



## **Seeking Beta in the Bond Market: A Math-driven Investment Strategy for Higher Returns**

By Georg Vrba, P.E.  
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Investors seeking permanent exposure to the bond market should invest in high-beta funds during up markets and low-beta funds during down markets. This simple strategy, as I will show, provides consistent long-term returns that are considerably higher than what a static investment in bond funds would achieve.

The reason is simple: High-beta funds – in other words, funds that are more sensitive to market movements – perform better than their benchmark index in up markets and worse in down markets. Low-beta funds perform worse than the index in up markets and better in down markets.

To implement my strategy, one has to identify turning points in the market and switch one's investments accordingly. My method of doing so is entirely math-driven, requires little input and does not depend on subjective market interpretation. Relatively few transactions are required – by my metric, the market does not flip often.

Most advisors advocate a conservative bond market investment approach of holding a diversified mix of fixed income securities that offer exposure to all maturities and all types of issuers. For example, the widely used Vanguard Total Bond Market Index Fund seeks to reflect the composition of the entire bond market. This fund has a beta of 1.00 and since 1990 has provided an average annual return of about 7%. In contrast, my investment method over the same time period would have provided, depending on the funds chosen, an average annual return of between 11% and 15% without incurring significant additional risk.

### **My strategy**

My method is based on the first three of Bob Farrell's rules:

1. Markets tend to return to the mean over time.
2. Excesses in one direction will lead to an opposite excess in the other direction.
3. There are no new eras -- excesses are never permanent.

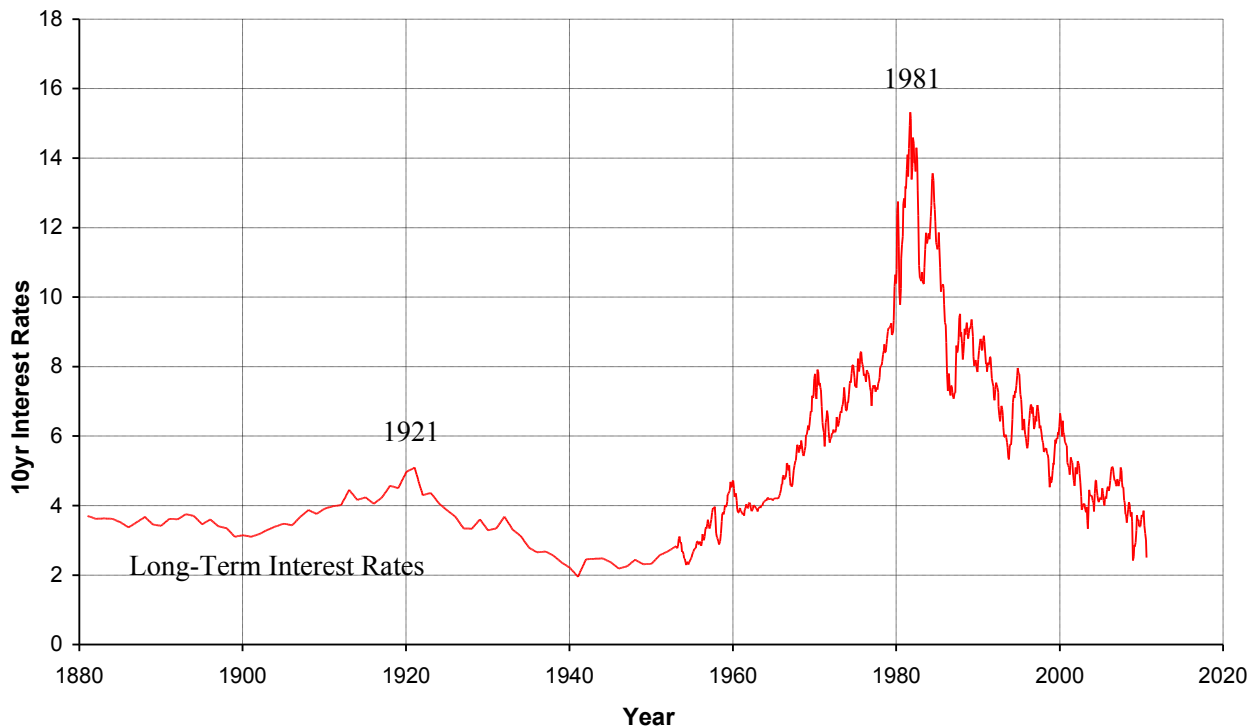


I establish a mean market direction and exploit deviation from the mean (the up and down markets) for positive investment results.

Interest rates follow long-term trends, as Figure 1, which shows the long-term U.S. interest rates for the last 130 years, illustrates. A recent article in *Advisor Perspectives*, [The Road Ahead: Is It Inflation or Deflation](#) by Martin Pring, makes the same point.

