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Factor Affecting Yields for Treasury Bills In Pakistan?

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Abstract
Treasury bills are the financial tool that is used by the government for two purposes such as for controlling money supply in the economy and to keep the inflation rate low. The pricing of these financial tools depend upon the market forces of demand and supply. In Pakistan T-bills are issued by the State Bank of Pakistan with the maturity of three, six months and also for one year. The return on bills depends upon the maturity duration of the securities. Different macroeconomic factors can influence the yield on securities. Many statistically researches had been done in this context but little work has been done in Pakistan's context. The study is conducted to check that how macroeconomic variables affect the yield of Treasury Bills. Other than the factor of maturity many other factors influence the rate of return. Most important macroeconomic variables that influence the yield are stock prices, prime lending rate, CPI and the supply of money. In this paper, the data is collected from State bank quarterly and annually reports, IMF, Karachi stock exchange and World Bank database. Normality of the data autocorrelation, multicollinearity and Heteroskedasticity were tested, that shows that data is stationary, data has no autocorrelation, data is not Heteroskedasticity. Data is taken from 1991-2015 while prime lending rate is of six months. Risk-Averse Preferred Habitat Model taking term premium as explained variable given by (Heuson, 1988). Results show that the overall model is significant. Individual significance of the variables shows that only one variable CPI is significant that shows that when inflation increases it increases the yield of T-bills. It is because of when rate of inflation increases the rate of interest in the economy is low and people prefer liquidity or holding cash.

Introduction

Treasury bills are one of the most important instruments of the money market. Treasury bills which are also known as T-bills a short term maturity promissory note issued by Government of the country as a primary instrument for regulating money supply and to make fluctuation in the liquidity in the economy of the country. (Business Dictionary). The availability of liquid assets greatly affects the economic activities and has significant contribution in the economic growth of the country. Treasury bills are issued by the central bank of a country having maturities of three months, six months and one year. The yield on bills depends upon the maturity duration of the bill. One year bill give greater yield on maturity than one and six month Treasury bill. Determination of price of such as financial tool depends upon the market forces (demand and supply). In Pakistan, treasury bills are issued by State Bank of Pakistan. State Bank of Pakistan significantly affects all economic activities through implementation of monetary policy accordingly. Here dual functions of T-bills are assumed i-e regulation of liquidity while keeping the rate of inflation rate at minimum level. The yield on treasury bills is high interest elasticity. Beside it there are many other factors which can affect the yield of Treasury bill. Many researchers worked on it qualitatively but few of them empirically measured the relationship between the factors and the yield on Treasury bill in Pakistan.

In market activities different macroeconomic variables affect the yield of investment on T-bills such as foreign direct investment, stock prices, banks interest rate, consumer price index and supply of money. Karachi stock exchange KSE-100 index is used as representation of stock prices. The status of the economy can be reflected when there is a change in index. If the status of the economy is improving it shows that the yield on treasury bills increases and vice versa. The cost of funds for banks can be represented by prime rate or Karachi inter-bank offer rate (KIBOR). If banks are interested in investing in T-bills, they increase the prime rate. Price of T-bills is also influenced by the broad money. When Supply of money in the economy increases, it lowers the return on investment.

This study empirically measures the yield of t-bills with different macroeconomic variables such as prime rate, stock prices, money supply and inflation. The observation of the data is from 1991-2015 and it is based upon the data taken from IMF, State Bank of Pakistan, World Bank and Karachi stock exchange.

Literature Review:

Rate of interest is an important factor that can determine the yield on different types of securities. Financial theory gives different view on yield of different securities. Return on securities is influenced by the term structure of the interest rate. Classical theory of "loanable funds" only gives us the rate of interest which is determined by market forces of demand and supply. In classical theory interest rate on loanable funds depend upon the saving condition (Rose, 1957). Later on in 1936 Keynes gives the liquidity preference theory. Keynes says that investors invest in that security which gives them greater return in the future (Keynes, 1936). Hicks in 1946 given more importance to the expected spot rate in the future, which shows that if the duration of the maturity of bonds is long it gives greater return in the future while short term maturity gives less return (Hicks, 1946). In 1957 Culbertson gives his view that investor's gives more important to the maturity of different types of the securities in different markets (Culbertson, 1957).John conducted a study about the pricing of bonds. Different factors such as consumption, risk, and other investment alternatives are important for determining the price of bond (John C. Cox, 1985) .

