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A Study On Risk Free Rate In The Context Of Indian Financial Market

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Abstract

It is not easy to identify the risk free rate in the context of developing countries like India , neither through both local and international investors' investigation. However in Indian financial market, there is availability of government securities, hence the rate of return on that securities shall be viable to be considered on the risk free status. To study, a standard risk free rate shall be available, once rate of return on the US treasury is considered by most of investors to be riskless rate. Therefore, the objective of stud is to compare the variability of rate of return on India government bonds with the US treasury's standard. The data of the 40 months in the year 2008 to 2012 of YTM on the three different maturities of government bonds both in the US and in India . The result indicated that the bonds with maturity of 1 year YTM was not considered as riskless rate due to the high variable in YTM of Indian government. Whereas, YTM on government bonds in India with maturity of 10 years and 20 years can be considered as risk free rate because there was no significant difference between its variability with standard one.

Keywords: Risk Free Rate, Indian Financial Market, Yield-to-Maturity, US Treasury, marking , US Financial Market , Z-test , US government securities, decision-making , return on Indian government .

Introduction and Research Design

The Researchers find that, in the developed countries, the investors have a clear view on getting the risk free rate to evaluate their investments. The return on local government securities is the only best forecasting method on riskless rate. Most investors in developed countries choose the return on the government bonds to be risk free rate. The valuation on their investment is done easily because of the basic point; the risk free rate, which is available every time. However, the concept of risk free rate in developing countries is very complicated for investors in choosing the right one, and sometimes finding the riskless rate to be basic start in

evaluating the investment is impossible.

The risk free rate is derived from the expected return on a risk-free asset. On the basis of risk free rate, the expected returns on the risky investments are calculated with the risk creating an expected risk premium, which is added on to the risk free rate. Moreover, the risk free rate is also the basic factor for some empirical tests of financial theories: Capital Asset Pricing Model (CAPM), Modern Portfolio Theory, and Black-Scholes Model.

In academic study, it is assumed to be given or easy to be obtained. In valuation of assets, it is most often long-term government security rate to be used as the risk free rate in order to apply the formula. However, one question has come up whether the investors shall consider the expected return on government short-term or long-term security. In the context of Indian financial market, the government has issued many types of securities, such as Treasury Bills, Cash Management Bills, Dated Government Securities and State Development Loans. Whether government securities of India should be the riskless assets or not, is still a question for all investors in India. The main focus of this study is to choose a proper risk free interest rate in the Indian financial market, which was indicated through two questions: so we need to know the availability of government securities in the Indian capital market And the return on government bonds in India be considered as risk free rate.

The purpose of this study is to determine the risk free rate using in valuation of investment in the context of India. The specific objectives set to: (1) determine the conditions for risk free rate, (2) find out the different types of government securities which are available in India, (3) distinguish the variability between the return on Indian and the US government securities, and (4) confirm the risk free status of the return on Indian government securities.

Hypothesis testing of the Z-test was employed in this study. The difference between two standard deviations of two samples is conducted in the Z-test. Setting up the null and alternative hypothesis were defined as follow:

- A null hypothesis (H_0: $\sigma 1 = \sigma 2$) - “There is no significant difference between two standard deviations of the samples of returns on Indian and the US government securities.” Or “the variability on the return on Indian government securities does not significantly differ from that in the United States.”
- Alternative hypothesis (H1: $\sigma 1 \neq \sigma 2$) is a positive statement or reverse of null hypothesis, that is - “There is significant difference between two standard deviations of the samples of returns on Indian and the US government securities.”, Or “The variability of the returns on the government securities in India significantly differs from that in the United States.

The monthly YTM data was employed for the study to determine the differences between the YTM data from two central banks of India and the Federal Reserve Bank United States by conducting the z-test. Monthly data of 1 year, 10 years and 20 years maturity was collected for this project. The sources for these data were retrieved as under: Monthly YTMs on Indian government bonds were taken from the official website of the Reserve Bank of India, and Monthly YTMs on the US treasuries were retrieved from the Board of Governors of the Federal Reserve System. This data was collected for the period of 40 months which started

from December 2008 to March 2012. The chosen period was considered to be neutral as the period is in the end of global financial crisis and the crisis of sovereign debts in the Euro Zone. Therefore, the period can indicate the variability of the return in both government bonds during the unstable global financial market.

