# The Future of the U.S. Bond Market Part II: Positioning Bond Portfolios During Difficult Bond Markets

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## Abstract

*A previous analysis of low interest rate environments and how bonds perform going forward identified that fixed income investments typically perform below their historical averages when yields are low. The conclusion of that analysis was that investors should allocate away from fixed income securities if their risk profile warranted a portfolio without bonds. Recognizing that most investors cannot build a portfolio without any exposure to bonds, this analysis will examine past yield environments and how different maturities within the bond market performed. This will result in identifying an efficient allocation within fixed income that will provide the best opportunity during what could be a very difficult bond market in the future.*

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A previous paper, "The Future of the U.S. Bond Market" (Graham), analyzed how fixed income investments performed after low interest rate environments combined with times of high leverage and episodes of financial stress. The research concluded that low yield environments occurred either during times of market stress and were very short-term in nature (lasting three years or fewer) or were extremely long-term (lasting over thirty years). The results of the study also found that bonds performed below their historical averages (over the forward three-, five-, and ten-year time horizons) on both a nominal and real basis. Therefore, investors that utilize fixed income investments in their portfolio could benefit by allocating assets away from bonds to ones that had a better expected future return profile (Graham).

Understanding that most investors do not have a risk profile that would allow them to construct a portfolio without utilizing cash or fixed income investments, this analysis will expand on previous research in order to determine how to structure a bond portfolio to provide the most efficient return possible for the investor. This analysis will focus on U.S. Treasury securities in order ignore default risk and credit spread movements, which could make it more difficult to analyze the underlying relationship of yield movements and future total returns. Four different maturities within the U.S. Treasury market will be examined: (1) 90-day U.S. T-Bills[1] [will be referred to as Cash]; (2) U.S. 2-Year Treasury[2] [Enhanced Cash]; (3) U.S. 5-Year Treasury[3] [Intermediate Bonds]; and (4) U.S. 20-Year Treasury[4] [Long Bonds]. These different maturities mimic the four most popular investment strategies used by bond investors. Differing types of yield environments will also be examined to determine the most efficient allocation of fixed income investments in light of today's yield environment.

## Low Yield Environments

"The Future of the U.S. Bond Market" examined low yield environments in order to gain a perspective on how the bond market, as a whole, reacted on a forward looking basis (Graham). Using the same methods as the previous examination, **Table 1**[5] summarizes how each maturity strategy performed during times of low interest rates. Looking at the average across all time periods, Long Bonds provided the highest return (4.5 and 3.4 percent per year) for the three- and five-year time horizons. Enhanced Cash was the ideal place to invest over the rolling ten-year time horizon, gaining 4.0 percent annualized.

On the surface, it seems that an investor who over weighted Long Bonds early in the low yield environment and switched to Enhanced Cash after five-years would have garnered the best performance. This interpretation would have ignored the conclusions of the previous research, which concluded that low yield environments are either three-years or less or thirty plus years. Taking this pattern into account, the results for long low yield environments are different as Intermediate Bonds outperform both Cash and Enhanced Cash and match the returns of Long Bonds over all of the time horizons. Considering that Intermediate and Long Bonds have basically the same returns, the shorter maturity would make Intermediate Bonds more attractive.

**Table 1: Forward Returns in Low Yield Environments**
**1926 - 2010**

| Time | Years of | Cash | | | Enhanced Cash | | | Intermediate Bonds | | | Long Bonds | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | Low Yield | 3-Years | 5-Years | 10-Years | 3-Years | 5-Years | 10-Years | 3-Years | 5-Years | 10-Years | 3-Years | 5-Years | 10-Years |
| 1926 - 1958 | 32 | 1.2% | 0.7% | 1.3% | 1.9% | 1.9% | 2.0% | 2.9% | 2.9% | 2.8% | 2.9% | 3.0% | 2.8% |
| 1960 | 1 | 2.7% | 1.6% | 4.3% | 2.9% | 3.3% | 4.8% | 2.3% | 2.4% | 3.7% | 3.0% | 2.6% | 1.3% |
| 1962 | 1 | 3.5% | 2.1% | 4.6% | 3.5% | 4.0% | 5.2% | 2.2% | 2.5% | 4.6% | 1.8% | -0.1% | 2.3% |
| 2002 | 1 | 1.8% | 1.1% | NA | 1.5% | 3.1% | NA | 1.5% | 3.4% | NA | 10.3% | 8.2% | NA |
| 2008 - 2010 | 3 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Average** | **8** | **2.3%** | **1.4%** | **3.4%** | **2.4%** | **3.1%** | **4.0%** | **2.2%** | **2.8%** | **3.7%** | **4.5%** | **3.4%** | **2.2%** |
| **Min** | **1** | **1.2%** | **0.7%** | **1.3%** | **1.5%** | **1.9%** | **2.0%** | **1.5%** | **2.4%** | **2.8%** | **1.8%** | **-0.1%** | **1.3%** |
| **Max** | **32** | **3.5%** | **2.1%** | **4.6%** | **3.5%** | **4.0%** | **5.2%** | **2.9%** | **3.4%** | **4.6%** | **10.3%** | **8.2%** | **2.8%** |