**Figure 1: Interest Rates from 1880 to 2010**

from Robert J. Shiller "Irrational Exuberance" Princeton University Press, 2000, 2005, updated



There are three clearly defined segments of this graph, each delineated by an interest rate peak: from 1880–1921, from 1921–1981, and from 1981 to now. The interest rate trend for each segment could be expressed as the equation of a curve that fits best to the underlying data. My method, which uses the interest rate trend, applies to the period from 1986 to now. The investment approach I have derived from it can be used as long as the current segment’s interest rate trend continues.

Turning points in the bond market result from interest rate changes alone and nothing else. Therefore, unlike the stock market’s movements, bond market direction is deducible by mathematical analysis.



The daily prognostications on market direction by financial “experts” may be fun to read, but don’t be confused by their predictions. The way to determine bond market direction is to correctly interpret the change of the yield curve over time. I calculate a “Bond Value Ratio” (BVR), which is based only on the daily yields-to-maturity of the 30-year Treasury bond and the 10-year note. Bond values derive from those yields, and the relationship between those bond values is captured by the BVR, which is an indicator of up or down markets. BVR increases if the value change of the 30-year bond exceeds the value change of the 10-year note, and vice versa. When BVR is plotted as a graph against time, an upward slope indicates an up market and conversely, a downward slope indicates a down market.

I performed a regression analysis of the BVR to determine its best-fit curve – its trend line. This curve represents the mean market direction referred to in Farrell’s rule one. I then place upper and lower offset lines from the best-fit curve to establish a reference for the directional excesses referred to in Farrell’s rule two. When the BVR turns upwards from below a lower offset line, I invest in a fund with high beta. When the BVR turns downwards from above an upper offset line, I remove my money from the high-beta fund and place it into a fund with low beta. This strategy invokes Farrell’s rule three, which is about excesses never being permanent.

Offset limits can vary depending on the desired time horizon and acceptable volatility of the investment. Lower offset limits result in more turning points, lower volatility and usually, but not always, lower returns. Higher limits result in fewer turning points and more volatility. Only limit settings so high that BVR can never penetrate the offset lines do not provide a higher return than a high-beta fund alone would provide. I have found the optimum offset limits to be 0.110 for a 10- to 12-year investment horizon and 0.040 for a five- to 10-year horizon.

### The bond funds

In order to eliminate default risk, I only consider bond funds with investments that are guaranteed by the U.S. Treasury and supported by the full faith and credit of the U.S. government. Seeking high-beta and low-beta funds in this category, I selected four funds with a reasonably long history: the first is an American Century zero-coupon fund and the other three are Vanguard funds with dividends. All funds have a very strong correlation with the BVR, as indicated by the calculated correlation coefficient “r.”

Ticker Symbol	Category	Beta (3y)	Beta (5y)	Beta (10y)	r
BTTRX	Long-Term Government	3.90	3.78	3.94	0.930
VUSTX	Long-Term Government	2.60	2.47	2.38	0.932
VFIIX	Intermediate-Term Government	0.69	0.74	0.73	0.923
VBISX	Short-Term Bond	0.53	0.54	0.56	0.928



(Note: This choice of funds should not be construed as a recommendation to invest in them; my sole purpose is to demonstrate my investment strategy.)

The data I'm working with does not go all the way back to fund inception, but it covers a significant time period nevertheless. In order to show the relative performance of the funds, I indexed them to the same starting value as of 12/14/89, the earliest date for which VUSTX data with dividends is available. The indexing date is before the inception date of BTTRX and VBIIIX. VUSTX was assumed to be a proxy for BTTRX before 2/15/96 and similarly, VBISX values were assumed to mirror VFIIIX values before 6/20/96.

**Figure 2: Performance of Bond Funds 1995 - 2010**  
adjusted for dividends and indexed to same initial value as of 12/14/1989

