Bonds in a Balanced Portfolio: Long Term or Short Term?

Peter A. Forsyth*

October 2, 2018

I think we all know that its a good idea to have a mix of bonds and stocks in an investment portfolio. The bonds dampen down the portfolio volatility, and act as a hedge when equities tank.

Let's look at some long term data. We are going to evaluate various portfolios using the *Sharpe ratio* which we define as

$$\text{Sharpe ratio} = \frac{\mu - r}{\sigma}$$

$\mu =$ annualized arithmetic return

$r =$ annualized risk-free rate of return

$\sigma =$ annualized volatility

We can interpret this equation as follows. The numerator is the return[1] generated by the portfolio in excess of the risk-free rate of return. We will assume that one-month T-bills are risk-free, which effectively means we assume that the government won't default. The numerator is the volatility of the portfolio, which is the annualized standard deviation.

Effectively, the Sharpe ratio tells you how much return the portfolio generates per unit of risk (volatility). The return is measured with respect to one month T-bills. Other things being equal, when comparing two portfolios, an investor should prefer the one with the largest Sharpe ratio. In other words, assuming I take on some risk, I want *" the biggest bang for my risk buck"*.

Now, let's examine some historical data, covering the time frame 1926:1 - 2015:12. Most of the data was obtained from the Center for Research in Security Prices (CRSP), on a monthly basis.[2] For the stock market data, we use the CRSP value (capitalization) weighted total return index. This index includes all distributions for all domestic stocks trading on major U.S. exchanges. We use two bond market indexes. The short term index is the one-month US T-bill index from CRSP. The long term index is the US 10-year Treasury index.[3] All of these various indexes are in nominal terms, so we adjust them for inflation by using the U.S. CPI index, also supplied by CRSP. We use real indexes since long term investors should be focused on real (not nominal) wealth goals.

Note that the 10-year treasury index is equivalent to

*David R. Cheriton School of Computer Science, University of Waterloo, Waterloo ON, Canada N2L 3G1, paforsyt@uwaterloo.ca, +1 519 888 4567 ext. 34415.

[1] We use the arithmetic return here since the geometric return includes a volatility adjustment, which already appears in the denominator. This is also the original definition of Sharpe ratio, see W.F. Sharpe, Journal of Business, January 1966, pp. 119-138.

[2] More specifically, results presented here were calculated based on data from Historical Indexes, ©2015 Center for Research in Security Prices (CRSP), The University of Chicago Booth School of Business. Wharton Research Data Services was used in preparing this article. This service and the data available thereon constitute valuable intellectual property and trade secrets of WRDS and/or its third-party suppliers.

[3] The 10-year Treasury index was constructed from monthly returns from CRSP back to 1941. The data for 1926-1941 were interpolated from annual returns in "A history of interest rates," S. Homer and R. Sylla.

- At the beginning of each month, we buy a 10-year Treasury
- At the end of each month, we collect any interest paid, and sell the Treasury
- We buy a new 10-year treasury at the start of the next month.

This would approximate a government bond index fund.

Now, let's look at the performance of two portfolios

- 60% CRSP equity index, 40% one-month T-bills. Rebalanced monthly.
- 60% CRSP equity index, 40% 10-year Treasury index. Rebalanced monthly.

We assume that no taxes are paid, and that there are no transaction costs.

We estimate the Sharpe ratios for these two portfolios, using the data over the entire period 1926:1-2015:12, which are shown in Table 0.1. As one would expect, the use of the 10-year treasury as the bond component of our 60:40 portfolio has a larger Sharpe ratio compared with the portfolio with the one-month T-bill bond component. Although longer term bonds have a larger volatility than short term bonds, the extra return seems to be worth the risk. In addition, conventional thinking supposes that bonds will increase in value (interest rates go down) during stock market downturns. Based on these results, it looks like longer term bonds are the way to go.