Inflation is another important factor that can influence the expected return on bonds. Study shows that the behavior of the expected return depend upon the past real behavior of the market (Fama, 1975). In 1976 he modified his study to check the uncertainties in real return of T bills especially due to inflation. He also concluded that the return on short term maturity bonds is less in comparison with long term bonds, but return on long term bonds is uncertain due to inflation (Fama, Inflation Uncertainty and Expected Returns on Treasury Bills, 1976). Another study is conducted on the different rate of bank borrowing and lending rate. The study shows that the share of interest-insensitive deposit is the important factor in determining the interest spread in Pakistan (Din, 2007). Hasan and Javed in their study make an empirical relationship between macroeconomic variables and equity (Hasan & Javed, 2009). (Thenmozhi & Nair, Feb 2014) In their study conducted that current return on bonds depends upon the past information and future return on bonds. Recent study is conducted in Pakistan's context about yields of T-bills from 2004-2014 (Shahid Ali, 2015).

2. Methodology

Method

It is important to develop a theoretical model that can form non-linear association which can explicate the term premiums of a T bill. It can be found through both macroeconomic factors and maturity term of the bills. In this connection, it is appropriate to approach (Heuson, 1988). Following this approach, a model could be developed as discuss below.

The term premium is defined as follows $(\theta,) - (t)$ _____ (i)

Where $(\theta,)$ in (i) is yield to maturity of a default-free bond that promises the payment of $1 in θ periods and is measured at time period t.

(θ) is yield on similar security that matures at the shortest possible time period t

Using the term premium the following model could be better off for bringing the explained and independent variables under the association of statistics using which factors could be identified in pricing of T bills indigenously.

$(\theta,t) = \beta t(\theta) + \varepsilon t$ _____ (ii)

$\beta t = \Upsilon 0 + \sum \Upsilon i Xi, mi=1$ _____ (iii)

In the mentioned (ii) and (iii) Υis are constants with Xi,t the values from macroeconomic factors in time t. The model described in (ii) exhibits $\Upsilon 0$ as non-zero only when term premiums are fully explained by term structure meaning that term premiums should assume a logarithmic curve. This should also suggest that coefficients for term premiums (βt) be positively related in period t to risk aversion of investors in market. From the above two equations, the below equation can easily be obtained.

$(\theta,t) = (t) + \Upsilon 0 \ln(\theta) + \sum \Upsilon i Xi,tmi=1 \ln(\theta) + \varepsilon t$ ___ (iv)

We could estimate (iv) equation on a pooled time series dataset where we have different values of θ in time periods t. X, represents macroeconomic variables in the equation and the variables are stock prices, consumer price index, prime lending rate, and money supply. When the prices of stock exchange change in KSE 100 index, it forms anticipation of equity investor and the changes reflects improving and disproving picture of the economy. An improvement means there is increase in required rate of return on T bills. This helps us in building hypothesis;

Hypothesis

H01: Unexpected rise in stock prices increases the required rate of return on T bills

(KIBOR) Karachi Inter Bank Offer Rate increases when the Banks are interested in investing in T bills and it will demand higher required yields and the cost of funds is approximated by the KIOBR. The second hypothesis is developed in the following manner.

H02: Rise in prime rate increases the required yield on T bills for banks

CPI can also be associated with the yields on maturity of the T bills. CPI indicates the rise in the general price level. The rise in the general price level increases the required rate of return on T-bills. By keeping the inflation rate constant in the short run, there would be additional return required as compensation.

H03: Unanticipated inflation increases the required rate of return on T bills
The fourth hypothesis is related to the association between money supply and return rate on the bills which is likely inverse. Increase in the money supply lower the rate of return on T-bills. The discussion enables us to form the hypothesis in the following manner.
H04: Increase in rate of change of money supply decreases the required rate of return on T bills
The presented four hypotheses could be tested using data on all concerned variables where the macroeconomic variables are hypothesized to have the following signs in the regression relationship where real return is a dependent variable.
Increase in stock prices Positive (+)
Increase in prime rate Positive (+)
Increase in inflation Positive (+)
Increase in money supply Negative (-)
Equation (iv) given above could be further modified in the following form that would enable testing our hypotheses on the basis of available data.
$(\theta,t) = \alpha 0 + \Upsilon 0\ln(\theta) + \Upsilon 1\text{Sp}\ u\ln(\theta) + \Upsilon 2Pru\ln(\theta) + \Upsilon 3\text{CPI}tu\ln(\theta) + \Upsilon 4Mtu\ln(\theta) + \varepsilon t$ _____ (v)
Where $(\theta,)$ is average yield of a T bill and 12 months of its maturity is taken into account; S is the rate of change in share prices, P is the change in prime rate, I is the change in inflation, and M is the change in money supply. $\alpha 0$ is the constant and represents the shortest possible yields on returns.