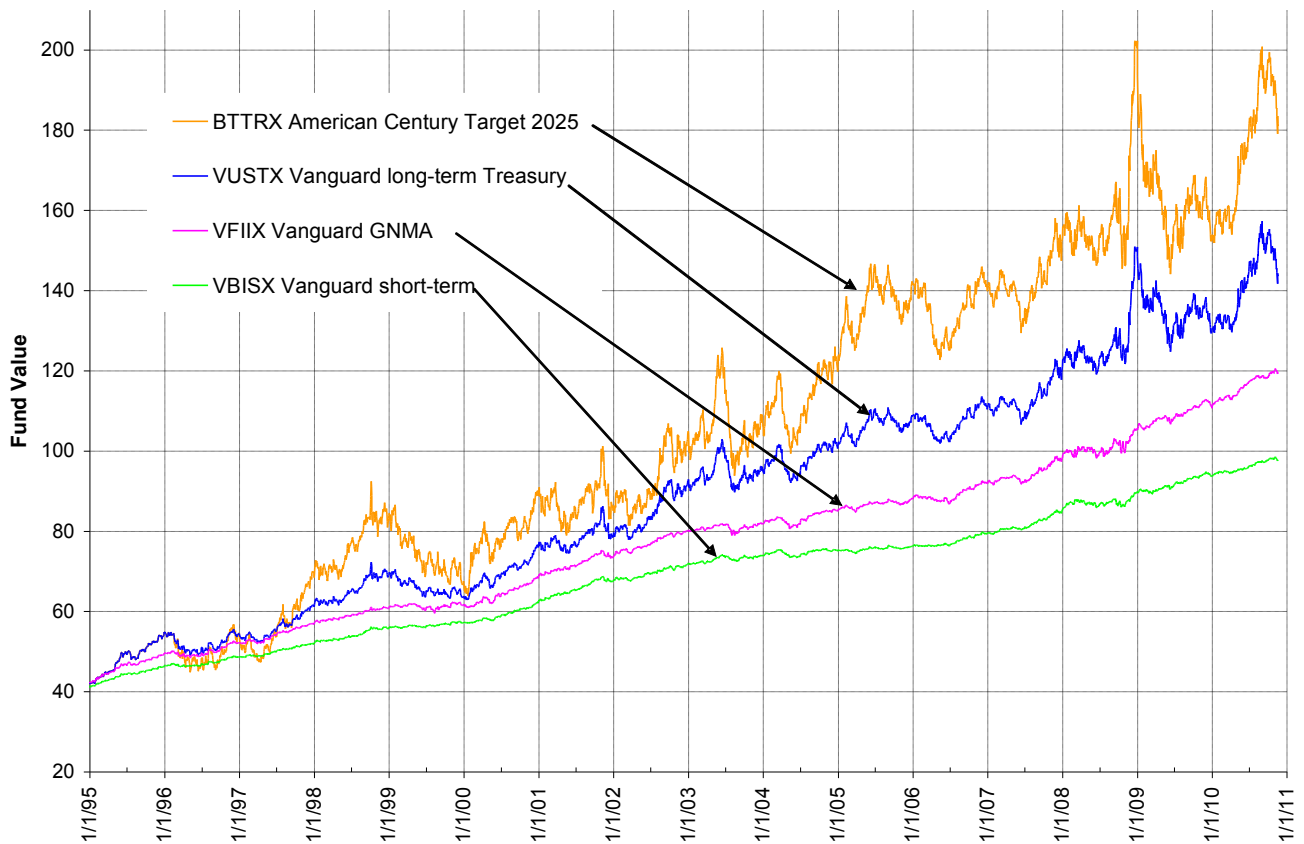


Figure 2 depicts the value of the selected bond funds over time with dividends re-invested. It is evident that the high-beta funds BTTRX and VUSTX appreciated most over time but also have a higher volatility than the low beta funds.



## The results

The investment period for this study is from 1/12/1990 to 11/18/2010.

The fund combinations used for evaluating my investment strategy are:

mix 1: VBISX & VUSTX as the low-beta and high-beta funds, respectively, and  
 mix 2: VBISX & BTTRX as the low-beta and high-beta funds, respectively.

Results are presented for two sets of offset limits, “A” and “B”:

“A”: upper offset limit = 0.110 and lower offset limit = -0.110

“B”: upper offset limit = 0.040 and lower offset limit = -0.040

Listed returns are the average annual return from 1/12/1990 to 11/18/2010.

offset limits	investment horizon	return mix 1	return mix 2	transactions	Figures
“A”	10- to 12 years	11.16%	15.06%	17	3 & 5
“B”	5- to 10 years	10.44%	14.61%	31	4

If VFIX is selected instead of VBISX as the low beta fund in mix 1 and mix 2, the returns are:

offset limits	investment horizon	return mix 1	return mix 2	transactions
“A”	10- to 12 years	10.92%	14.80%	17
“B”	5- to 10 years	10.10%	14.25%	31

Returns are considerably higher than for permanent investments in the high-beta funds, which would have produced average annual returns of 8.04% for VUSTX and 9.24% for BTTRX. (The return for BTTRX does not coincide with its published “since inception return” because of the adjustments made to determine a hypothetical value for BTTRX prior its existence, as mentioned earlier.) Also, since VFIX has a higher beta than VBISX, the returns with VFIX as the low-beta fund in mix 1 and mix 2 are, as expected, lower. The obvious choice is to select respectively the highest and the lowest beta bond funds for the investments in up markets and down markets.