*Sources: U.S. Treasury; Citigroup; Shiller; Sylla, Wilson and Jones; Ibboston*

Examining low yield environments can provide good insight as to how the different duration strategies might perform on a forward basis; however, the analysis can be improved by taking a closer look and analyzing yield environments that more closely resemble today's environment. The next section will take the information in **Table 1** and examine more closely the periods that also exhibited a steep yield curve[6].

## Low Yield and Steep Yield Curve Environments

Due to the financial crisis, the U.S. Federal Reserve has held the Federal Funds rate at a zero bound (from zero to 25 basis points), which has created a yield curve slope (measured from the two-year to ten-year U.S. Treasury bonds) of 269 basis points. This is extremely steep compared to the historical average of 72 basis points and puts the current slope at approximately 2.3 standard deviations above historical averages. This is common during financial duress because it allows financial institutions to borrow funds at extremely low short rates and lend at much higher rates. The result is that financial intermediaries are able to repair their balance sheets through higher interest rate margins.

When examining the periods identified in the previous section and focusing on the ones that had a steep yield curve[7], the results of the analysis begin to look different from the results in **Table 1**. **Table 2** summarizes the data of combining both low yield and steep yield curve environments. Long bonds were the best place to invest during these time periods over all time horizons. The return differential between maturities also widened, as the performance was wide enough not to warrant rolling down to shorter maturities.