Though good effort has been made to put up an empirical research; however, the following factors have been unavoidable absent as a result of their critical limiting factors for this study. This project study is limited the samples such as the rates of return during the period selected to study. The data collected from December 2008 to March 2012 only. The findings of the paper were furnished in this project study were based on the analysis of the three maturities of both long-term government securities listed above. The market affecting factors like political scenarios, natural calamities, international economic event, war, etc. are not taken into this project study.

The remainder of this paper is divided into four sections. Section 2 provides a literature review of risk free rate. Section 3 gives the review of Indian government instruments and yield-to-maturity(YTM). Section 4 presents the data collection and methodology and section 5 presents the summary result of the paper. Section 6 concludes the paper.

Literature Review on Risk Free Rate

According to Aswath Damodaran (2008), in order to get expected return which is riskless, there are two basic conditions to be satisfied: (a) no default risk is in the expected return, and (b) no reinvestment risk during the holding period of investors.

By "default risk", it means the possibility that the issued companies may fail to pay the principal or interest on the securities during the stipulated date. Therefore, this risk is associated with any securities issued by a private company. As the largest or safest firms have some measures of default risk, the case of collapse was still existed, for instance the case of Lemad Brother, the biggest private company in the US. Thus, the only securities which provide riskless are government securities. It is not because the government performs better than the private firms, but because the government has the authority in printing the money in the country, plus the government never shut down but private firm does.

Additionally, "no reinvestment risk during the holding period of investors" is the risk that the investment's principal market value will raise or fall during the period to maturity as a function of change in the general level of interest rate. Each security which has no default risk, does not mean that there is no reinvestment risk. For example, the government bonds have no default risk, but they don't have no reinvestment risk since the coupons on the bond will be invested at rates that cannot be predicted today.

Roger J. Grabowski (2010) demonstrated the definition of risk-free rate as the return available on the security, which the market regards as free of the risk of default. There are three main components that the risk-free rate reflects: (1) the rental Rate which is a real return from the fund you lend over a period of investment, (2) the inflation, which means the expected rate of inflation over term of the risk-free investment, and (3) the maturity risk or reinvestment,

which is the risk that investors can invest their funds during the period of holding government bonds. All the securities will give the yields to maturity equipped with these three economic factors for any given maturity length.

At all, there are three main conditions for risk free rate, which are no default risk, no reinvestment risk and the inflation expectation. The most important feature of riskless rate is no default risk. Once investors participate in any type of investment, the principal back along with return on time are expected. And the most important desire for investors is to get out of fear of losing their money, while taking investment decision making. The government securities give the investors the guaranty in paying back their principal and interest. It is not because government can earn more profit than other issuance companies, but it is because the government never falls down. It can be said that government would run forever. Even though it does not have ability to pay its debt this year, then it has obligation to pay back next year. Moreover, government is legal controller of money circulation in the country. Therefore, if the government issues the debts for publics and it does not have ability to pay back, the government will manage to give them back. All these reasons give guarantee to government securities.

Another important condition for risk-free rate of return is that there can be no reinvestment risk, which investors always considered. Market interest rates have fluctuated from day to day, which leads to the chance of reinvestment on the investor's fund and interest generated. The chance of reinvesting in getting a higher return from new investment will be possible during the period holding the securities. For example, you have invested in company's bonds which have face value of Rs. 10,000 for each one with the coupon rate of 10%. After one month, because of the fluctuation in the market interest rate, there is a chance for you to invest in another type of bond which provides you a coupon rate of 12%. This leads to risk of reinvestment for your fund if other conditions remain the same. That is why most of investors consider government securities as no reinvestment risk instruments. It is because the rates of return on government securities do not significantly differ from time to time. The reason is that the government has authority in determining the interest rate in the country. During the short-term period there is a slightly change in the yields in the government securities. This is what investors think about government instruments.

Inflation is also considered as another risk factor for investors' decision-making. Under conditions of high and unstable inflation, valuation is often done in real terms. Effectively, this means that cash flows are estimated using real growth rates and without allowing for the growth that comes from price inflation. In decision related to riskless rate, the rate should reflect the expected effect of inflation. While the government bonds may offer returns that are risk-free in normal terms, they are not risk free in real terms since expected inflation can be volatile. The standard approach of subtracting an expected inflation rate from the normal interest rate to arrive at a real risk free rate provides at best an estimate of the real risk free rate. Until recently, there were few traded default-free securities that could be used to estimate real risk free rates, but the introduction of inflation-indexed treasuries has filled this void. However, the inflation-indexed treasury security (TIPs) is available in some developed countries. We cannot find it in developing country, like in India. But this year, 2013, the government of India will introduce TIPs to the investors who can use it to cope with inflation.

