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Time Track:
Analyzing Historical Asset Returns

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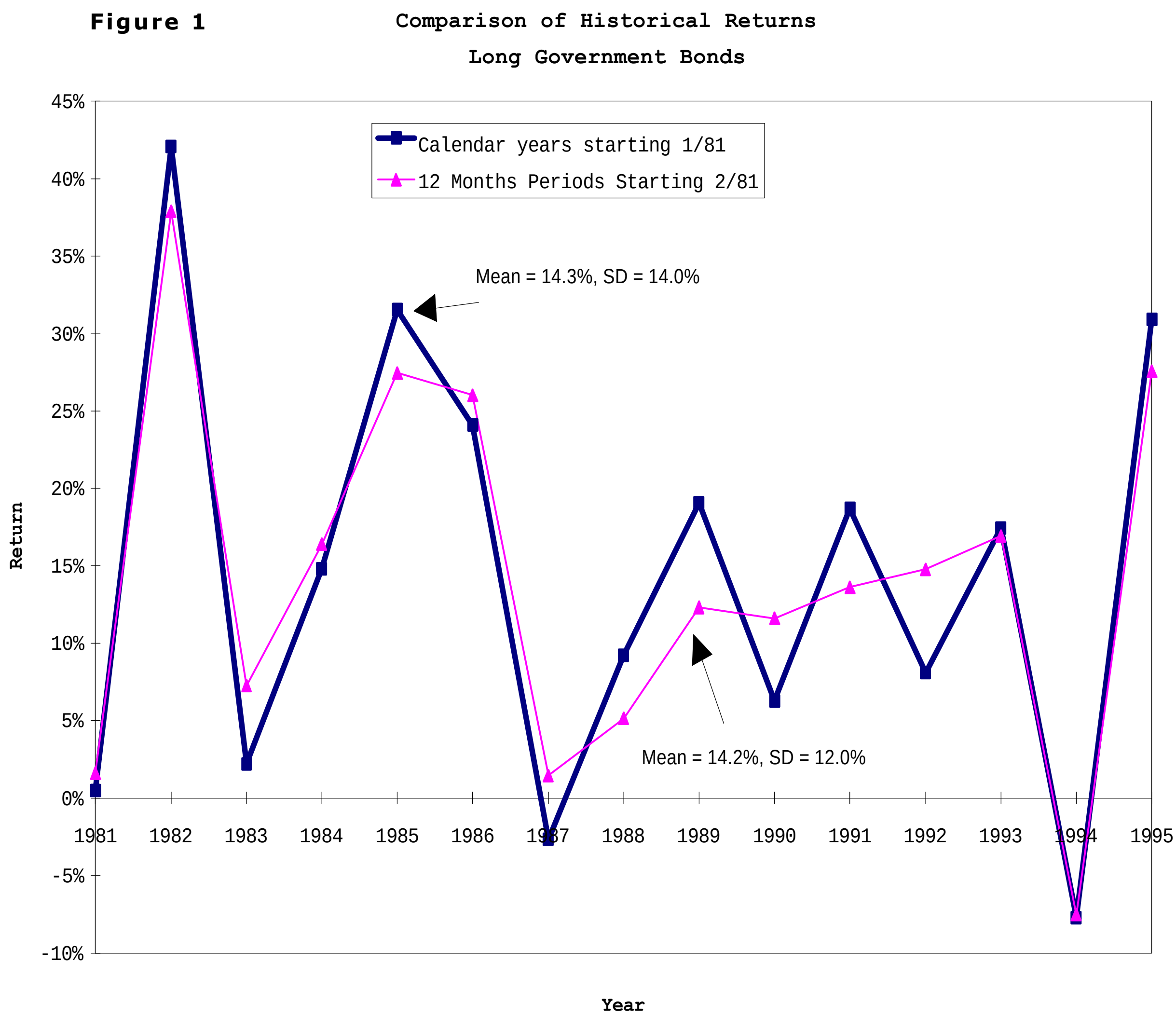
Is the standard deviation of Long Government Bonds 14% or 12%? A small difference in the measurement period can make a major difference in the calculated standard deviation. For example, for the 15 calendar years ending December 1995, the standard deviation of bond returns is 14%, while shifting the time periods forward by one month yields a standard deviation of 12%. Figure 1 shows the historical results for the two periods:

Figure 1



Traditional analysis of historical results has focused on the calendar year results, calculated over a small number of time horizons. For instance, the standard deviation over the last 10, 25 and 50 calendar years is typically presented. Closer analysis of the data shows that the calendar year view is extremely limiting. Some analysts look to "pure" monthly data for information on standard deviations and correlations; unfortunately, the monthly data approach is not effective for time series with significant serial correlation.