**Table 2: Forward Returns for Low Yield Environments with Steep Yield Curve**
**1926 - 2010**

| Time Period | | Slope of | Cash | | | Enhanced Cash | | | Intermediate Bonds | | | Long Bonds | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Begin | End | Yield Curve | 3-Years | 5-Years | 10-Years | 3-Years | 5-Years | 10-Years | 3-Years | 5-Years | 10-Years | 3-Years | 5-Years | 10-Years |
| Apr 1931 | Jun 1931 | 166.1 | 0.6% | 0.5% | 0.3% | 2.7% | 2.2% | 1.5% | 4.4% | 4.7% | 4.1% | 5.2% | 5.1% | 4.8% |
| Sep 1932 | Nov 1932 | 166.3 | 0.2% | 0.2% | 0.1% | 2.0% | 1.5% | 1.2% | 5.9% | 4.6% | 4.0% | 5.1% | 4.4% | 4.5% |
| May 1933 | Oct 1933 | 169.0 | 0.2% | 0.2% | 0.1% | 1.7% | 1.3% | 1.0% | 5.3% | 4.6% | 3.6% | 5.3% | 4.6% | 4.3% |
| May 1934 | Jun 1934 | 162.9 | 0.2% | 0.1% | 0.2% | 1.1% | 1.2% | 0.9% | 3.6% | 4.5% | 3.3% | 3.7% | 5.0% | 3.9% |
| Apr 1935 | Jul 1935 | 168.6 | 0.2% | 0.1% | 0.2% | 0.9% | 1.0% | 0.8% | 0.7% | 3.5% | 2.8% | 3.9% | 4.1% | 4.0% |
| Nov 1935 | Jan 1937 | 174.9 | 0.1% | 0.1% | 0.2% | 0.9% | 0.8% | 0.8% | 3.8% | 3.5% | 2.6% | 3.9% | 4.4% | 4.0% |
| Nov 1937 | Dec 1937 | 179.8 | 0.0% | 0.1% | 0.2% | 0.9% | 0.7% | 0.7% | 4.6% | 3.3% | 2.5% | 5.9% | 4.4% | 3.5% |
| Mar 1939 | Jul 1939 | 162.8 | 0.0% | 0.2% | 0.3% | 0.4% | 0.6% | 0.8% | 2.2% | 2.1% | 1.9% | 3.4% | 2.9% | 3.0% |
| Dec 1939 | Apr 1940 | 161.1 | 0.1% | 0.2% | 0.4% | 0.2% | 0.6% | 0.9% | 1.8% | 2.0% | 1.8% | 3.3% | 3.3% | 3.1% |
| Nov 1940 | Dec 1940 | 157.8 | 0.2% | 0.3% | 0.5% | 0.3% | 0.7% | 0.9% | 1.8% | 1.9% | 1.6% | 2.2% | 3.8% | 2.7% |
| Apr 1941 | Feb 1942 | 175.5 | 0.3% | 0.3% | 0.6% | 0.6% | 0.7% | 0.9% | 1.9% | 1.8% | 1.5% | 2.3% | 3.4% | 2.2% |
| Sep 1942 | Dec 1942 | 177.9 | 0.3% | 0.4% | 0.8% | 0.9% | 0.7% | 1.1% | 2.2% | 1.7% | 1.5% | 4.4% | 3.0% | 2.0% |
| Oct 1944 | Nov 1944 | 159.3 | 0.4% | 0.6% | 1.0% | 0.6% | 1.1% | 1.5% | 1.3% | 1.7% | 1.7% | 4.0% | 3.5% | 2.5% |
| Sep 2002 | Jun 2003 | 219.4 | 1.9% | 3.0% | NA | 1.4% | 3.3% | NA | 1.1% | 3.6% | NA | 7.7% | 7.5% | NA |
| Sep 2003 | Oct 2003 | 246.0 | 2.6% | 3.1% | NA | 1.7% | 3.6% | NA | 1.2% | 3.9% | NA | 8.9% | 8.3% | NA |
| Feb 2004 | Mar 2004 | 229.5 | 3.3% | 3.1% | NA | 2.1% | 4.0% | NA | 1.3% | 5.1% | NA | 7.5% | 9.8% | NA |
| Feb 2008 | Mar 2008 | 185.5 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Sep 2008 | Dec 2010 | 234.4 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Average** | | **183.1** | **0.7%** | **0.8%** | **0.4%** | **1.1%** | **1.5%** | **1.0%** | **2.7%** | **3.3%** | **2.5%** | **4.8%** | **4.8%** | **3.4%** |
| **Min** | | **157.8** | **0.0%** | **0.1%** | **0.1%** | **0.2%** | **0.6%** | **0.7%** | **0.7%** | **1.7%** | **1.5%** | **2.2%** | **2.9%** | **2.0%** |
| **Max** | | **246.0** | **3.3%** | **3.1%** | **1.0%** | **2.7%** | **4.0%** | **1.5%** | **5.9%** | **5.1%** | **4.1%** | **8.9%** | **9.8%** | **4.8%** |

*Sources: U.S. Treasury; Citigroup; Shiller; Sylla, Wilson and Jones; Ibboston*

The effect of the steep slope on the results of the analysis is not surprising as a steep yield curve increases the differential of income between short-dated and long-dated bonds. While this can be beneficial in extended low yield environments, the investor is taking on more interest rate risk. This risk becomes more obvious during times of rising interest rates. Therefore, the next step of this analysis will be to examine the data further to focus on the periods of rising yields.

## Low Yield, Steep Yield Curve, and Rising Rate Environments

The previous step in this analysis indentified that longer maturity bonds performed better during times of low yields combined with a steep yield curve. Pushing further out the yield curve introduces a higher degree of interest rate risk into an investor's portfolio, which can be measured by the higher duration of the bonds. In its most simple form, the duration of a bond is the price change a bond will experience given a 100 basis point (or 1.0 percent) change in yield. For example, a bond with a duration of four will experience a four percent decline in price if the market yields increased by 100 basis points. This step of the analysis will take the data points in the previous two sections and focus only on the data points that experienced rising interest rates[8].

The results of analysis are listed in **Table 3**. Examining the data reveals that long bonds continue to be the better place to invest over all the time horizons. The results are counterintuitive given the nature of the higher duration securities. The higher income levels of these longer-dated securities have apparently been sufficient to overcome the price decline experienced due to rising interest rates.