In valuation of long term investment made by businesses, practitioners generally

consider long-term U.S. government bonds as riskless rate security. This convention represents a realistic simplifying assumption. Most business investments have long durations and suffer from a reinvestment risk comparable to that of long-term U.S. government bonds. Most of financial analysts use the return on government long-term bond as risk free rate. It is the rate of return on 10-year or 20-year government bond with constant maturity, or sometime 30-year bond. While the choice of risk-free rate was relatively easy during period of stability, it became problematic beginning in September 2008, as financial crisis started to unfold. All U.S. government security yields declined and long-term U.S. government bond yields became abnormally low for several months. So, it is not easy to choose the riskless rate because it varies from one day to another.

In short, risk-free rate is known as the return on riskless assets which normally refer to the government securities. There are three main conditions for risk-free rate of return: no default risk, no reinvestment risk and inflation.

Review on Indian Government Instruments and Yield-to-Maturity (YTM)

Indian Government Instruments

There are two main types of government securities, short-term and long-term securities. Short-term government securities refer to treasury bills, with original maturity of less than one year, while as, long-term government securities are the government bonds or dated securities with original maturity of more than one year. However, in reality, Indian Government securities have divided three main categories which are shown in the following table 1.

Table 1: *Issuers, Instruments and Maturity in Indian Government Securities*

Issuer	Maturity	Instruments
Central Government State Government	91/182/364 days Less than 91days 2-30 years 5-13 years 5-13years	T-Bills Cash Management Bills Dated securities Dated Securities State Development Loans

Source: RBI, 2011

Risk involving in Government Securities

Government securities are normally considered as risk free instruments because sovereigns are not expected to default on their payments. However, there are some risks associated with holding the Government securities in developing country. According to hand book for investors issuing from SBI on website , the following are the major risks associated with holding Indian Government securities.

Market risk

Market risk refers to adverse movement of prices of the securities which are held by an investor due to changes in market interest rates. Losses on marking to market will happen if the securities are sold at the adverse prices. Investors, to some extent, can mitigate this risk through holding the bonds until maturity, so the yield on government instruments will be the same at which the securities were actually bought.

Reinvestment risk

Reinvestment risk refers to a risk that the investor may not be able to reinvest the return from investing in government securities at profitable rates due to changes in interest rate scenario.

Liquidity risk

Liquidity risk refers to the inability of an investor to liquidate (sell) his holdings due to non-availability of buyers for the security, i.e., no trading activity in that particular security. Normally, when a liquid bond of fixed maturity is bought, its tenor gets reduced due to time decay.

According to hand book for investors issuing from SBI, Investors can mitigate the above risks through many techniques. Holding securities till maturity could be a strategy through which one could avoid market risk. Market risk and reinvestment risk could also be managed through Asset Liability Management (ALM) by matching the cash flows with liabilities. ALM could also be undertaken by matching the duration of the cash flows in assets with that in liabilities. Advanced risk management techniques involve use of derivatives like Interest Rate Swaps (IRS) through which the nature of cash flows could be altered. However, these are complex instruments requiring advanced level of expertise for proper understanding. Adequate caution, therefore, need to be observed for undertaking the derivatives transactions and such transactions should be undertaken only after having complete understanding of the associated risks and complexities.

Yield-To-Maturity on G-sec

It is crucial to understand the method to measure the return on government bonds. The most widely used measure of return on bonds is known as yield to maturity(YTM). YTM may be defined as the compounded rate of return which an investor is expected to receive from a bond purchased at the current market price and held to maturity. YTM is really the internal rate of return earned from holding a bond until maturity.

The relation between the cash outflow, the cash inflow and the YTM of a bond can be expressed

$$MP = \sum_{t=1}^{n} \left(\frac{Ct}{(1+YTM)^t} + \frac{TV}{(1+YTM)^t} \right)$$

Where

MP= Current market price of the bond

Ct = Cash inflow from the bond throughout the holding period.

TV= Terminal cash inflow received at the end of the holding period.

