exchange rate, money supply etc., both in univariate and multivariate contexts.[1] Another issue that has received much attention is the pricing of economic factors in a multi-factor asset pricing framework, particularly the Arbitrage Pricing Theory (APT) of Ross (1975).[2] These studies find some evidence to the effect that stock returns are predictable from economic factors and that some economic factors are priced by the market. Most previous studies, however, have been carried out on developed capital markets. The purpose of the present study is to examine the ability of interest rates, measured by Treasury bill rates, to track stock returns in the emerging Sri Lankan stock market.

Since the economic variable considered in the present study is the interest rates, major studies on the relationship between stock returns and interest rates are briefly reviewed. The earliest studies have employed the Treasury bill rate as a proxy for expected inflation, and the motivation of these studies has been to examine the relation between stock returns and inflation, rather than stock returns and interest rates [Fama and Schwert (1977), Fama (1981)]. These studies find a reliable negative relationship between stock returns and the Treasury bill rate. This finding is interpreted as evidence against the Fisher (1930) hypothesis which predicts a positive relation between stock returns and expected inflation.

[1] For example, Bodie (1976), Nelson (1976), Fama and Schwert (1977), Jaffe and Mandelker (1977), Firth (1979), Fama (1981), Gultekin (1983), Geske and Roll (1983), Keim and Stambaugh (1986), Kaul (1987), Chen (1991), Fama (1990), Schwert (1990), and Samarakoon (1993).

[2] For example, Chen, Roll and Ross (1983), Burmeister and Wall (1986), and Bodutha, Cho and Senbet (1986), Ferson and Harvey (1991), and Poon and Taylor (1991).

One major piece of work on the issue of predictability of returns using variables derived from the yield curve is Fama and French (1989). They examine the expected return variation tracked by the dividend yield, term premium and default premium, using the US data for the 1927-1987 period. Their results show that the term spread is significantly related to future monthly returns, while the default spread tracks expected returns up to four years into the future. Both variables are positively related with expected returns. These two interest rate spreads jointly explain upto 1 percent of monthly returns, 2 percent of quarterly returns, 7 percent of one-year returns, 16 percent of 2-year returns, 20 percent of 3-year returns, and 23 percent of 4-year returns. The predictable variation tends to increase with the time horizon. Fama and French interpret their results as evidence of the ability of variables relating to business conditions to track the time-variation of expected returns.

Chen (1991) examines the relation between stock returns and a number of state variables. The state variables include dividend yield, default spread, Treasury bill rate, term spread, and industrial production growth. Using the quarterly returns of NYSE value-weighted index for the 1954-1986 period, Chen finds that the default spread has the power to forecast returns over the next 4 quarters, while the term spread can forecast returns over next 3 quarters. However, the Treasury bill rate is significantly related to returns of the next one quarter only. The results show that the term spread and default spread have positive slopes while the Treasury bill rate has a negative slope. Chen further shows that these state variables are indicators of recent and future economic growth, and that via their forecasts on the macroeconomy, state variables forecast stock returns.

Fama (1990) finds that the default spread is strongly positively related to future stock returns, particularly the quarterly and annual returns, in a multi-factor model of returns which uses U.S. data for the 1953-1987 period. Schwert (1990) confirms Fama (1990) findings for a longer sample period of 1919-1988. Samarakoon (1993) extends Fama (1990) work to international markets and finds that the term spread has significant predictive power in Canadian and Australian monthly returns, Canadian, Australian and Japanese quarterly returns, and Australian annual returns. However, most of these relationships are negative and in most other countries the relation between term spread and expected returns is weaker.

Premawardhana (1997) finds that weekly and monthly stock returns in Sri Lanka are positively related to contemporaneous and lagged 12-month Treasury bill yields during the 1990-95 period. He also shows that contemporaneous Treasury bill yield spread between 12-month and 3-month yields is reliably positively related to weekly and monthly stock returns, while lagged yield spread has a strong positive relation with weekly returns. However, Premawardhana (1997) does not examine quarterly and annual returns. Samarakoon (1996) investigates the relationship between stock returns and inflation in Sri Lanka using monthly and quarterly data for the period January 1985 to August 1996 with a view to providing empirical evidence on the generalized Fisher Hypothesis which states that nominal stock returns are positively related to expected inflation in a one-to-one correspondence. The results indicate that both lagged inflation and expected inflation are significantly positively related to stock returns in a manner predicted by the Fisher Hypothesis suggesting that stocks in Sri Lanka, different from evidence in most other countries including the U.S., are an effective hedge against expected inflation.