**Table 3: Forward Returns for Low Yield Environments with Steep Yield Curve and Rising Rates**
**1926 - 2010**

| Time Period | | Change in | Cash | | | Enhanced Cash | | | Intermediate Bonds | | | Long Bonds | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Begin | End | Yield Level | 3-Years | 5-Years | 10-Years | 3-Years | 5-Years | 10-Years | 3-Years | 5-Years | 10-Years | 3-Years | 5-Years | 10-Years |
| Apr 1931 | Jun 1931 | 29.6 | 0.6% | 0.5% | 0.3% | 2.7% | 2.2% | 1.5% | 4.4% | 4.7% | 4.1% | 5.2% | 5.1% | 4.8% |
| Sep 1933 | Oct 1933 | 10.1 | 0.2% | 0.2% | 0.1% | 1.8% | 1.3% | 1.0% | 5.3% | 4.5% | 3.6% | 5.4% | 4.6% | 4.2% |
| Jul 1935 | Aug 1935 | 0.1 | 0.2% | 0.1% | 0.2% | 0.8% | 0.9% | 0.8% | 3.5% | 3.4% | 2.8% | 3.9% | 4.1% | 4.0% |
| Mar 1936 | Nov 1936 | 16.1 | 0.1% | 0.1% | 0.2% | 0.9% | 0.8% | 0.8% | 3.7% | 3.4% | 2.6% | 4.2% | 4.4% | 3.9% |
| Jan 1937 | Feb 1937 | 13.8 | 0.1% | 0.1% | 0.2% | 1.0% | 0.8% | 0.8% | 4.1% | 3.3% | 2.6% | 3.9% | 3.9% | 3.7% |
| Nov 1937 | Dec 1937 | 2.9 | 0.0% | 0.1% | 0.2% | 0.9% | 0.7% | 0.7% | 4.6% | 3.3% | 2.5% | 5.9% | 4.4% | 3.5% |
| May 1939 | Jun 1939 | 10.0 | 0.0% | 0.2% | 0.3% | 0.4% | 0.6% | 0.8% | 2.1% | 2.0% | 1.8% | 3.2% | 2.7% | 2.9% |
| Nov 1940 | Dec 1940 | 23.0 | 0.2% | 0.3% | 0.5% | 0.3% | 0.7% | 0.9% | 1.8% | 1.9% | 1.6% | 2.2% | 3.8% | 2.7% |
| Apr 1941 | Feb 1942 | 32.6 | 0.3% | 0.3% | 0.6% | 0.6% | 0.7% | 0.9% | 1.9% | 1.8% | 1.5% | 2.3% | 3.5% | 2.2% |
| Sep 1942 | Dec 1942 | 24.0 | 0.3% | 0.4% | 0.8% | 0.9% | 0.7% | 1.1% | 2.2% | 1.7% | 1.5% | 4.4% | 3.0% | 2.0% |
| Oct 2002 | Dec 2002 | 18.6 | 1.7% | 2.9% | NA | 1.5% | 3.0% | NA | 1.5% | 3.1% | NA | 10.3% | 8.2% | NA |
| Feb 2003 | Jun 2003 | 66.4 | 2.1% | 3.0% | NA | 1.3% | 3.4% | NA | 0.4% | 3.6% | NA | 4.8% | 6.3% | NA |
| Sep 2003 | Oct 2003 | 51.4 | 2.6% | 3.1% | NA | 1.7% | 3.6% | NA | 1.2% | 3.9% | NA | 8.9% | 8.3% | NA |
| Feb 2004 | Mar 2004 | 111.4 | 3.3% | 3.1% | NA | 2.1% | 4.0% | NA | 1.3% | 5.1% | NA | 7.5% | 9.8% | NA |
| Nov 2008 | Dec 2008 | 8.2 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Jan 2009 | Apr 2009 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Average** | | **27.9** | **0.8%** | **1.0%** | **0.3%** | **1.2%** | **1.7%** | **0.9%** | **2.7%** | **3.3%** | **2.5%** | **5.1%** | **5.2%** | **3.4%** |
| **Min** | | **0.1** | **0.0%** | **0.1%** | **0.1%** | **0.3%** | **0.6%** | **0.7%** | **0.4%** | **1.7%** | **1.5%** | **2.2%** | **2.7%** | **2.0%** |
| **Max** | | **111.4** | **3.3%** | **3.1%** | **0.8%** | **2.7%** | **4.0%** | **1.5%** | **5.3%** | **5.1%** | **4.1%** | **10.3%** | **9.8%** | **4.8%** |