Portfolio	Sharpe ratio
60% CRSP, 40% 1-month T-bill	.40
60% CRSP, 40% 10-year Treasury	.46

TABLE 0.1: *Estimated Sharpe ratios, using the data 1926:1 - 2015:12. All data are based on real (inflation adjusted) returns.*

But, hold on a minute here. Figure 0.1 shows a plot comparing the one month T-bill index and the 10-year treasury index. Each index starts at $100 in 1926. These indices are all real, i.e. in 1926 dollars. Note that over the entire period, the real return of the one-month T-bill is almost zero (annualized real return is 0.5%). If you had held on to a 10-year treasury index, over the period 1926:1-1980:1, then your final return would have been roughly the same as a one-month T-bill portfolio. There was no extra reward in holding the 10-year treasury compared to the one-month T-bill. However, there is a real break in the data around 1980. This was a time of high inflation and high interest rates. Over the last 35 years, interest rates have dropped, as well as inflation. This has made long term bonds a fantastic investment. But, clearly this is an anomalous situation. In the coming years, inflation and interest rates will almost surely go up.

So, let's repeat our experiments with our two portfolios, this time we will leave out the data from 1980 to the present. The results are shown in Table 0.2, for the time period 1926:1-1980:1. In this case, the Sharp ratios for the 60:40 portfolio are the same (to two digits) regardless of whether or not we use short term or long term bonds.

We can cherry pick another interesting time period from the historical data. Table 0.2 also shows the Sharpe ratios for the period 1940:1-1980:1. In this case, we were better off rebalancing using short term bonds.

Finally, just to emphasize the unusual nature of the last 35 years, we also show the Sharpe ratios of the rebalanced portfolios over the last 35 years. In this case, we can see that there was a big advantage to rebalancing with long term bonds.

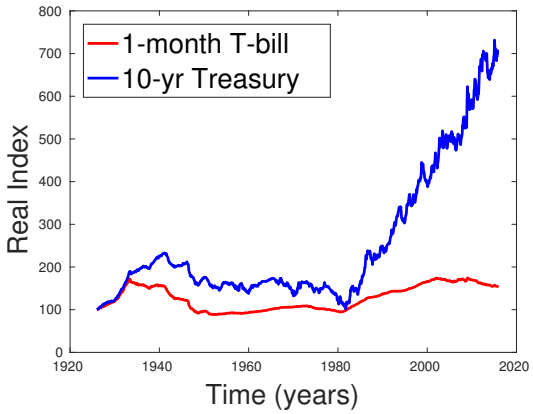

FIGURE 0.1: *Real one-month US T-bill and 10-year US treasury indices, 1926:1-2015:12.*

Of course, our criteria here is the Sharpe ratio, which assumes that investors are measuring risk in terms of volatility. The picture may look different if other measures of risk are used. I have also used two extreme cases (one-month T-bills and 10 year treasuries) to make my point.

In summary, looking at long term data, only for the last 35 years was there a real advantage to combining long term bonds with equities. This appears to be basically because of the unusual situation where real long term bond returns were very good, due to falling interest rates and falling inflation (as in Figure 0.1). Going forward, this is not likely to be repeated.

So what is the take away message here? For the last 35 years, it has definitely been a winning strategy to include long term bonds in a balanced portfolio. However, this has not been true for other historical periods.

Normally, the yield on long term bonds beats the yield on short term bonds. This compensates the investor for the extra volatility of long term bonds. The Sharpe ratio criteria simply adjusts the extra return by factoring in the volatility. In terms of Sharpe ratio, if you are willing to take on some extra risk, then more equities may be better than more long term bonds.

If we are in for a period of rising interest rates and increasing inflation, then long term bonds are probably not the best idea in terms of maximizing the Sharpe ratio of your portfolio.

So, what is the best plan going forward? Almost everyone's portfolio should have some bonds. So, this is not an argument for avoiding bonds. The volatility of 10 year treasuries is smaller than the CRSP index, so even long term bonds are generally less risky than stocks.

But, if you have to choose between long term bonds and short term bonds (in a rebalanced portfolio), shorter looks like a better bet than longer. On the other hand, my colleague down the hall notes that I have been telling her this for the last five years, and she has stayed long term. She then cruelly asked me who has done better.

Portfolio	Sharpe ratio
1926:1 - 1980:1	
60% CRSP, 40% 1-month T-bill	.38
60% CRSP, 40% 10-year Treasury	.38
1940:1 - 1980:1	
60% CRSP, 40% 1-month T-bill	.61
60% CRSP, 40% 10-year Treasury	.51
1980:1 - 2015:1	
60% CRSP, 40% 1-month T-bill	.45
60% CRSP, 40% 10-year Treasury	.67

TABLE 0.2: *Estimated Sharpe ratios, using subsets of the data. All data are based on real (inflation adjusted) returns.*