As discussed above, previous studies on the relation between stock returns and interest rates have employed Treasury bill rates, term spread and default spread as explanatory variables. The evidence suggests that stock returns are negatively correlated with Treasury bill rates, and that the term spread and default spread are positively related to expected returns. The purpose of the present study is to examine the ability of interest rates, as measured by the Treasury bill rates of all three matuarities, to track the expected monthly, quarterly and annual returns in the Sri Lankan stock market during the 1990-97 period.[3] While filling an important gap in the literature on the Sri Lankan stock market, this study will enhance the understanding of the significance of the interest rate variables in predicting stock returns in the emerging Sri Lankan stock market.

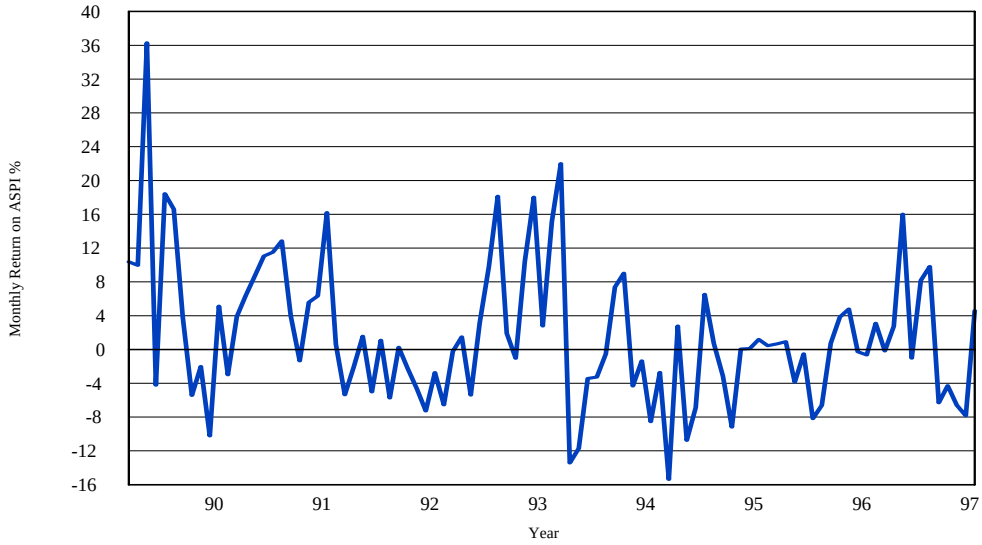
II. Data

This study measures stock returns by the continuously compounded monthly returns on the All Share Price Index (ASPI), and the Sensitive Price Index (SPI) for the 1990-1997 period. These represent the two market indices that measure the price levels of the Colombo Stock Exchange (CSE). Both indices are value-weighted and do not include dividends. The ASPI represents the broadest measure of the market and consists of all the listed stocks which numbered 175 in 1990, and 239 in 1997. The SPI measures the price levels of 25 blue-chip stocks. The stock index data are obtained from the CSE.

The behaviour of monthly returns is plotted in Figure 1 which shows a higher degree of volatility of returns. As Table 1 shows, monthly stock returns have fluctuated highly around a mean of 1.36% per month. The standard deviation of monthly ASPI returns is about 8%. Return autocorrelations indicate that autocorrelations of ASPI as well as SPI returns become insignificant after the 3rd lag. Table 2 shows the correlations among variables. Accordingly, the two returns series are highly correlated with a coefficient of 0.96. Both return series have the highest correlation with the 12-month Treasury bill rate, although the coefficients are small. SPI returns seem to be more correlated with Treasury bill rates than ASPI returns.

