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Fixed Income Investing

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MANAGERS OF INVESTMENT PORTFOLIOS are concerned about risk, return, and the amount of risk required to achieve a specific return. In the pursuit of returns, history and theory confirm that the expected return on equities exceeds the expected return on fixed income. Managers looking for superior inflation-adjusted returns begin with equities. The first line of defense in risk reduction is diversification. Managers reduce the risk of equity portfolios by diversifying. They spread the risk among domestic and foreign equities, large companies and small companies, growth stocks and value stocks, etc. Still, even a highly diversified equity portfolio may have a higher volatility than is desired by the investor. At this point, a less volatile asset class—fixed income—is introduced into the portfolio. The primary reason for adding fixed income is volatility reduction.

The Maturity Decision

Most investors recognize that short-term fixed income strategies are less volatile than long-term bond strategies. The difference in standard deviations between short-term securities like treasury bills and long-term securities like 20-Year Treasury Bonds is startling (see Table 1). In fact, long bonds have volatilities approximately 5 times that of the One-Year Treasury Bill. In addition, short-term bonds have a lower correlation with equity portfolios than do long-term bonds (see Table 2). The evidence is strong, if risk reduction is the primary goal, that short-term is far more effective than long-term fixed income.

Table 1

Standard Deviations

Annualized from Quarterly Data
January 1964-December 2001

Maturity	Standard Deviation
1 Month	1.23
6 Month	1.65
1 Year	2.35
5 Year	6.34
20 Year	11.12

Table 2

Correlations

Quarterly Data

January 1964-December 2001

Maturity	Correlation with S&P 500
1 Month	-0.08
6 Month	0.01
1 Year	0.05
5 Year	0.22
20 Year	0.30

January 1969-December 2001

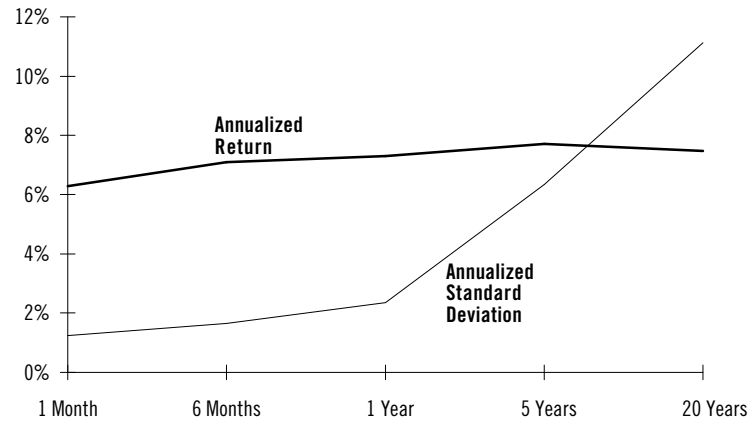
Maturity	Correlation with EAFE
1 Month	-0.13
6 Month	-0.04
1 Year	-0.01
5 Year	0.17
20 Year	0.22

Yet long-term bonds still fill many investment portfolios. Many investors hold long-bonds in the hope of higher returns. There is often the intuition that long-term bonds *must* have higher expected returns than their short-term counterparts. Historically, this has not been the case (see Figure 1). The data shows there has not been a reliable return premium for extending maturities into longer bonds. One reason this result may be surprising to many is that recent history does not conform to this long-term result. The data from the period 1982 through 1993 shows a tremendous premium for maturity extensions. In this period long-term bond returns were more than double the returns of short-term, and almost kept pace with the return of the stock market (see Table 3). Yet a longer perspective would indicate this outcome was more the exception than the norm. In data going back to 1926, there is no other period for bonds like the bull market of the 80's. Then again, there has never been a period where long-term interest rates declined from 16% to 6% as they did over this time span. In the five-year period preceding 1982, rates climbed

from 7% to 16% and long-term bond returns trailed the returns on One-Month Treasury Bills by more than 10% per annum (see Table 4). For there to be a substantial decline in rates, there first has to be a substantial rise in rates. When the entire interest rate cycle is considered, return premiums disappear.