*Sources: U.S. Treasury; Citigroup; Shiller; Sylla, Wilson and Jones; Ibboston*

Recognizing that the shortest time horizon listed in **Table 3** is three-years and no volatility measures are included, further analysis was performed to ensure the data was telling the correct story. Examining the volatility, the price changes due to the increased duration can be seen. The standard deviation for the different maturities was 0.2, 1.1, 7.5, and 9.6 percent annually for cash, enhanced cash, intermediate bonds, and long bonds, respectively. This volatility can be seen in **Figure 1**, which illustrates each of the data points (blue dots) and the median annualized returns for the entire data set (black line).

When looking at the data, it becomes apparent that the shorter low yield environments (red line in **Figure 1**) have a far different return pattern than the longer yield environments (black line). The longer periods exhibit very low volatility and lower returns. While the shorter low yield environments have higher volatility and higher returns going forward. Even though the pattern has been for higher returns, the overall results remain consistent with the analysis performed in **Tables 2** and **3**, which reveals that longer maturity bonds have experienced higher returns; however, the efficiency of the returns needs to be examined before any final conclusions can be drawn.



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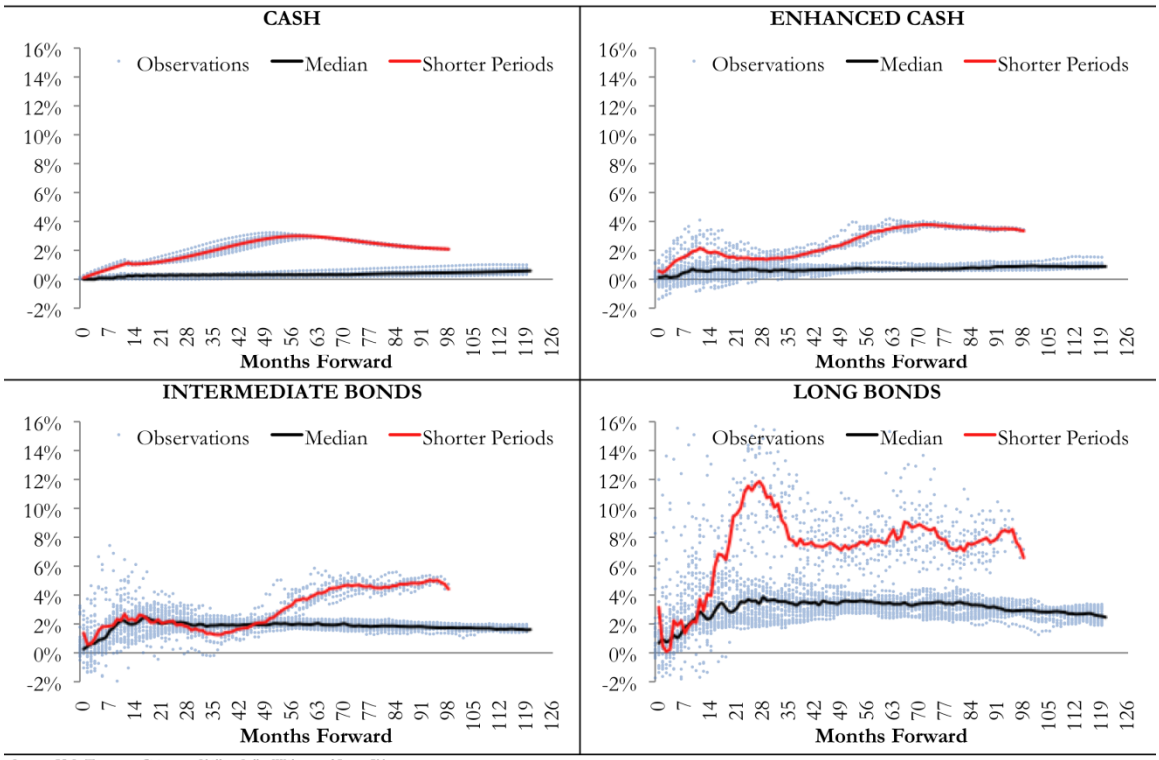
**Figure 1: Annualized Forward Returns During Low Yield, Steep Curve, and Rising Rate Environments**
**1926 - 2010**