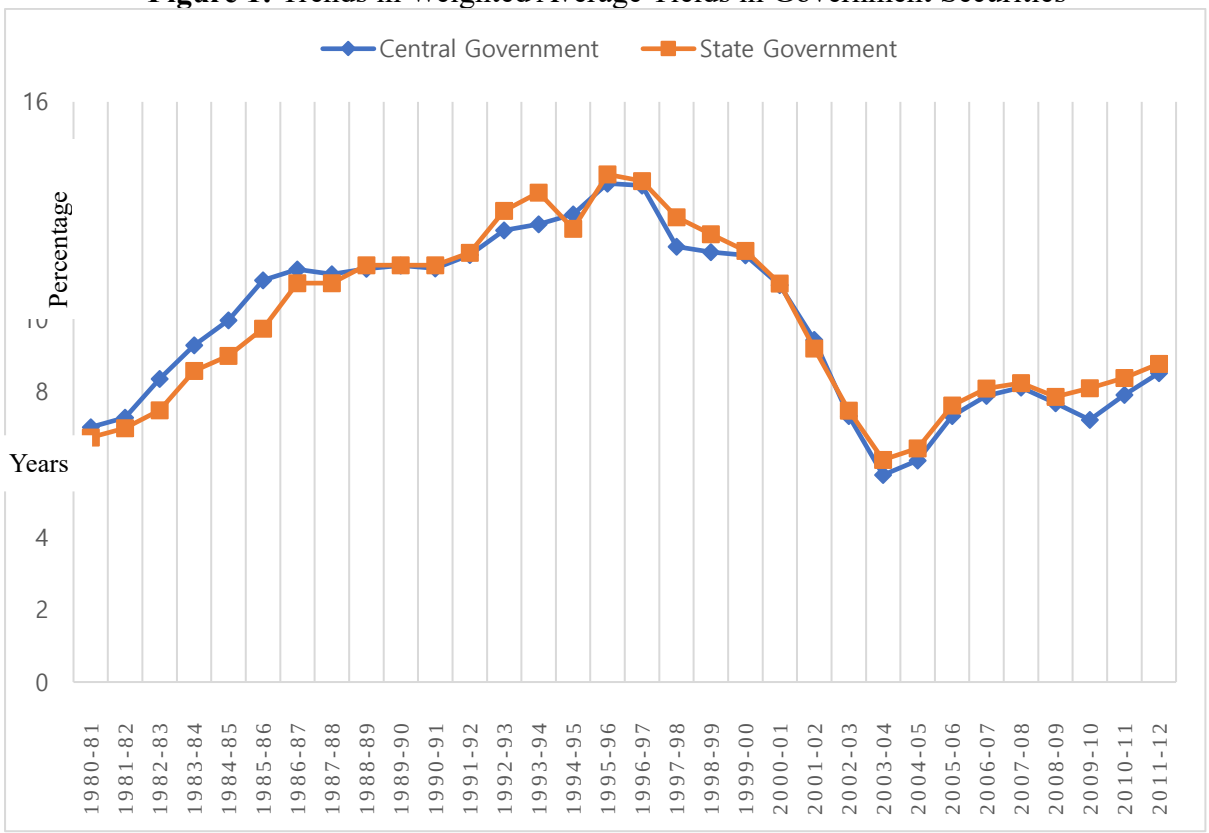
In India, the government securities have been issued by two main bodies- the central government and state government. The central government has issued the government bonds in order to raise the fund available for development of the whole country, while the state government has issued them in order to raise fund for the sake of its own state. However, the YTMs on both securities are not far different from each other. The following is the trend in YTM in government bonds.

Yields on government securities are determined by the monetary policy stance affecting the short-rate coupled with the yield curve. They had followed a U-shaped pattern since liberalization reaching a trough in 2003-2004 and rising since then as shown in figure 1. Trends in weighted average yields in both central government and state government securities in India for the period starting from 1980-81 to 2011-12, are shown in figure 1. The yields on both types of securities, as can be observed, are significantly different, even though there is slightly different in some years. The shaped pattern of both curves is the same. It means that while the return on central government securities rose, the yield on the state government securities also increased.

As can be seen, starting from 1980-81 to 1987-88, the return on central government securities is somewhat higher than that on state government instruments. Until 1988-89 both securities yield the same rate of return which was about 11.5%. That rate continued until 1991-92. The rate of return on state government securities has been higher than that of central government securities in 1992-93 onward. Both securities reached the peak in 1996-97 at the rate of 14%.

After that the yields have dramatically decreased from year to year. Until 2003-04 the yields on both securities fell down at the lowest point, only 6% of rate of return. However, the yields started to raise but not much, because from 2007 to 2009 there was financial crisis all over the world and adding the sovereign debt crisis in EU in 2010, the rates of return fluctuated over the last 3 years.

Figure 1: Trends in Weighted Average Yields in Government Securities



Source: Reserve Bank of India, 2012

Data Collection and Methodology

Data Collection

The data was mainly collected from the statistic source of Reserve Bank of India and Board of Governors of the Federal System, the United State. Under this study, we take into consideration only the monthly yield to maturity on both government bonds in the US and in India, starting from December 2008 to March 2012. The date was at the end of global financial crisis and during the EU sovereign debt crisis.