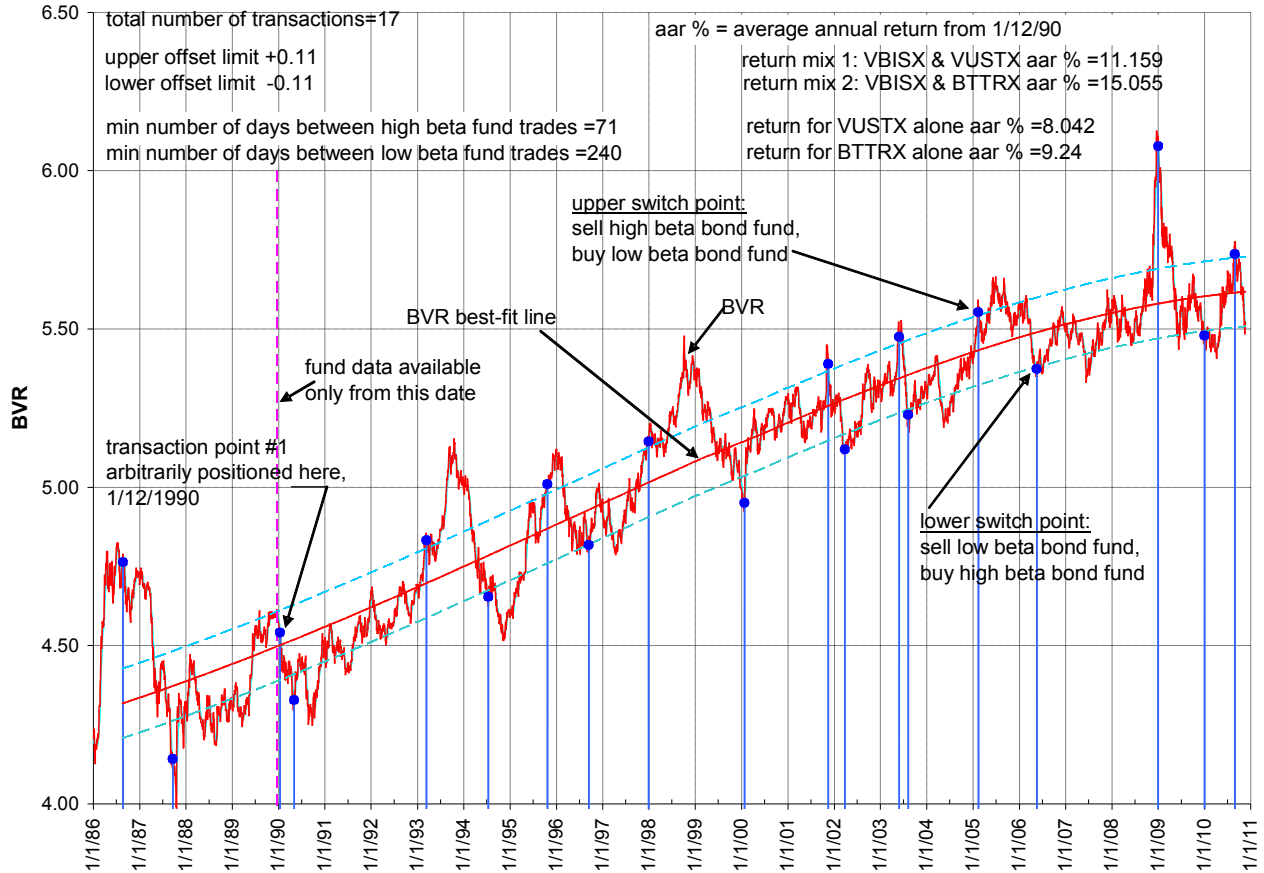
I have investigated combinations with limit settings ranging from 0.160 to 0.010, changing the limits in steps of 0.005. The minimum average annual return from this range of combinations resulted from an offset limit setting of 0.055, which returned 9.66% for mix 1 and 12.85% for mix 2. Even these minimum returns are better than returns from a static investment in the high-beta funds alone.



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**Figure 3: Bond Value Ratio (BVR)**

Model updated to: ...11/18/10 with offset limits "A" for long-term investment horizon.