[3] Initial work suggested that interest rate spread variables constructed from the 12, 6, and 3-month Treasury bill rates do not have any predictive power. Therefore, this study does not employ spread variables.

Figure 1
Monthly Returns on All Share Price Index



The short-term interest rates are represented by continuously compounded primary market yields of Treasury Bill (TB) of 3, 6, and 12-month matuarities, which are obtained from the Central Bank of Sri Lanka. The TB yield for all three matuarities are available only from 1990, although stock returns are available from 1985. As a result, the study covers only the 8-year period from 1990 to 1997.

In order to provide some idea about the behaviour of interest rates during the sample period, the month-end values of the 12-month TB yields are shown in Figure 2. The TB yield has been quite high fluctuating in the 15 to 19 percent range during most of the sample period. Summary statistics given in Table 1 show that the 3, 6, and 12-month TB yields have averaged 14.92%, 15.13%, and 15.72% during the period. Their volatility has been just over 2% per year. Autocorrelations of TB of all three matuarities die down fairly slowly, and large autocorrelations are observed up to about the 6th lag.[4] The correlation matrix indicates that all three TB rates are very highly correlated.

[4] Examination of the autocorrelation and partial autocorrelation functions reveals that each return and TB series can be described as an autoregressive series of order 1 (AR1).

Figure 2
Movements of the 12-month Treasury Bill Yield

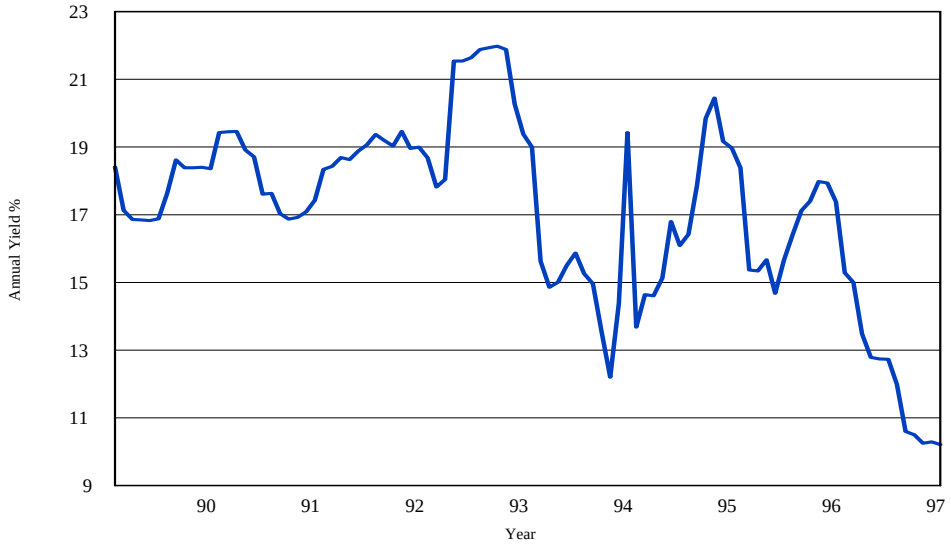


Table 1
Summary Statistics of Variables

R(ASPI) and R(SPI) are the continuously compounded monthly returns (without dividends) of the All Share Price Index (ASPI), and the Sensitive Price Index (SPI). 3TB, 6TB, and 12TB are the month-end observations of continuously compounded annualised primary market yields of Treasury Bills of 3-month, 6-month, and 12-month maturity. The table shows the arithmetic mean, standard deviation, and autocorrelations of each variable. The number of observations is 95 for returns and 96 for Treasury Bill yields covering the time period 1990-1997.