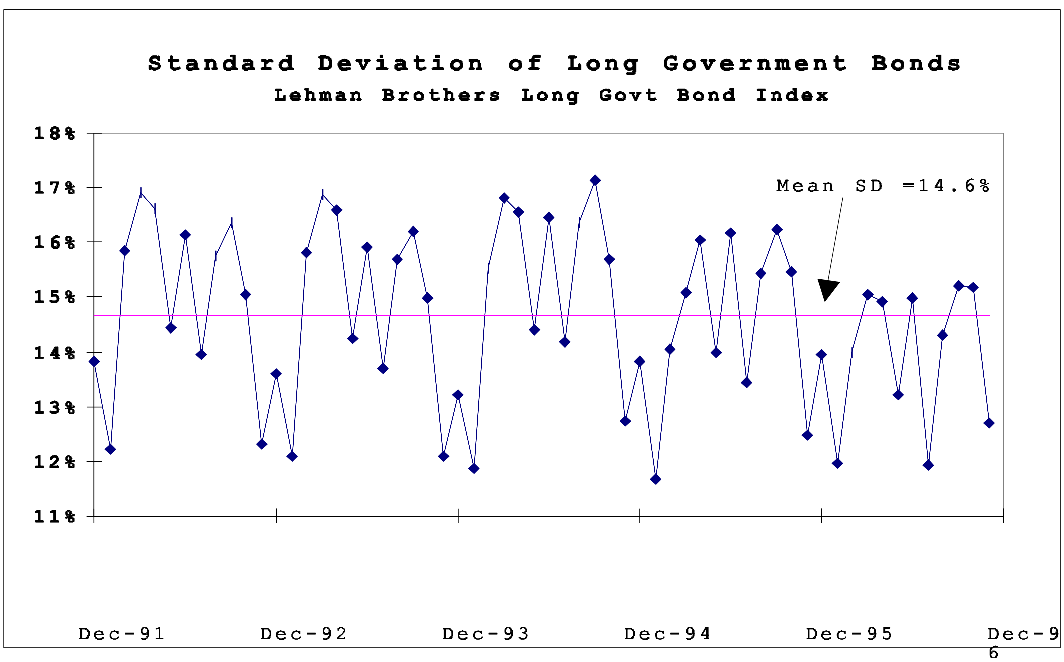
This paper proposes a more detailed analysis of history — the Time Track approach — rolling 12-month periods instead of calendar years. The inclusion of all monthly data provides 12 times as many observations and provides a track of trends in the statistics. Applying this analysis to standard deviation, correlation and risk premium clarifies the interpretation of historical data.

Description of the Time Track Methodology

The basic approach is to slice monthly return and inflation data into rolling periods of 12 months and calculate year over year returns for each period. Periods starting in January would obviously be a calendar year; however, we also include periods starting in February, March, etc. Once the "annual" returns are calculated, we use a 15-year horizon for calculation of the statistics.

Although there is substantial overlap in the time periods (179/180 months are identical), the "slicing" process injects considerable variation into the statistics. For example, for the 60 periods ending between December 1991 and November 1996, the average standard deviation is 14.7%, but the values range between 11.7% and 17.1%. The "standard deviation of the standard deviation" is 1.6%. Figure 2 highlights this period:

Figure 2



Note that the traditional analysis of referencing the standard deviations for periods ending in December would give a standard deviation about one percentage point below the average standard deviation of all the periods. (Astute readers may notice that monthly patterns appear in the chart. This is apparently due to outlier results that persist for 15 years.)

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A second type of traditional analysis is to look at the standard deviation of monthly returns. For this analysis, the convention is to convert the monthly standard deviations to annualized standard deviations by assuming independent distributions and multiplying by the square root of 12. However, if there is substantial serial correlation between months, then the annualized monthly standard deviation will be quite different from the annual standard deviation. (As stated in Ibbotson, the annualizing formula assumes that there is no monthly autocorrelation. *Stocks, Bonds, Bills and Inflation 1997 Yearbook*. (Ibbotson Associates: Chicago, 1997, p 106.) Figure 3a compares the annualized monthly standard deviation to the annual standard deviation for Long Government Bonds:

Figure 3a

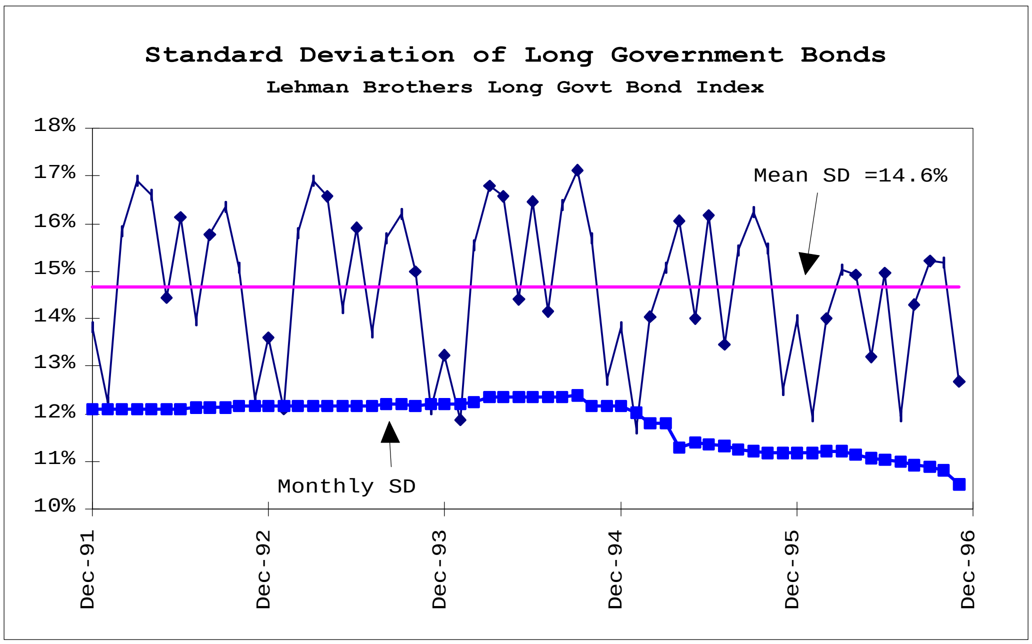
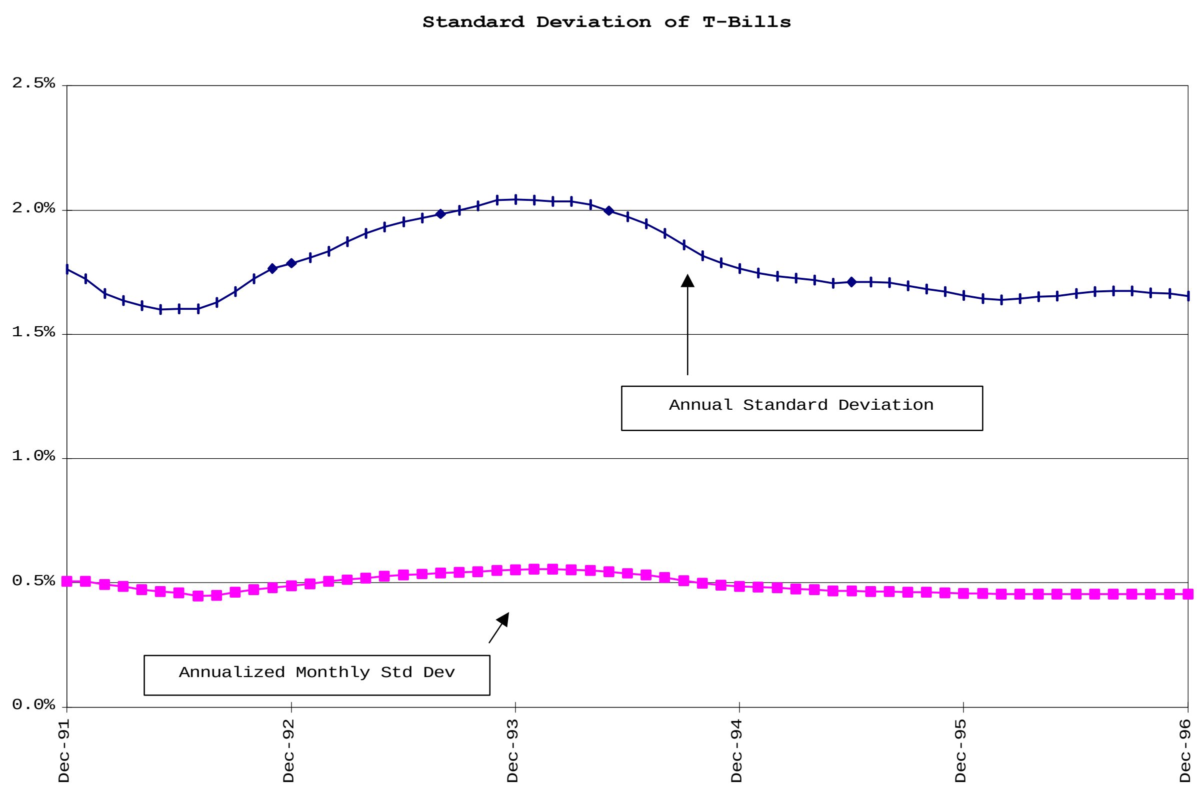


Figure 3b illustrates the difference between the annualized monthly standard deviation and the true annual standard deviations for Treasury Bills. Since the serial correlation in monthly T-Bill returns is extremely high, the annualized monthly statistic is significantly lower than the annual standard deviation.