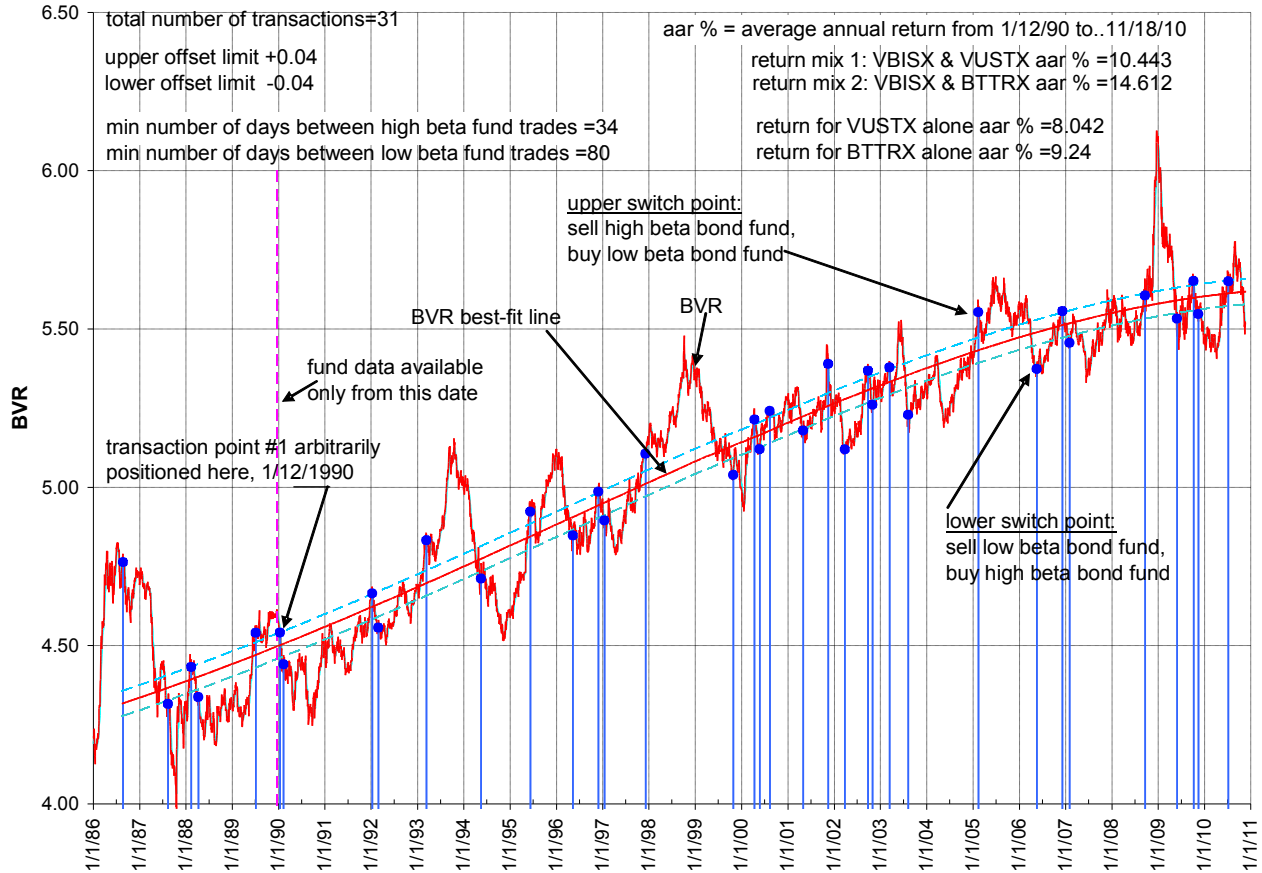


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**Figure 4: Bond Value Ratio (BVR)**

with offset limits "B" for intermediate to long-term investment horizon.

Model updated to: ...11/18/10



Figures 3 and 4 depict BVR with offset limits "A" and "B" respectively. Upper switch points are shown when the high-beta fund is sold and the investment is switched into the low-beta fund, and lower switch points indicate the opposite.



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Model updated to: 11/18/10

**Figure 5: Bond Value Ratio (BVR) and Fund Values**

(fund values indexed to same value as of 12/14/89)

with offset limits "A" for long-term investment horizon.