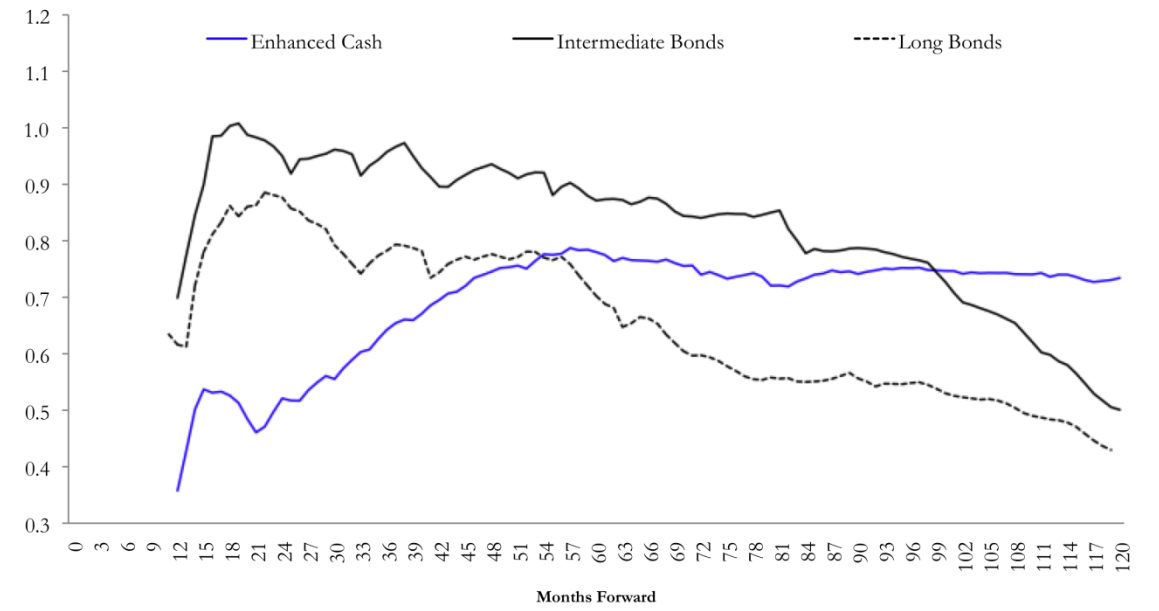



*Sources: U.S. Treasury; Citigroup; Shiller; Sylla, Wilson and Jones; Ibboston*

In order to determine the most efficient return, a risk-adjusted return was calculated for the time periods analyzed in **Table 3**. The Sharpe Ratio (on an ex-post basis) was utilized and is defined as difference between the return of a security and a benchmark (also referred to as alpha) divided by the standard deviation of the alpha (Sharpe). In analyzing the Sharpe Ratio, a positive number implies outperformance and the higher the number the more efficient the risk-adjusted return.

**Figure 2** graphs the Sharpe Ratio as measured versus the risk-free asset (Cash) and reveals that longer dated maturities (intermediate bonds and long bonds) outperformed, on a risk-adjusted basis, enhanced cash for approximately the first five years. Long bonds then began to trail; however, intermediate bonds continued to outperform until about the eight-year mark in which enhanced cash becomes the most efficient asset. The result is that longer dated maturities have been the most efficient place, versus cash, in the short run; however, enhanced cash became more efficient during the later months. It is important to note that this conclusion is based on risk-adjusted returns versus the risk-free asset; therefore, in order to garner a better comparison the next step is to calculate risk-adjusted returns for longer dated maturities versus enhanced cash.