Figure 3b



Changes Over Time

By extending the analysis to include longer time periods, we are able to see significant trends in standard deviations and other statistics. The moving average of standard deviations for the last 60 periods provides a reliable indication of the trend. Figure 4 shows standard deviations for Long Government Bonds for returns starting in 1926.

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Figure 4

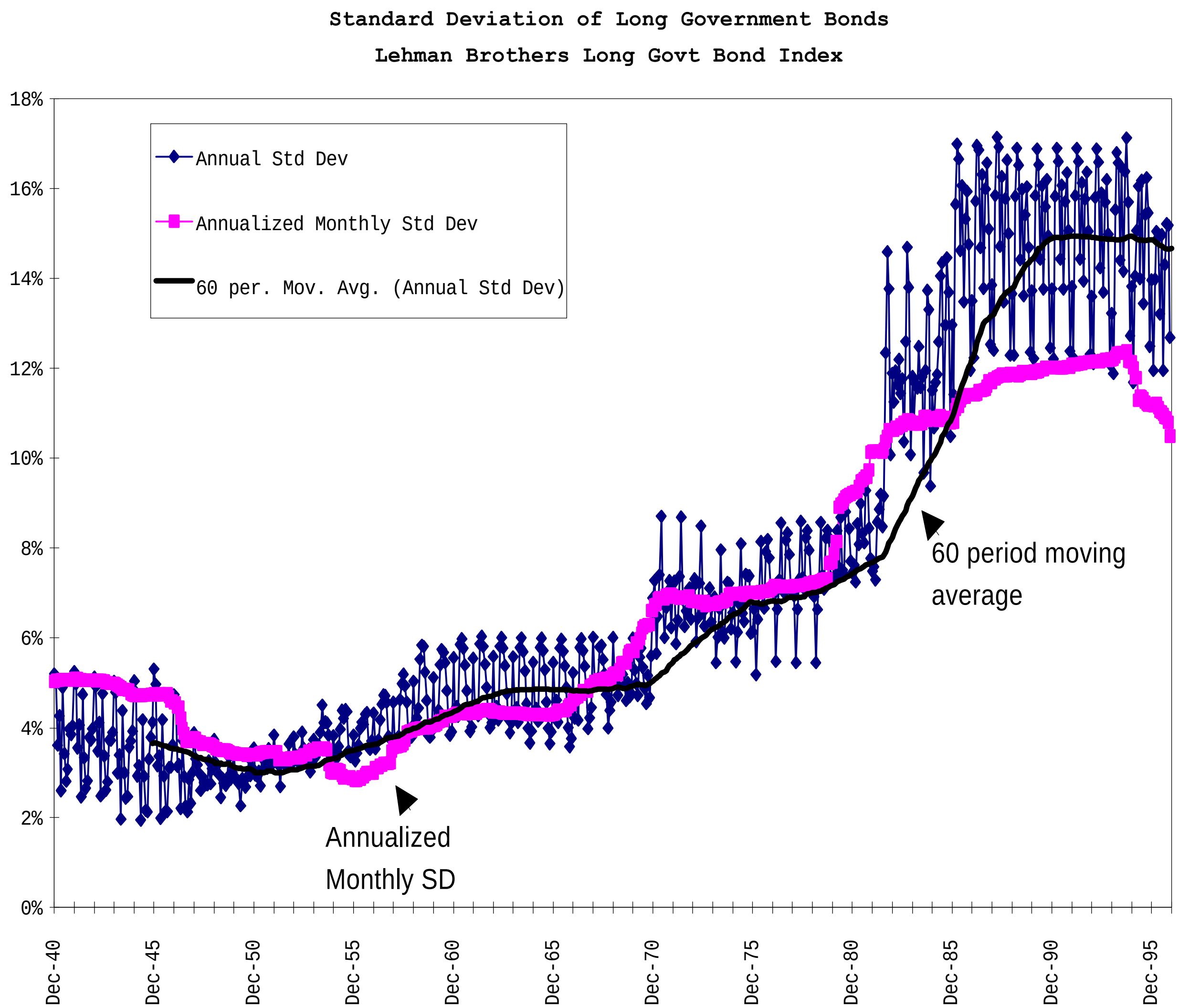

Figure 4 shows dramatic changes in the standard deviation of Long T-Bonds over the last 70 years. From 1926 to about 1960, the annual standard deviation was below 4%. Starting in 1960, the volatility increased, hitting 10% by 1985 and 15% by 1990. The standard deviation has leveled off to the 15% neighborhood for the 90s.

Summary

This article uses the Time Track methodology to analyze historical statistics. This method is superior to either pure calendar year data or annualized monthly data. For time series with substantial serial correlation, such as inflation and T-Bill yields, Time Track overcomes the limitations of the annualization formula. For all asset classes, Time Track provides a better indication of temporal patterns than alternative measures.

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