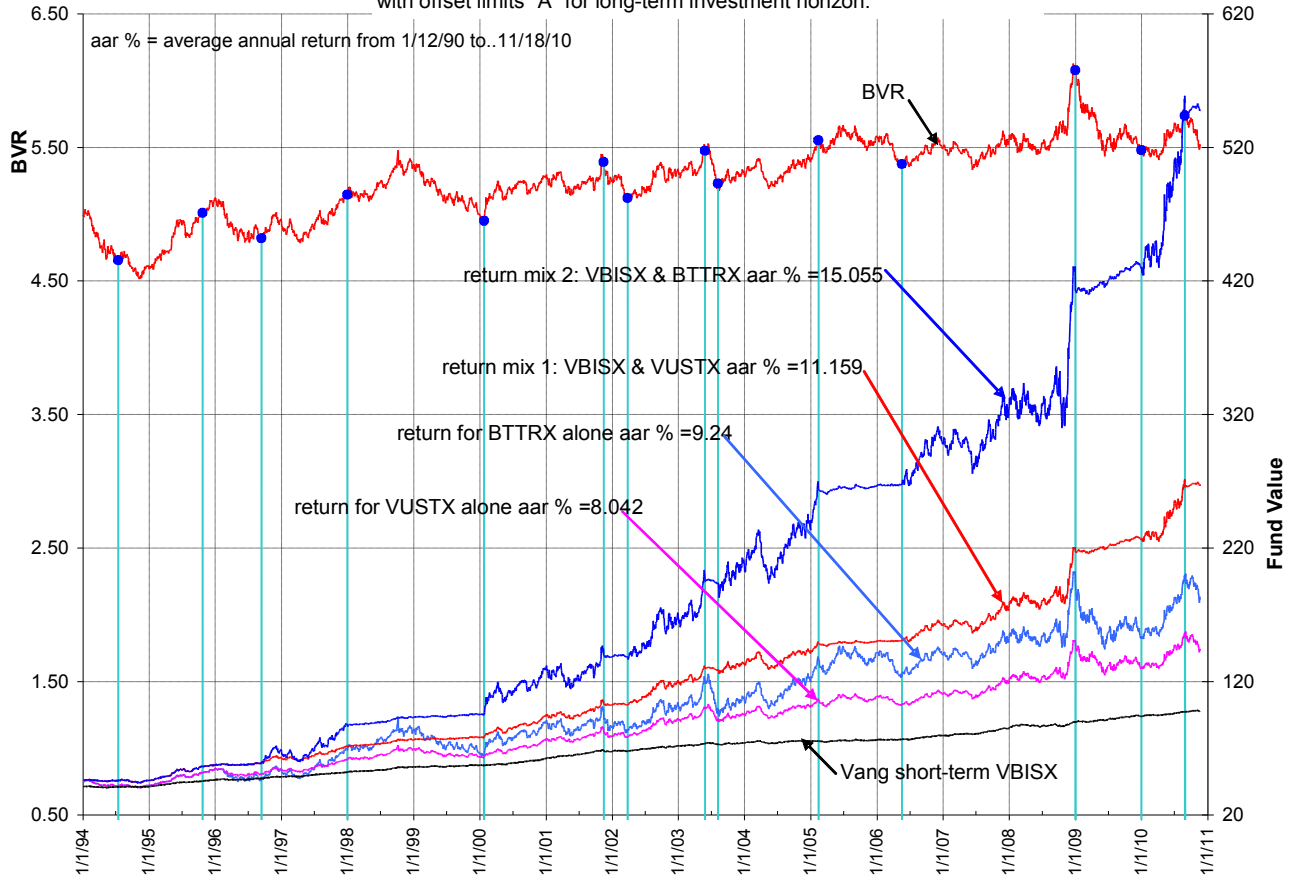


Figure 5 depicts the fund values and the values obtained for mix 1 and mix 2 when using offset limits "A." The volatility for mix 1 and mix 2 is considerably lower when the investment is in the low-beta fund, as indicated by the relatively smooth line between the switch points. This, obviously, reduces the overall volatility of the investment.



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**Figure 6: Bond Value Ratio (BVR) and Fund Values after periodic withdrawals**

(fund values indexed to same value as of 12/14/89)