Variable	Mean %	SD %	Autocorrelations									
			1	2	3	4	5	6	7	8	9	10
R(ASPI)	1.36	8.08	0.30	0.21	0.17	0.05	-0.08	0.02	0.00	0.01	-0.04	-0.00
R(SPI)	1.09	8.56	0.27	0.19	0.16	-0.03	-0.13	-0.03	-0.04	0.02	-0.06	-0.03
3TB	14.92	2.40	0.86	0.73	0.60	0.46	0.34	0.24	0.17	0.12	0.07	0.06
6TB	15.13	2.30	0.85	0.71	0.59	0.45	0.34	0.24	0.15	0.09	0.04	0.03
12TB	15.72	2.39	0.87	0.75	0.65	0.53	0.42	0.33	0.24	0.17	0.12	0.08

Table 2
Correlation Matrix

R(ASPI) and R(SPI) are the continuously compounded monthly returns (without dividends) of the All Share Price Index (ASPI), and the Sensitive Price Index (SPI). 3TB, 6TB, and 12TB are the month-end observations of continuously compounded annualised primary market yields of Treasury Bills of 3-month, 6-month, and 12-month maturity. The table shows Pearson correlation coefficients. The number of observations is 95 for returns and 96 for Treasury Bill yields covering the time period 1990-1997.

	R(SPI)	**3TB**	**6TB**	**12TB**
R(ASPI)	0.96	0.07	0.08	0.13
R(SPI)		0.08	0.11	0.14
3TB			0.98	0.97
6TB				0.98

III. Tests

The research issue is whether short-term interest rates track expected stock returns in Sri Lanka. In order to answer this issue, a regression of the following form is specified.

$$R(t,t+T) = \alpha + \beta X(t) + \varepsilon (t,t+T) \quad (1)$$

where R(t,t+T) is the continuously compounded ASPI or SPI returns (without dividends), measured for monthly (T=1), quarterly (T=3), and annual (T=12) return intervals. X(t) is Treasury Bills of 3-month ($3TB_t$), 6-month ($6TB_t$), or 12-month ($12TB_t$) maturity, determined in the primary auction immediately preceding the commencement of the return horizon. This ensures that the information on TB yields is available prior to the return measurement interval. This regression specification follows the Fama and French (1989).

The regressions use overlapping monthly observations. The problem of autocorrelated disturbances that arise due to the use of overlapping observations is remedied by estimating the regressions by the Estimated Generalised Least Squares (EGLS) procedure. The essential statistics of interest are the slopes, their t-statistics and the adjusted coefficient of determination (R^2) of regressions.

IV. The Regressions Results

Table 3 reports the results of regressions of ASPI returns on TB yields. The $3TB_t$ is weakly significant with a slope of 0.92. Both the magnitude and statistical significance of coefficients increase with longer maturity TB yields. The coefficient on $6TB_t$ is 0.97 and significant at 5%. $12TB_t$ produces a slope of 1.06 and a t-statistic of 2.26, both of which are higher than those for $6TB_t$. These results suggest that ex-ante TB yields, particularly those of 6-month and 12-month maturity, have reliable predictive ability. The explained variation is in the 3% to 4% range. More interestingly, the $12TB_t$ contains more information about the next month stock return than $6TB_t$ and $3TB_t$. Furthermore, all the slope coefficients are positive and close to unity, implying that ex-ante TB yields and monthly stock returns have approximately one-to-one correspondence.

The regressions of quarterly ASPI returns exhibit the same patterns observed in monthly results. All three TB yields are positively related to future quarterly returns. The slopes are larger in magnitude and more significant than those found in monthly regressions. Generally, quarterly slopes are more than twice the monthly slopes, and increase with longer maturity TB yields. These results indicate that, as with monthly results, $12TB_t$ has more information about future quarterly returns than $3TB_t$. $12TB_t$ is able to track as much as 10% of future quarterly returns.

The regressions of annual ASPI returns also provide reliable evidence that short-term interest rates track expected returns in Sri Lanka. All the slopes are positive and significant at 5%, while their magnitudes are larger than the quarterly slopes, except in the case of $12TB_t$. However, interest rates track a lower proportion of annual expected returns than quarterly expected returns. The R^2 of $12TB_t$ drops the most, and $6TB_t$ appears to predict annual returns better than other two regressors.