The data was collected only for the Yield-to-Maturity on the government bonds with maturity of 1 year, 10 years and 20 years both in the US and India. In all the three conditions, the YTM on Indian government bonds were considerably higher than that on the US treasuries. It means that the rate of return on the US treasury is lower because the US treasury is preferable for investors. Another reason is that The US is a well-developed country with stable economy, while India is one of among developing countries with fragile economy. Therefore, the cost of borrowing in India is higher than in the US.

There are internal and external factors affecting YTM of both government securities. For internal factors, the monetary policy of each country is more relevant to YTM. For external factors, the world economic and financial crisis will be the most important factor for determining YTM of government.

In this study, because we cannot compare the mean of YTM on both the countries, we study only the variability of YTM with help of statistical tool of standard deviation (SD).

The YTM on government bonds both in the United States and India with maturity of 1 year starting from December 2008 to March 2012 illustrates in the figure 2. There are significantly different between the YTM on the government securities in the US and India. While YTM on Indian government bonds is more than that of the US government.

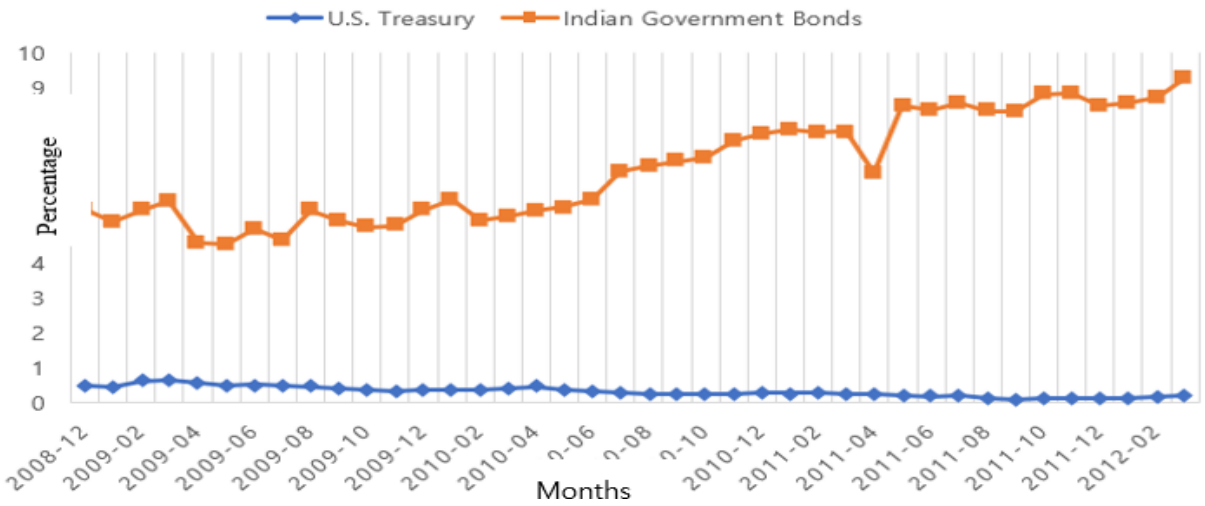


Figure 2: *The Yield-to-Maturity on the 1-year government bonds in the US and India*
Source: Reserve Bank of India and Board of Governors of the Federal Reserve System, 2012

It can be said that there is no factor affecting YTM on the US treasury during the date stated above. As can be seen, the curve of YTM of the US treasury is nearly straight line. There was slightly changed during that period. Whereas, YTM on the Indian government fluctuated between December 2008 and March 2012. Government bond in India with 1 year maturity yielded not stable. For example, in March 2011 YTM is 7.49 percent and then it declined sharply to 6.31 percent.

In short, YTM on 1-year government bonds in India has increased while that on the US treasury has decreased for the period of study.

The graph 3 depicts the YTM on the 10-year government bonds in India and the 10-year US treasury. The shapes of curves for both countries look similarity for 10 years maturity. From the starting point, December 2008, the Indian government bond's YTM increased at higher rate than that of the US treasury.

When there was an increase in YTM of Indian government security, there was also an increase in YTM of the US treasury. As can be seen, the rate of return decreased during the months of April 2010 until October 2010 which was the EU sovereign debt crisis. This situation affected both the economy of India and the United States. At the end of the study period, we found that YTM in the context of India had declined while that in the US had been stable.