Figure 1

Risk/Reward: Does it Pay to Extend Maturities?
Quarterly: January 1964-December 2001



	1-Month T-Bills	6-Month Rolling T-Bills	1-Year Rolling T-Bills	5-Year T-Notes	Long-Term T-Bonds
Annualized Return (%)	6.28	7.09	7.30	7.71	7.47
Annualized Standard Deviation	1.23	1.65	2.35	6.34	11.12

Table 3

Annualized Returns (%)
Quarterly data: January 1982-December 1993

Maturity	Return (%)
1 Month	6.89
6 Month	8.09
1 Year	8.73
5 Year	12.45
20 Year	15.26
S&P 500	16.09

Table 4

Annualized Returns (%)

Quarterly data: January 1977-December 1981

Maturity	Return (%)
1 Month	9.69
6 Month	10.32
1 Year	8.99
5 Year	4.43
20 Year	-1.04
S&P 500	8.08

Interest Rate Forecasting

With no reliable "term premium", investors could only hope for astute active manage-ment in order to extract value out of long-term bonds. Managers possessing the ability to forecast interest rates stand to profit more from their approach by using long-bonds when their forecast calls for declining interest rates. The question that naturally follows is whether or not managers can reliably forecast interest rates. Inextricably linked to this active vs. passive argument is the question of market efficiency. Many studies have been done regarding the question of bond market efficiency. Much of this research is similar in nature to efficient market studies performed on the stock market. The conclusions are similar—there is no reliable method of forecasting future bond prices, and therefore future interest rates. The bond market is efficient. If this is true, the returns of active bond portfolios should mirror the results found in active stock portfolios—an inability to consistently outperform their benchmarks. Indeed, this was the outcome found in research conducted by Blake, Elton & Gruber.[1] The researchers found that when properly categorized, bond funds underperformed relevant indexes. The amount of this underperformance was approximately equal to the fund expenses. Gross of fees, bond funds on average perform on par with their appropriate index.

Dimensional's Fixed Income Approach

Investors seeking short-term, non-forecasting strategies are not limited to "buy and hold" or indexing strategies. While these approaches may be conceptually appealing in that they do not attempt the difficult task of forecasting interest rates, they fail to capture changing opportunities offered by a changing yield curve environment.

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[1] Christopher R. Blake, Edwin J. Elton, and Martin J. Gruber, "The Performance of Bond Mutual Funds," *Journal of Business* 56.3 (1993): 371-403.

Indexing strategies are essentially static maturity approaches. The average maturity, or duration, generally fluctuates only in a small band. Bonds are held in an index portfolio only because they conform (or help the portfolio to conform) to the characteristics of the index. For example, if a Five-Year Treasury Bond is held in an indexed portfolio, it is typically held through all yield curve shapes. Even if the less risky Two-Year Treasury Bond offers a higher yield, as is the case in inverted yield curves, the portfolio will continue to hold the five-year bond. While the volatility of the portfolio can be reduced (and yields increased) by trading the five-year bond for the two-year bond, the indexing strategy generally will not execute the trade if it increases the risk of tracking error. Risk, to an indexer, is measured by tracking error. Trades that reduce volatility and increase yield may have no inherent appeal in an index approach even though they may be very attractive to the diversified investment portfolio. Buy and hold strategies, such as a laddered approach, are equally indifferent to a changing opportunity set.