Table 4 contains results of regressions of returns of the SPI, which is a more sensitive price index. The monthly regressions show that all three measures of TB yields are positively related with future monthly returns, and slopes are reliably different from two standards errors. Compared with ASPI monthly results, the coefficients are slightly larger and more significant. The quarterly results are the strongest with 1% significance. $12TB_t$ explains about 11% of annual returns. However, there is no discernible pattern of slopes increasing with longer maturity TB yields.

These results are indeed very much contrasting with what is known about the relationship between stock returns and TB yields in most developed markets. As discussed previously, previous studies, particularly the ones that use US data, document a reliable negative relation between stock returns and TB yields rates [Fama and Schwert (1977), Fama (1981), Chen (1991)]. However, the relation in Sri Lanka is strongly positive. The effect of interest rates on future returns becomes larger and stronger with longer maturity TB yields, particularly in monthly and quarterly return horizons. In addition, the explanatory power also tends to increase with return horizon, except for $12TB_t$ in annual regressions. Interestingly, these findings are similar to the results reported by Fama and French (1989) using term and default spreads as explanatory variables. They find that slopes as well as the explanatory power increase with return horizon. The difference here is that the present study uses short-term rates than spreads.

Table 3
Regressions of ASPI Returns on Treasury Bill Yields

$$R(t,t+T) = \alpha + \beta X(t) + \varepsilon (t,t+T)$$

where R(t,t+T) is the continuously compounded returns (without dividends) of the All Share Price Index (ASPI), measured for monthly (T=1), quarterly (T=3), and annual (T=12) return intervals. X(t) is month-end observations of continuously compounded annualised primary market yields of Treasury Bills of 3-month ($3TB_t$), 6-month ($6TB_t$), or 12-month ($12TB_t$) maturity. The table shows OLS slope coefficients, t-statistics (within parentheses) and adjusted R^2. The number of observations is 95, 93, and 84 respectively for monthly, quarterly, and annual regressions.

	Slope Coefficients (t-statistics)		
T	**$3TB_t$**	**$6TB_t$**	**$12TB_t$**
M	0.92 (1.95)[c]	0.97 (2.00)[b]	1.06 (2.26)[b]
Q	2.10 (2.65)[a]	2.43 (3.06)[a]	2.66 (3.26)[a]
A	2.49 (2.43)[b]	2.60 (2.63)[b]	2.42 (2.32)[b]
	Regression R^2		
M	0.03	0.03	0.04
Q	0.06	0.09	0.10
A	0.06	0.07	0.05

[a] Significant at 1% [b] Significant at 5% [c] Significant at 10%

The results of the present study provide useful insights into the relation between stock returns, inflation, and interest rates as well. As pointed out earlier, early studies on this issue use TB yield as an estimate of expected inflation and find a negative relationship. In contrast, Samarakoon (1996), using lagged inflation and expected inflation derived from an ARIMA procedure as estimates of expected inflation, finds a positive one-to-one correspondence between

nominal stock returns and expected inflation. The finding of the present study of a positive relationship between stock returns and TB yields implies that, under the assumption of a constant real rate, one should expect to find a positive relationship between inflation and interest rates in Sri Lanka. This requires further study.

Table 4
Regressions of SPI Returns on Treasury Bill Yields

$$R(t,t+T) = \alpha + \beta X(t) + \varepsilon (t,t+T)$$

where R(t,t+T) is the continuously compounded returns (without dividends) of the Sensitive Price Index (SPI), measured for monthly (T=1), quarterly (T=3), and annual (T=12) return intervals. X(t) is month-end observations of continuously compounded annualised primary market yields of Treasury Bills of 3-month ($3TB_t$), 6-month ($6TB_t$), or 12-month ($12TB_t$) maturity. The table shows OLS slope coefficients, t-statistics (within parentheses) and adjusted R^2. The number of observations is 95, 93, and 84 respectively for monthly, quarterly, and annual regressions.