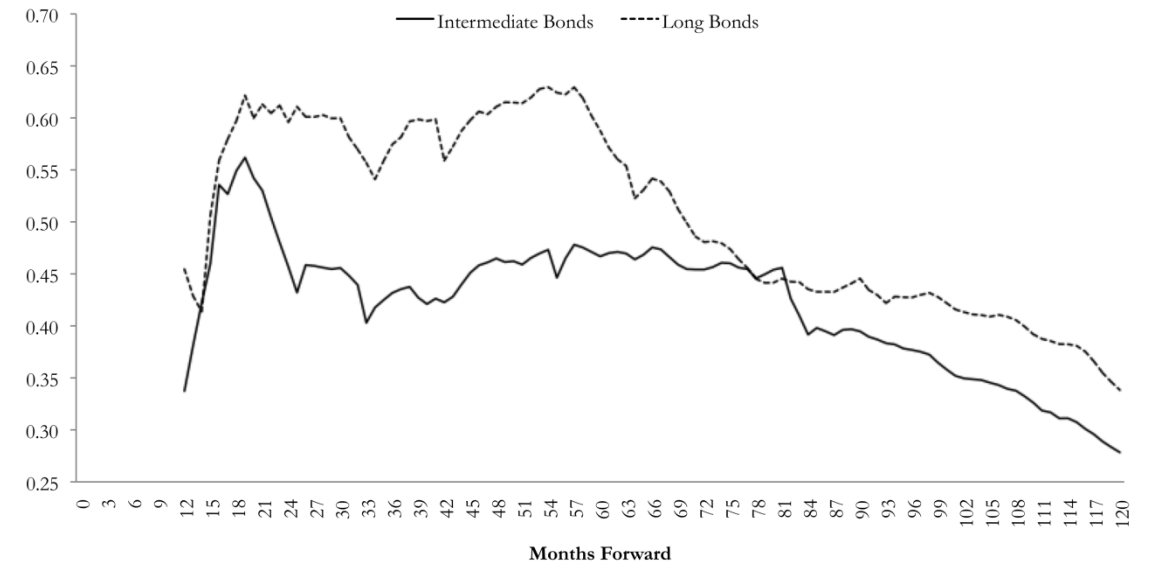
**Figure 2: Ex-Post Sharpe Ratios vs. Cash During Low Yield, Steep Curve, and Rising Rate Environments**
**1926 - 2010**




*Sources: U.S. Treasury; Citigroup; Shiller; Sylla, Wilson and Jones; Ibboston; Sharpe*

**Figure 3** graphs the Sharpe Ratios of intermediate bonds (solid line) and long bonds (dashed line) versus enhanced cash. Interestingly, both intermediate and long bonds maintained positive ratios throughout the entire ten-year period. This suggests that both intermediate and long bonds were superior assets as the ratio remained positive. While longer maturity bonds were superior on a risk-adjusted basis, the efficiency of these assets was reduced as time passed, suggesting that the additional return per unit of additional volatility fades over time but remains positive over the entire period.

**Figure 3: Ex-Post Sharpe Ratio vs. Enhanced Cash During Low Yield, Steep Curve, and Rising Rate Environments**
**1926 - 2010**




*Sources: U.S. Treasury; Citigroup; Shiller; Sylla, Wilson and Jones; Ibbotson; Sharpe*

## Conclusion

Market pundits have written that today's circumstances are unprecedented and make it extremely difficult to formulate rational future expectations for the capital markets. Investment strategists have also made assertions that relying on history would be foolish and those unprecedented times call for unprecedented strategies, ultimately claiming that "this time it's different." While the conditions witnessed in today's environment have not been observed in recent history, a careful examination of U.S. capital market history has revealed that these times are not unprecedented. The U.S. has experienced many financial crises and has witnessed extremely long periods of low yields (Graham).

Identifying previous periods that resemble today's environment is a difficult task, but can provide investors with valuable insight on the behavior of investable markets, allowing for the formulation of future expectations. This analysis utilized previous research to identify common periods in the U.S. capital markets and examined how the different maturities in the U.S. Treasury market performed on a forward looking basis. Examining these different maturities can provide edification to investors and allow them to position their fixed income portfolio in an efficient manner.

Due to the structure of fixed income securities, coupon payments and principal due on the maturity date, bonds have an inverse relationship with the change in interest rates (i.e. rising rates causes a decline in value). The sensitivity of a bond's price to interest rate movements is measured by duration and the longer the maturity, the higher duration. Using this simple understanding of the interest rate/bond price relationship would suggest that investors should roll down the yield curve (invest in shorter maturity bonds) in times when rising interest rates are expected.

Due to the current market environment (i.e. low yields and a steep yield curve), "The Future of the U.S. Bond Market" concluded that there are two distinct possibilities: (1) yield levels will remain low for a very short period (three-years or less) or (2) yields will stay low for an extended period (i.e. thirty years or more) (Graham). This analysis examined common periods throughout U.S. capital market history in order to determine the efficient positions on the yield curve during these two distinct periods.