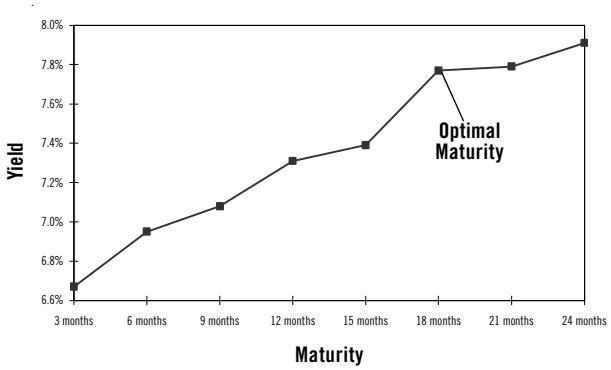
Investors can increase their risk-adjusted returns with an alternative approach developed by Professor Eugene Fama of the University of Chicago. This variable maturity strategy shifts the maturities of the portfolio as yield curve changes create the possibility for lower risk, higher expected return outcomes. In recognizing the bond market as being highly efficient, the variable maturity approach does not *anticipate* changes in the yield curve, rather it seeks to maximize the risk-adjusted returns present in the current curve. The variable approach *would* shorten from five-year maturities to two-year maturities in the example above. The cornerstone of this approach is efficient market theory. Bond prices (and therefore their yields) reflect all available information and follow the classic "random walk" pattern. In this type of market, the best estimate of future bond prices/yields is simply today's price/yield. New information is unpredictable. Summarized, Fama's research showed that the best estimate of future yield curves is simply today's yield curve. (For a partial list of Fama's research articles, refer to the appendix). It is not a statement that the curve will not change, but a statement that the changes are unpredictable. The objective of the strategy is then to take what is offered by the current curve. In broad terms, this means shortening maturities in inverted curves, and extending in upwardly sloped curves (see Figure 2).

While Figure 2 graphically depicts broad maturity differences due to yield curve differences, it describes only one aspect of the variable maturity strategy. Even without forecasting changes in today's yield curve, there exists a myriad of potential strategies, each with a unique expected return. If the two-year bond is purchased, how long should it be held? Can expected returns be improved if the two-year bond is held for only a portion of its life, then sold, and the proceeds reinvested back in a new two-year bond? Figure 3 shows a sample matrix of expected returns generated for varying initial maturity choices and holding periods. For each expected return a horizon analysis is conducted. In each case, the

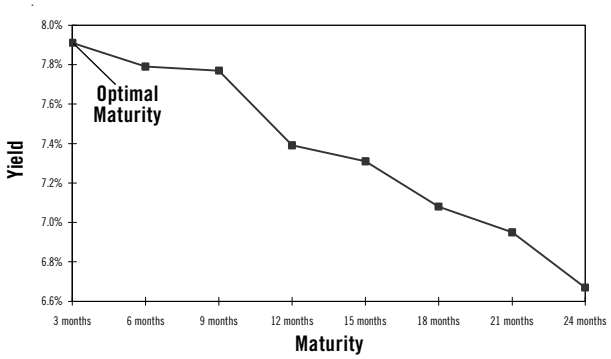
Figure 2

Determining the Optimal Maturities

The Shape of the Yield Curve



- **Extend maturities when there is an anticipated reward for doing so.**
- **With a steep yield curve extend the maturity.**



- **Stay short when longer maturities do not provide additional return.**
- **With an inverted yield curve invest in cash equivalents.**

Figure 3

Finding the Optimal Maturity and Holding Period

Maturity (Months) at Time of Sale	Maturity (Months) at Time of Purchase							
	24	21	18	15	12	9	6	3
21	8.65							
18	8.32	7.98						
15	8.79	8.85	**9.73**					
12	8.50	8.45	8.68	7.64				
9	8.39	8.32	8.44	7.80	7.95			
6	8.22	8.13	8.17	7.65	7.65	7.35		
3	8.07	7.98	7.98	7.54	7.51	7.29	7.22	
0	7.90	7.79	7.76	7.37	7.30	7.08	6.94	6.66

analysis depends on three factors: the purchase price of the bond, the yield or income generated over the holding period, and the sale price of the bond. To calculate, for example, the expected return for the strategy of buying a two-year bond and holding for six months, we start with the purchase price of two-year bonds. This is observed in today's marketplace. This price will determine a yield which will be earned over the six month holding period. The unknown factor is the sale price of the bond six months hence. To generate an expected return, an expected price/yield is needed for what will be an 18-month bond, six months from now. Using the Fama research, we use today's curve as our estimate of the curve six months from now. We use today's price/yield of 18-month bonds to estimate the price/yield of 18-month bonds six months hence.

In general, yield is a poor estimate of expected return. In upwardly sloped curves, expected returns are generally higher for strategies that do not hold bonds to maturity. The variable maturity approach will highlight the optimal combination of initial maturity and holding period—in essence the best *segment* of the curve to hold. This combination will change as the shape of the curve changes. In each case though, the strategy makes optimal use of information imbedded in today's efficiently priced yield curve.