	Slope Coefficients (t-statistics)		
T	**$3TB_t$**	**$6TB_t$**	**$12TB_t$**
M	1.06 (2.20)[b]	1.01 (2.06)[b]	1.12 (2.35)[b]
Q	2.56 (3.11)[a]	2.46 (2.92)[a]	3.00 (3.53)[a]
A	2.81 (2.67)[a]	2.16 (2.06)[b]	2.45 (2.26)[b]
	Regression R^2		
M	0.04	0.03	0.04
Q	0.08	0.07	0.11
A	0.07	0.04	0.05

[a] Significant at 1% [b] Significant at 5% [c] Significant at 10%

V. Explanations

What explains the seemingly reliable positive relationship between stock returns and measures of short-term interest rates in Sri Lanka? A cursory examination of the behaviour of monthly returns (Figure 1) and 12-month TB yields (Figure 2) provides a simple explanation. In both figures, the period under examination can be broken into two distinguishable sub-periods, namely 1990-93, and 1994-97. During the 1990-93 period stock returns have been predominantly positive while the TB yields have been high. In complete contrast, during the 1994-97 period stock returns have been predominantly negative while the TB yields have been falling and low. This observation is confirmed by looking at the mean values of returns and TB yields during the two sub-periods. The statistics in Table 5 reveal that the returns which are large and positive in the first sub-period have become negative in the second sub-period. Similarly, TB yields during the second sub-period are about 2.5% to 3.0% lower than the yields in the first sub-period. It appears that during a period of positive returns TB yields have been high, while during a period of negative returns TB yields have been low, thus creating a positive correlation between stock returns and TB yields. This seems to be what is captured by the regressions results reported earlier.

Table 5
Mean Returns and Treasury Bill Yields for Sub-periods

Variable	1990-93	1994-97
R(ASPI) %	3.45	-0.69
R(SPI) %	2.84	-0.63
3TB %	16.26	13.59
6TB %	16.42	13.84
12TB %	17.23	14.21

Obviously, this does not imply causality. During the 1990-93 period the Sri Lankan stock market recorded phenomenal returns. This has been largely attributed to the liberalisation of the stock market to foreigners which resulted in large inflows of foreign portfolio investments. The higher interest rates was not a negative factor since the potential risk premium was quite high.[5] Therefore, the apparent positive relation (higher returns and higher TB yields) between stock returns and interest rates during this sub-period seems to be spurious. Most of the 1994-1997 period can be described as a bearish market, due to factors such as high and volatile interest rates (see Figure 2), low economic growth, and withdrawal of foreign portfolio investments. Although the average interest rate during this period was lower, interest rates were substantially lower only in 1997. It seems that rather than relatively lower interest rates contributing positively to the

[5] See Samarakoon (1998) for a detailed analysis of the behaviour of the historical risks and returns on stocks, Treasury bills and inflation in Sri Lanka during the 1985-1997 period.

business environment, high interest rate volatility in an environment of relatively poor economic prospects, and divestment by foreign portfolio investors impacted the stock market negatively. This suggests that the positive relation (lower returns and lower TB yields) observed in the second sub-period is also potentially spurious.

VI. Conclusions

This study examines the ability of interest rates, as measured by Treasury bill rates of all three matuarities, to track the expected monthly, quarterly and annual returns in the Sri Lankan stock market during the 1990-97 period. In contrast to the findings in most prior studies on foreign markets, the results of this study indicate that short-term interest rates in Sri Lanka are positively related to future returns. They are able to reliably track expected returns of all three returns horizons. The effect of interest rates on future returns becomes larger and stronger with longer maturity Treasury bill yields, particularly in monthly and quarterly return horizons. In addition, the explanatory power also tends to increase with return horizon, except in annual returns. The Treasury bill yields explain up to 4%, 11%, and 7% of monthly, quarterly, and annual future returns respectively. Of the three interest rate matuarities considered, the 12-month yield is found to have the most power to track monthly and quarterly expected returns.

While these results provide strong statistical evidence of a positive relation between stock returns and interest rates in Sri Lanka, a qualitative examination of the behaviour of the Sri Lankan stock market and the factors that have contributed to its movements suggests that there does not seem to be an obvious and direct link between the behaviour of interest rates and stock returns during the time period considered. Perhaps, the apparent statistical relationship is potentially spurious. Further research is necessary to uncover any economic linkage between stock market and interest rates.

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