Model updated to: 11/18/10

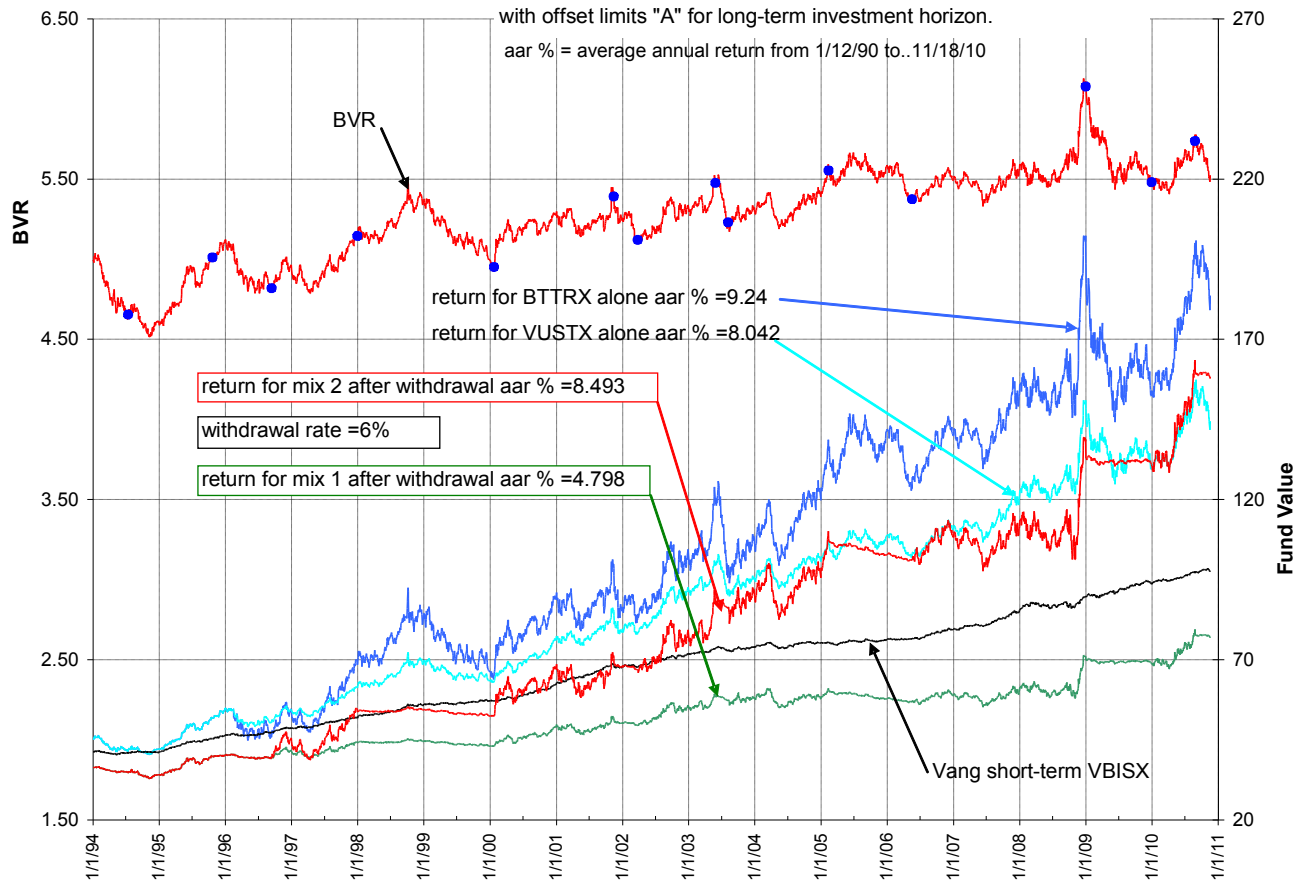


Figure 6 graphs the investment value after periodic monthly withdrawals based on a withdrawal rate of 6.0% per annum. This is 1.5 times the normally accepted safe withdrawal rate of 4.0%. Over the investment period considered, and with an offset limit setting of 0.110, the average annual return for mix 1 after withdrawals is still a respectable 4.80%, and for mix 2 it is 8.49%. My investment strategy can provide a higher safe withdrawal rate while still producing significant investment growth.

### Testing and updating the model

An argument could be made that this method is an exercise in back-fitting and that at an earlier end date the best-fit curve for the BVR, derived from the shorter data set, would have had a different shape. A different curve would have resulted in different transaction points than those that the best-fit curve for the full data set produced.

In order to evaluate this criticism, I calculated the best-fit curves for shorter time periods and projected them forward to find the period over which they would still reflect the trend of



the BVR correctly. I did this for 16 consecutive one-year periods starting in 1995 and ending in 2010. I found that the forward projected curves could safely be relied upon for a minimum of three months to produce the same transaction points as the present model did, provided the chosen offset limits did not exceed a value of 0.110.

One should re-calculate the equation of the best-fit line monthly using the entire available data set, so that the most recent data is taken into account. The model should also be regularly updated with the most current bond yields. This is especially important when the BVR is above an upper-offset limit line, which may indicate an imminent signal for a switch into a low-beta fund. Staying too long in the high-beta fund once the BVR moves below the upper limit line can lead to significant losses. To reduce risk, one can use a lower setting for the upper offset line than for the lower offset line. This would have the effect of selling the high-beta fund earlier, and in exchange for the added security one would expect a slightly lower return. See the Appendix for results of such a strategy.

### Recent investment results

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**Figure 7: Bond Value Ratio (BVR) from 2006 to 2010**

with offset limits "A" for long-term investment horizon.





Figure 7 is a graph of BVR for the period 2006 to 2010.

The last three switch points occurred on 12/31/08, 12/30/09 and 8/27/10. To demonstrate the effect of my method on investment returns, the actual performance of the funds including dividends, if applicable, is shown below:

The transaction point of 12/31/08 signaled the switch from the high-beta fund to the low-beta fund.