The Use of Global Bonds

The arguments of active vs. passive, long vs. short, and static vs. variable maturities hold in developed foreign bond markets as well. With non-dollar bonds, however, there is the additional concern of foreign currency exposure. Efficient market research conducted on exchange rates found the same random walk phenomenon. Exchange rates move unpredictably. Currency exposure clearly increases the volatility of the fixed income portfolio (see Table 5), while there is no reliable evidence to suggest that the expected return of exchange rates is anything other than zero. Our belief is that currency exposure should be hedged in global bond

Table 5

Risk Measures of Fixed Income Strategies

January 1985-December 2001

	Global Hedged*	Global Unhedged*	Lehman US Gov't./Credit Index
Annualized Standard Deviation (%)	3.73	7.47	4.77
Approximate Duration (years)	5.69	5.69	5.40

* Equal weighted portfolio of Salomon Brothers Country indices: US, UK, Japan, Germany, Canada and Australia.

portfolios. Investors pursue global portfolios in order to diversify. Statistically, diversification should result in a lower portfolio volatility due to the combination of uncorrelated assets. If volatility is increased with the addition of global assets, the whole purpose of international diversification is defeated.

With currency exposures hedged away, the goal of diversification is attained. Introducing hedged foreign bonds into a domestic portfolio reduces the volatility of the portfolio. Portfolios of hedged global bonds take advantage of imperfect correlations among developed bond markets (see Table 6) and enjoy the classic benefits of diversification. Further, given the global nature of highly rated debt issuers, this international diversification can be reached without sacrificing the credit standards maintained in domestic portfolios.

Table 6

Correlations of Hedged Country Bond Indexes

Monthly data: February 1991-December 2001

	Australia	Canada	Euro (12)	Denmark	UK	Japan	Sweden	US
Australia	1.000							
Canada	0.723	1.000						
Euro (12)	0.427	0.413	1.000					
Denmark	0.363	0.390	0.743	1.000				
UK	0.436	0.509	0.713	0.650	1.000			
Japan	0.269	0.227	0.304	0.030	0.102	1.000		
Sweden	0.450	0.401	0.579	0.650	0.521	0.129	1.000	
US	0.661	0.689	0.574	0.397	0.501	0.262	0.341	1.000

In terms of returns, just as investors are no longer subject to the risk of one bond market, they are no longer subject to the expected returns of just one yield curve. Expected returns across hedged bonds differ as the shape of each yield curve is different. Portfolios can be formed which are tilted toward the higher expected return countries. In this case, portfolio maturities *and* country weightings follow a variable approach based on the expected return matrix generated for each eligible country.

In our view, global bonds *do not* represent a separate and distinct asset class from domestic fixed income. Instead, the use of currency hedged non-dollar bonds along with domestic bonds allows investors to create a more diversified, less risky fixed income portfolio. Global bond portfolios are often better suited than their domestic-only counterparts to achieve the primary goal of fixed income in the investment portfolio—reducing its volatility.

Conclusion

Dimensional's fixed income strategies are designed to provide superior risk-adjusted returns. The objective of each strategy is to maximize returns for a given maturity range through the use of a disciplined non-forecasting approach. The global portfolios are simply extensions of the domestic strategies with a larger universe of eligible instruments. Fully hedged global bond strategies increase expected returns and decrease volatility through improved portfolio formation. Table 7 displays the expected returns for Dimensional's fixed income strategies relative to popular benchmarks.

Table 7

Performance Expectations

Dimensional's Strategy	Benchmark	Expected Annual Premium over Benchmark
DFA One-Year Fixed Income Portfolio	Institutional Money Market Funds	50-100 b.p.
DFA Two-Year Corporate Fixed Income Portfolio	Merrill Lynch 1-3 Year	25-50 b.p.
DFA Two-Year Global Fixed Income Portfolio (Currency Hedged)	Merrill Lynch 1-3 Year	50-100 b.p.
DFA Five-Year Global Fixed Income Portfolio (Currency Hedged)	Lehman Aggregate	50-100 b.p.

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