$$\sum (etTt=2 - et-1\ )2\sum et2\ Tt=1 / \_\_\_\_\_ \text{ (vi)}$$

When the value of (vi) is equal to 2 there may be no evidence of autocorrelation. A value reasonably lower or greater than 2 indicates negative or positive autocorrelation respectively. Another potential threat to regression coefficients is the presence of multicollinearity which could be detected using a number of diagnostics. Highly correlated predictors lower our confidence in estimated values of the dependent variable. The paper suggests using Variance Inflation Factors (VIF) in measuring serious correlations between predictors. Multicollinearity between predictors would be considered serious if VIF>10
Y: yields on 12 month Treasury bills (%)
Sp: stock prices (%)
CPI: Consumer price index, inflation (%)
M: broad money (%)
Pr: Prime rate based on 6 months (%)

2.3. DATA and FINDINGS

Data of the yields on Treasury bonds(Y) and KIBOR (prime rate, Pr) are collected from the state bank of Pakistan official website. The data for 1 month, 3 months and 12 months on Treasury bonds are given on monthly basis. We got the average of 12 month Treasury bonds from 1991 to 2015

Data about the stock prices (Sp) is available on the official website of Karachi Stock Exchange (KSE 100 Index). It was also given in quarter and annual form. We took the average of annual data in percentage form.

Findings about the inflation (CPI) and Broad money (M) are available on World Bank indicator in percentage form.

2.4unit root test (Stationarity)

H_0= Y, CPI, Sp, Pr, M has unit root or non-stationary
H_1= Y, CPI, Sp, Pr, M do not have unit root or stationary

variables	Level	First difference
Y	**0.0614**	**0.0004**
Sp	**0.0476**	**0.0004**
CPI	**0.1382**	**0.0000**
M	**0.0937**	**0.0008**
Pr	**0.2373**	**0.002**

Interpretation: Almost all the variable's probabilities are significant at first difference. Therefore, we reject **H_0** and accept **H_1** and state that variables are stationary

2.5. Multicollinearity:

H_0=Cov (CPI, Sp, CPI, M) ≠0

H_1=Cov (CPI, Sp, CPI, M) =0

Covariance Analysis: Ordinary
Date: 02/27/16 Time: 10:00
Sample: 1991 2015
Included observations: 25

Covariance Correlation	SP	PR	M	CPI
SP	0.344478 1.000000			
PR	-0.760847 -0.364791	12.62831 1.000000		
M	-0.113714 -0.062668	-5.577509 -0.507669	9.558171 1.000000	
CPI	-0.249499 -0.116041	0.376709 0.028937	0.316020 0.027903	13.42013 1.000000

Since the probabilities of all the stated variables are significant. Therefore, we reject **H_0**and accept **H_1** and say that there is no multicollinearity between the explained

2.6. Heteroskedasticity:

H_0= var (ε_t) ≠0 (homoscedasticity)

H_1= var (ε_t) =0 (Heteroskedasticity)

Heteroskedasticity **WHITE TEST:**

F-statistic	1.743365	Prob. F(14,9)	0.2024
Obs*R-squared	17.53431	Prob. Chi-Square(14)	0.2288
Scaled explained SS	13.35834	Prob. Chi-Square(14)	0.4985

As shown the probability of the observed R-squared is insignificant. Therefore, we accept H_0 and state that variance of the residual is constant and there is homoscedasticity in the data.

2.7. Autocorrelation:

H_0=Cov (ε) ≠0 (autocorrelation exists)

H_1=Cov (ε) =0 (autocorrelation does not exists)

Durbin-Watson test:

Durbin-Watson stat 1.869453

Value of the Durbin-Watson test statistics lies within the range i.e. 1.8<D<2.2
And ours is 1.86. Therefore, we state that there is no autocorrelation in the data.

2.8 OLS TECHNIQUE:

According to the above tests and result we can develop the econometric model for the analysis of the factor affecting the yields on treasury bills as following:

Model for test: $Y= \beta_0 + \beta_1 Sp + \beta_2 CPI + \beta_3 M + \beta_4 Pr + \varepsilon$

Dependent Variable: Y
Method: Least Squares
Date: 02/27/16 Time: 11:17
Sample (adjusted): 1993 2015
Included observations: 23 after adjustments
Failure to improve SSR after 21 iterations
MA Backcast: 1992

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.368380	1.313974	7.129806	0.0000
D(M)	0.095637	0.188993	0.506032	0.6197
D(PR)	0.248798	0.139403	1.784746	0.0933
D(CPI)	0.360520	0.071166	5.065889	0.0001
D(SP)	-0.440309	0.831858	-0.529308	0.6039
AR(1)	0.225002	0.266528	0.844194	0.4110
MA(1)	0.999843	0.288635	3.464035	0.0032

R-squared	0.576473	Mean dependent var	9.357609
Adjusted R-squared	0.417650	S.D. dependent var	3.467938
S.E. of regression	2.646447	Akaike info criterion	5.030103
Sum squared resid	112.0589	Schwarz criterion	5.375688
Log likelihood	-50.84618	Hannan-Quinn criter.	5.117017
F-statistic	3.629666	Durbin-Watson stat	1.869453
Prob(F-statistic)	0.018195		

Inverted AR Roots	.23
Inverted MA Roots	-1.00

2.8.1 Vector auto regressive model (VAR):
In order to find the short run relationship between the yields on Treasury bill and its factor affecting the Treasury bill, we apply the VAR model and the result is given below.