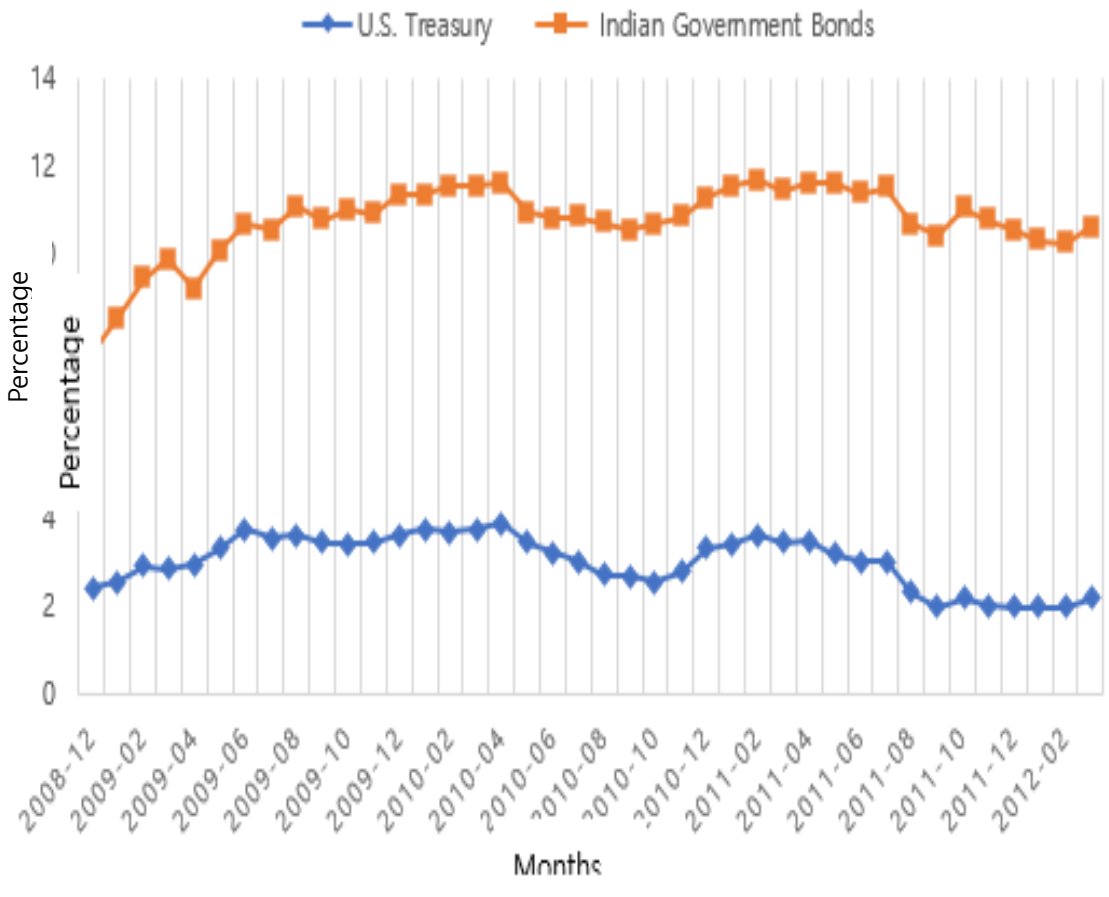


Figure 3: *The Yield-to-Maturity on the 10-year government bonds in the US and India*
Source: Reserve Bank of India and Board of Governors of the Federal Reserve System, 2012

YTM on the 20-year government bonds both in India and in the US, which is shown in figure 4. The graph looks the same pattern of fluctuation in YTM on the government bonds in both countries. However, the difference is that the YTM in case of Indian government is higher than in case of the US.