Fund performance was:

<b>Period 12/31/08 to 12/30/09</b>	<b>BTRTX</b>	<b>VUSTX</b>	<b>VFIIX</b>	<b>VBISX</b>
Fund value change %	-20.48%	-12.04%	+4.93%	+4.26%

The next transaction point of 12/30/09 signaled the switch from the low-beta fund to the high-beta fund. Fund performance was:

<b>Period 12/30/09 to 8/27/10</b>	<b>BTRTX</b>	<b>VUSTX</b>	<b>VFIIX</b>	<b>VBISX</b>
Fund value change %	+26.62%	+17.22%	+6.96%	+3.54%

The last transaction point of 8/27/10 signaled the switch from the high-beta fund to the low-beta fund. The BVR has since dropped further, indicating that an investment would have performed better in a low-beta fund than in a high-beta fund since that date. Fund performance from 8/27/10 to 11/18/10 was:

	<b>BTRTX</b>	<b>VUSTX</b>	<b>VFIIX</b>	<b>VBISX</b>
8/27/2010 fund price/value	\$ 71.81	\$ 12.49	\$ 11.05	\$ 10.66
dividends paid	0	\$ 0.076	\$ 0.066	\$ 0.036
11/18/2010 fund price	\$ 66.68	\$ 11.63	\$ 11.07	\$ 10.67
11/18/2010 fund value	\$ 66.68	\$11.706	\$11.136	\$10.706
Fund value change	(\$ 5.13)	(\$ 0.784)	\$ 0.086	\$ 0.046
Fund value change %	-7.144%	-6.277%	+0.778%	+0.432%

The most recent change in value of the funds was significant, and in this relatively short period of twelve weeks the high-beta fund VUSTX underperformed the low-beta fund VBISX by 6.71%. Thus, by switching into the low-beta fund at the right time, one could improve performance by 6.71% relative to a permanent investment in VUSTX. When most people expected bond yields to fall after Bernanke's Jackson Hole speech, the BVR dropped immediately from above the upper offset limit line and began a steep fall. Over the last twelve weeks the BVR has fallen and is now below the lower offset limit line. Long-bond values have declined by about 7% over this period. When the BVR reverses direction, it will indicate that it should be profitable again to invest in high-beta funds for a while.



In the down market (12/31/08 to 12/30/09), the high-beta funds had large negative returns, while the low-beta funds provided positive returns. (During previous down markets the low-beta funds always out-performed the high beta funds, which generated the additional return over a permanent investment in the high-beta funds.) When the BVR was in a rising mode, indicating an up market (12/30/09 to 8/27/10), the returns of the high-beta funds over this period were vastly superior to those of the low-beta funds. The performance of the funds relative to each other proves that the beta values correctly predicted a fund's performance under varying market conditions.

### **Further observations**

My investment strategy is based on a quantitative method and does not rely on hope to produce better returns. The superior investment returns of my method do not require an assumption of unusual risks. On the contrary, the volatility risk of my strategy is lower than for an investment in a high-beta fund alone. And recall that I eliminated all default risk by investing in U.S. Treasury bond funds only. The mantra "higher returns with higher risk" does not apply here.

My investment strategy is not limited to U.S. bond funds. The model's principles apply equally to other well-developed bond markets and markets in which funds of various maturity levels are available. If there are no beta values published, then a long-maturity bond fund can be used as a high-beta fund and a short-maturity bond fund can be used as low-beta fund. Historical data for bond yields is also necessary to determine the Bond Value Ratios and the BVR trend line, as previously described.

## **Appendix**

### **Beta vs. Standard Index**

(from Morningstar Report: Mutual Fund Data Definitions)

Beta, a component of Modern Portfolio Theory statistics, is a measure of a fund's sensitivity to market movements. It measures the relationship between a fund's excess return over T-bills and the excess return of the benchmark index. Bond funds are compared with the Lehman Brothers Aggregate Bond index. By definition, the beta of the benchmark (in this case, an index) is 1.00. Accordingly, a fund with a 1.10 beta has performed 10% better than its benchmark index--after deducting the T-bill rate--than the index in up markets and 10% worse in down markets, assuming all other factors remain constant. Conversely, a beta of 0.85 indicates that the fund has performed 15% worse than the index in up markets and 15% better in down markets. A low beta does not imply that the fund has a low level of volatility, though; rather, a low beta means only that the fund's market-related risk is low.



## Returns when upper and lower offset settings are not equal

mix 1: VBISX & VUSTX as the low beta and high beta fund, respectively, and  
mix 2: VBISX & BTTRX as the low beta and high beta fund, respectively.

Results are presented for the following offset limits "C":

"C":upper offset limit = 0.090 and lower offset limit = -0.110

offset limits	investment horizon	return mix 1	return mix 2	transactions
"C"	long	11.00%	14.84%	17

(return is the average annual return from 1/12/1990 to 11/18/2010)

## Data Source

Fund category and beta data, as well as data on historical fund prices and dividends, were obtained from Yahoo!Finance.

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