Common sense would suggest that investment strategies would be different for the short periods than for the long periods; however, this was not the case. History suggests that longer dated maturities were beneficial during periods of low yields, a steep yield curve, and rising rates. The strategy of longer dated maturities during long periods of low yields makes intuitive sense, as stable rates would lead to minimal price volatility and extending would provide the investor with higher yielding assets.

Purchasing longer dated maturities during short low yield environments seems to go against common logic. The key to understanding the outcome resides in the steepness of the yield curve. Steep yield curves are usually the result of the U.S. Federal Reserve injecting liquidity into economy by lowering the Federal Funds Rate and shorter-dated maturities following suit. The yield on longer-dated maturities falls at a much lesser rate, resulting in a steep yield curve (similar to today's environment). Therefore, there is usually a significant yield advantage for purchasing longer-dated maturities. This income advantage is wide enough to subsidize falling prices (due to rising interest rates); therefore, the total return remains positive and higher than short-dated bonds.

The historical data illustrates common knowledge about duration can be misleading if the steepness of the yield curve is not taken into account. The data observed by this analysis finds that financial history suggests that investing further out the yield curve could prove to be a more efficient allocation for investors going forward than rolling down the yield curve. While each investor must examine his or her own risk aversion to determine whether the additional income/return is worth the increased price volatility, it appears that staying in an intermediate or a core mandate would be beneficial on both an absolute and risk-adjusted basis.



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## Notes

[1] U.S. T-Bills are assumed to have a 90-day maturity. The yields used by this analysis were provided by Ibboston (from 1926 to 1961) and U.S. Treasury (from 1961 to 2010). Ibboston total return data from 1926 to 1978 was used. The Citigroup 3-Month Treasury Bill Index was used for total return data from 1978 to 2010.

[2] The yields used from 1926 to 1961 were calculated by examining yield curve slopes (from T-Bills to 2-Year and from 2-Year to 5-Year) combined with various shifts in the yield curve, which are described below:

- **Rising T-Bill Yield and Rising 5-Year Yield:** the average of the T-Bill yield plus 94 basis points and the 5-Year minus 12 basis points was used to determine the 2-Year yield.
- **Falling T-Bill Yield and Falling 5-Year Yield:** the average of the T-Bill yield plus 95 basis points and the 5-Year minus 73 basis points was used to determine the 2-Year yield.
- **Rising T-Bill Yield and Falling (or No Change) 5-Year Yield:** the average of the T-Bill yield plus 49 basis points and the 5-Year minus 30 basis points was used to determine the 2-Year yield.
- **Falling (or No Change) T-Bill Yield and Rising 5-Year Yield:** the average of the T-Bill yield plus 115 basis points and the 5-Year minus 71 basis points was used to determine the 2-Year yield.

Yields provided by the U.S. Treasury were used from 1961 to 2010. The total return was calculated from 1926 to 1980 using a theoretical 2-Year bond (Sylla, Wilson and Jones) (Graham). The Citigroup 2-Year Benchmark Treasury On-the-Run Index was used for total return data from 1980 to 2010.

[3] The yields used by this analysis were provided by Ibboston (from 1926 to 1961) and U.S. Treasury (from 1961 to 2010). Ibboston total return data from 1926 to 1980 was used. The Citigroup 5-Year Benchmark Treasury On-the-Run Index was used for total return data from 1980 to 2010.

[4] The yields used by this analysis were provided by Ibboston (from 1926 to 1993) and U.S. Treasury (from 1993 to 2010). Ibboston total return data from 1926 to 1993 was used. The Citigroup 20-Year Benchmark Treasury STRIPS Index was used for total return data from 1993 to 2010.

[5] Due to the limitation of data by maturity, this analysis begins in 1926 rather than 1800, which was used in the previous research (Graham).

[6] A steep yield curve is defined as one in which the difference between the 2-Year yield and the 10-Year yield is 0.5 standard deviations from the mean. The 10-Year yield utilized in this analysis was provided by Shiller (from 1926 to 1962) the U.S. Treasury (from 1962 to 2010).

[7] Steep yield curve environments were defined as periods when the difference in the yield between the two-year and ten-year U.S. Treasury was 0.5 standard deviations above the average of 72 basis points.

[8]Rising interest rate environments are defined as the periods in which the interest rate one year later was higher. The difference was determined by calculating the interest rate change for each level of maturity and then determining the average for the entire yield curve. This method was used to eliminate the importance of predicting absolute point of change in interest rates, reducing the need to correctly time the market.



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