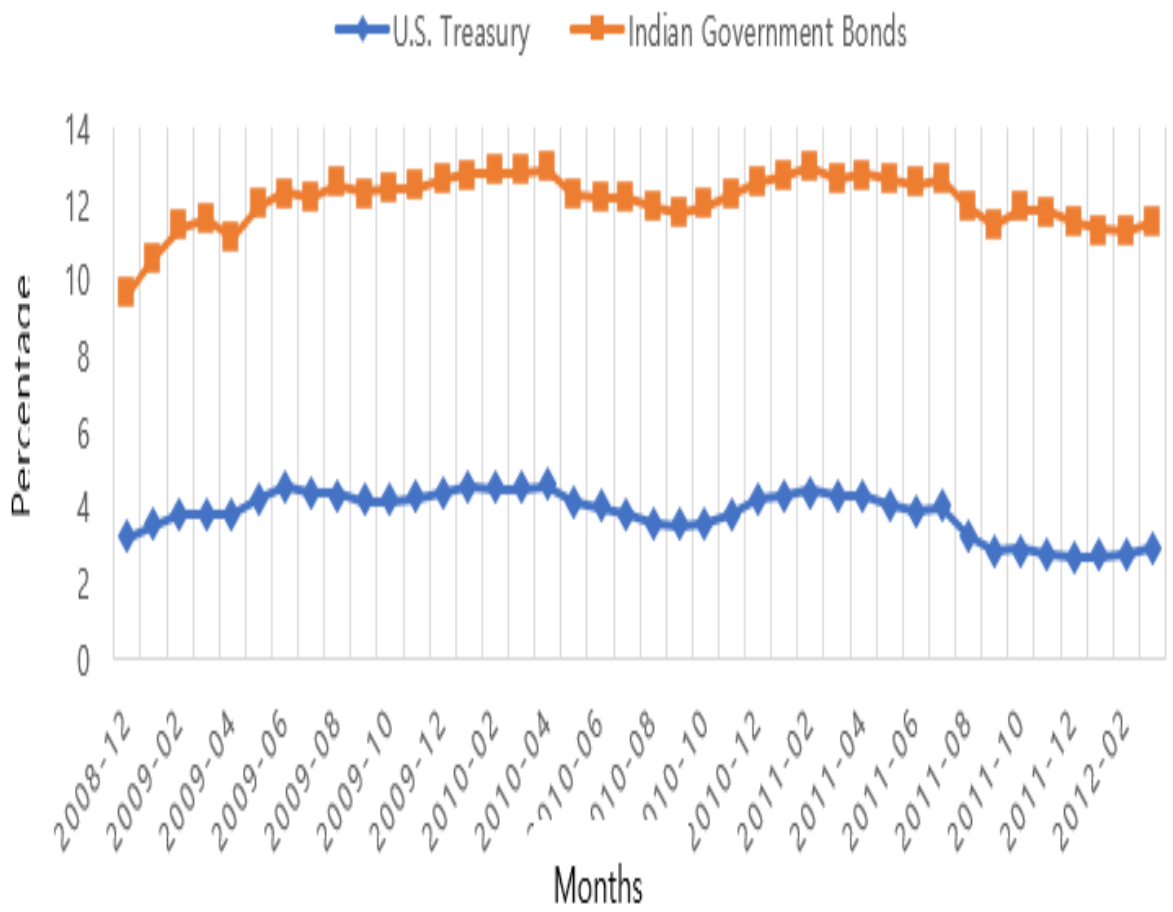


Figure 4: *The Yield-to-Maturity on the 20-year government bonds in the US and India*
Source: Reserve Bank of India and Board of Governors of the Federal Reserve System, 2012

To cut the story short, the YTMs on the US Treasury with maturity of 1 year have less volatility for over period of times, compared with that of 10-year and 20-year maturity. However, YTM of Indian government bonds with 1-year maturity have more volatility, in comparison of that with 10-year and 20-year maturity.

Data Analysis

In order to study the variation of YTM on Indian government securities the Hypothesis Testing of sample of variables was employed. The Z-test was applied here to find out the difference between the two standard deviations of two random samples. According to the hypothesis, the two tail test was applied in this study.

The formula is:

$$Z = \frac{s_1 - s_2}{\sqrt{\frac{{s_1}^2}{2n_1} + \frac{{s_2}^2}{2n_2}}}$$

Where,

s_1 = the standard deviation of the first sample
s_2 = the standard deviation of the sencond sample
n_1 = the size of the first sample
n_2 = the size of the second sample

Results and Discussion

Table 1: *Mean, Variance and SD on 1-Year-Maturity Government Bonds*

Details	Numbers of Data	Mean	Variance	Standard Deviation	Z
US Government Bonds	40	0.31525	0.021308	0.145971	-8.1114
Indian Government Bonds	40	6.3617	2.660458	1.631091	

Here in the table 2, the numbers of both the samples were the same 40 months. The mean of YTM of the US treasury is 0.31525%, while in India it is 6.3617% which the difference was large, i.e. 6.04645%. The standard deviation of the US treasury and Indian bond were 0.145971 and 1.631091, respectively.

The hypothesis testing was used to test at the level of significance of 5%, and the confident level was 95%.