R-squared	0.805364	0.590619	0.577459	0.570404	0.608312
Adj. R-squared	0.643167	0.249469	0.225341	0.212408	0.281905
Sum sq. resids	51.49786	3.438221	124.5540	100.1701	128.9798
S.E. equation	2.071591	0.535274	3.221723	2.889205	3.278462
F-statistic	4.965344	1.731257	1.639958	1.593323	1.863661
Log likelihood	-41.90512	-10.77938	-52.06190	-49.55640	-52.46344
Akaike AIC	4.600445	1.893859	5.483644	5.265774	5.518560
Schwarz SC	5.143507	2.436921	6.026706	5.808836	6.061623
Mean dependent	9.357609	10.22885	8.671656	43.13407	9.250026
S.D. dependent	3.467938	0.617863	3.660436	3.255574	3.868826

Again the value of R-square and F-statistics are significant and it is concluded that in short run the factors selected in the model are significantly affecting the yields on treasury bills.

2.9 Johinson (Cointegration Vector):
In order to find the long run relationship between the dependent and independent variables there should be at least one Cointegration vector between the given variables. Therefore, to find the Cointegration vector Johinson Cointegration vector test is applied on the data.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.829610	40.70236	34.80587	0.0088
At most 1	0.604006	21.30618	28.58808	0.3188
At most 2	0.499614	15.92465	22.29962	0.3036
At most 3	0.396529	11.61633	15.89210	0.2094
At most 4	0.114377	2.793663	9.164546	0.6200

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

2.9.1 Vector Error Correction Model (VECM):

To find the long run relationship between the yields on treasury bills and factor affecting the yields on treasury bills.

H_0: long run relationship does not exist

H_1: long run relationship does exist

R-squared	0.639844	0.297267	0.212932	0.111894	0.344941
Adj. R-squared	0.504786	0.033743	-0.082218	-0.221146	0.099294
Sum sq. resids	104.1194	6.659915	164.5623	187.8702	194.4838
S.E. equation	2.550973	0.645170	3.207046	3.426644	3.486436
F-statistic	4.737536	1.128043	0.721437	0.335978	1.404215
Log likelihood	-50.00109	-18.38263	-55.26523	-56.78854	-57.18641
Akaike AIC	4.956617	2.207185	5.414368	5.546830	5.581427
Schwarz SC	5.302202	2.552770	5.759953	5.892415	5.927013
Mean dependent	-0.120870	-0.025030	-0.004348	-0.098261	-0.207784
S.D. dependent	3.625011	0.656339	3.082817	3.100882	3.673586

Value of F-statistics is significant. Therefore, over all model is significant. R-square value is 63% which states that all the important factor affecting the yields on Treasury bill are taken in the model. And the variables have a significant effect on the yields on Treasury bill

3.0 Result

Observed model:

$\hat{Y}$ **= 9.3683+0.095637M+0.248798Pr+0.360520CPI+ (-0.440309) Sp**

3.1. Individual significance

The calculated value of t-statistics for CPI is larger than tabulated value of its t-statistics and its probability is also significant. Therefore, we can say that CPI significantly affects that yields on Treasury bond. Beside it no any other variable in the context of our model significantly affects the dependent variable.

3.2. Overall significance:

The calculated value of F-statistics (3.6296) is larger than the tabulated value (2.194) or the probability of the F-statistics(0.018195) < 5%. Therefore, according to the definition both are significant. And on the basis of this result of F-statistics we say that overall model is significant.

3.3. Short run and long run relationship:

Both in the short run and in the long run the model is significant and result obtained that of T-statistics (for individual significance), F-statistics (overall model significance) and R-square are significant indicating that all the explanatory variables considered in the model are significantly affecting the yields on treasury bills in the context of Pakistan economy for the annual data of 1991 to 2015 and almost all the important variables are taken into account.

4.0 CONCLUSSION

The overall model is significant. As for as the individual significance is concerned, the probability of CPI is only significant and it states that if the value of CPI increases means inflation rates increases. It also increases the yields on treasury bonds. Because in such phenomenon the rate of interest in the economy is low and people prefer liquidity or holding cash. Therefore, money supply in the economy increases and it increases the general average price level. Then in order to control inflation state bank issues the Treasury bills (government securities) at higher rate of return and induce people to invest in it.

The higher value of R-square also indicates that almost all the important factors affecting the yields on treasury bills are taken in the model.