According to table, for 5% level of significance the critical value is -1.96 and +1.96. Since the calculated value (Z = -8.1114) falls in the rejection region, the H_0 is rejected at 5% level of significance. Hence, it can be concluded that there is significantly different between the two standard deviations. It means that for 1-year maturity government bonds, the variation in YTM on Indian government bond is different from that on the US treasury.

Table 2: *Mean, Variance and SD on 10-Year-Maturity Government Bonds*

Details	Numbers of Data	Mean	Variance	Standard Deviation	Z
US Government Bonds	40	2.99025	0.352038	0.593328	-0.153199
Indian Government Bonds	40	7.7260	0.579587	0.761306	

In the table 3, the numbers of both the samples are the same 40 months. The mean of

YTM of the US treasury is 2.99025% while in India it is 7.7260% which the difference is large, i.e. 4.78235%. The standard deviation of the US treasury and Indian bond are 0.593328 and 0.761306, respectively.

The hypothesis testing is used to test at the level of significance of 5%, so the confident level is 95%.

According to table, for 5% level of significance the critical value is -1.96 and +1.96. Since the calculated value (Z = -0.153199) falls in the acceptance region, the H_o cannot be rejected at 5% level of significance. Hence, it can be concluded that there is not significantly different between the two standard deviations. It means that for 10-year maturity government bonds, the variation in YTM on Indian government bond is the same as that on the US treasury.

Table 3: *Mean, Variance, and SD on 20-Year-Maturity Government Bonds*

Details	Numbers of Data	Mean	Variance	Standard Deviation	Z
US Government Bonds	40	3.81675	0.354638	0.595515	0.9828
Indian Government Bonds	40	8.2400	0.259498	0.509409	

In the table 4, the numbers of both the samples are the same 40 months. The mean of YTM of the US treasury is 3.81675% while in India it is 8.24% which the difference is large, i.e. 4.42325%. The standard deviation of the US treasury and Indian bond are 0.595515 and 0.509409, respectively.

The hypothesis testing is used to test at the level of significance of 5%, so the confident level is 95%.

According to table, for 5% level of significance the critical value is -1.96 and +1.96. Since the calculated value (Z = 0.9828) falls in the acceptance region, the H_o cannot be rejected at 5% level of significance. Hence, it can be concluded that there is no significant difference between the two standard deviations. It means that for 20-year maturity government bonds, the variation in YTM on Indian government bond is not different from that on the US treasury.

Based on the result of the above test, there is significant difference between the standard deviations of YTM on the US and Indian government bonds with maturity of 1 year. Hence, the variability in rate of return on Indian government securities with 1-year maturity is higher than that of the US Treasury. With maturity of 10 years , there is no significant difference between standard deviations of YTM on the US and Indian government bonds. Therefore, the variability in the rate of return on both government securities with 10-year maturity of the two countries is considered as the same for the period of study. Last but not least, there is no significant difference between the two standard deviations of the two random samples which are YTMs on the US and Indian government securities with 20-year maturity. Hence, there is no difference in variability in the rate of return on both government bonds.

Some of the suggestions are furnished hereunder, based on the interpretation and findings from this study. The market participants including regulators, especially RBI, should take note of this project study in understanding or framing appropriate strategies, rules, regulations and policies, especially on the bonds with 1-year maturity. Individual and institutional investors can take the risk free rate in India from the long-term government securities, saying more than 10 years. The rate of return on India government securities is higher than in that of the US treasury and the availability of that securities is easy to access, so investors should consider investing in Indian government bonds in their portfolio.

Conclusion

The risk free rate is an important input in one the most widely used finance models such as the Capital Asset Pricing Model, Black-Scholes Model, etc. In India there is problem in choosing risk free rate to valuation of assets because of various factors. According to RBI, there are 4 different types of government securities in India. They are Treasury Bills, Cash Management Bills, Dated Securities and State Development Loans.

However, this study gives the empirical test of the rate of return on Indian government with that of the US treasury which is considered as the standard one. The goal of this study is to identify the variation of YTM on Indian government bonds higher than that on the US Treasury. The study is on monthly YTM on government bonds in Indian and the US for the period of 40 months only. The results show that India 1-year maturity government bonds have higher variability in YTM than that with maturity of more than 1 year. Investors can choose any rate of return on government securities with maturity of 10 years or 20 years depended on the maturity of their investment. Since this study uses only the 40 months of data available in Indian government bonds' YTM, the results have been limited. The further study should be made in the future in order to make it more comprehensive. Researchers shall consider to exercise caution when they attempt to generalize our findings.

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