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Equity Duration – Updated Duration of the S&P 500

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❑ In early 2004, we published a paper describing a simple model of asset allocation for pension plans that incorporates the concept of equity duration. We believe that a diversified portfolio of equities and bonds can be immunized and lowers the risk of deficits.

❑ Akin to the well-known concept of bond duration, equity duration measures the sensitivity of equities to interest rates. Although research on this subject is more recent and the concept is rarely used in practice, we believe equity duration is of significant importance in immunization, risk management, and asset allocation.

❑ We developed a simple model of equity duration that uses the dividend discount model and incorporates the sensitivity of growth to rates. Based on our empirical model, duration (or interest-rate sensitivity) is higher for high-growth stocks, stocks whose dividend growth is not sensitive to interest rates, and in low–discount rate environments.

❑ Standard & Poor's publishes, on an annual basis, a current report and a 30-year history of duration for the S&P 500. We acknowledge that equity duration estimation is an evolving science. We also believe that a regularly available and updated source of equity duration data will make this important metric more accessible for further research and practitioner use.

❑ We estimate the duration of the S&P 500 index to be 19 years at the end of third quarter of 2004. It has risen from its level of 15 years at the middle of 2003, suggesting that the market has become more rate-sensitive. However, duration of the index is still below the 22-23 years figure seen in 1999.

Equity Duration

In our earlier paper, we discussed various approaches to equity duration evaluation and described a rather simple model of asset allocation in pension funds.[1] Duration is a standard and ubiquitous measure of the price sensitivity of a bond to interest rate changes in fixed income analytics. Equity duration measures the sensitivity of equity prices to rate changes.[2] The extension of the duration concept to equities is more recent, with the earliest literature on the subject dating back just 20 years and its use in investment management is far from widespread. The reasons for this are not hard to find:

- Unlike plain bonds, the terminal value of equities is not fixed.
- Interest payments of plain bonds are predetermined and known in advance. Dividend payments of equities are not as certain.

We suggested that the difficulties in estimating equity duration do not detract from its importance in immunization, tactical asset allocation, and risk management.

Immunization: Immunization refers to investment of assets in such a manner so as to enable matching of assets and liabilities regardless of changes in interest rates. It refers not only to matching the present value of assets with the present value of liabilities, but also to matching the interest rate sensitivities of assets with those of liabilities. Since the duration of any instrument varies with time and changes in rates, complete immunization is costly or impractical. Immunization in practice is often a tradeoff between cost and efficiency. As we mentioned in the previous section, a common example is a pension plan that not only has to match its present value of assets with its projected obligations, but also has to ensure that the duration of assets matches those of its obligations. Since equities account for nearly half of assets in most pension plans, an estimate of equity duration is important.

Risk Management: Equities constitute a significant proportion of investor portfolios, and empirical evidence suggests that equities do react to changes in rates. Therefore, any risk management plan needs to factor in the sensitivity of the equity portfolio to rate changes.

Tactical Asset Allocation: Tactical asset allocation makes opportunistic bets on changes in the external economic environment by shifting allocations among different asset classes. Since interest rate changes are one signal of the external economic environment, knowledge of equities' rate sensitivity would be very important for plan managers considering shifts in asset allocations to take advantage of projected changes in interest rates.

There are three distinct approaches to evaluate equity duration.[3] The Dividend Discount Model Approach is the earliest and simplest approach. However, it gives high estimates of equity duration. More importantly, it does not take into account the "flow-through" effects of interest rates; that is, it does not consider the fact growth might be sensitive to rates. The Empirical Approach derives equity duration from historical changes in equity prices and interest rates, and yields much shorter duration estimates. While statistically

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[1] "Using Equity Duration In Pension Fund Asset Allocation - Introducing a new data series: The 30-year history of duration for the S&P 500," January 27, 2004, www.standardandpoors.com.

[2] It is important to note that, unlike in bonds, interest rates do not have significant explanatory power for equity returns; rather, the rate effect is transmitted to equity prices through other variables that have significant explanatory power.

[3] See our previous paper for a fuller description of these approaches and historical estimates derived from them.

appealing and direct, it suffers from biases that result in lower than expected estimates of duration. Flow-Through Duration Models follow from the Dividend Discount Model and factor in the sensitivity of growth to rates. In our previous paper, we derived our estimate of equity duration as

$$1/P \, (\delta P/\delta k) = \, -1/(k\text{-}g) \, (1\text{-}\delta g/\delta k) \tag{4}$$

Where P is the price of the stock, k is the equity discount rate, and g is the dividend growth rate. This is a simple flow-through model, where dg/dk measures the sensitivity of dividend growth to changes in the equity discount rate. Several properties of duration can be drawn from this approach. Ceteris paribus,

1. Higher growth implies higher duration. That is, higher-growth portfolios will have a higher duration and, therefore, greater sensitivity to interest rates.

2. If the dividend growth rate is steady, a higher equity discount rate implies a lower duration and, therefore, a lower sensitivity to changes in interest rates.

3. Low sensitivity of growth opportunities to the discount rate increases the duration of a portfolio and therefore increases the sensitivity of a portfolio's value to changes in interest rates.

In our calculations for evaluating the duration of the S&P 500, we take quarterly dividend growth of the S&P 500 for g. For k, we choose to use the Moody's Baa yield series. The choice of a corporate bond yield series departs from literature, but we believe is more practical. Traditionally, the equity discount yield in this context has been taken as a long-term (10- or 20-year) treasury bond, with a constant equity risk premium added to it. However, because the equity risk premium varies from one time period to another, an average might not be appropriate — leaving aside the intricacies involved in computing the risk premium if one is not adding an average number. The corporate bond series gives a market-determined, risk-adjusted measure of the discount rate. The sensitivity of g to k is difficult to estimate. Following some prior literature, we take this factor as the correlation of change in g to change in k. Recognizing that the denominators are long-term factors and duration is not a high-frequency estimation parameter, we take the previous 10-year (40-quarter) averages for the g and k terms and for the correlation estimation.

Updated Duration Estimates

The duration of the S&P 500 since 1973 is shown in Appendix 1 and plotted in Exhibit 1. Over the long run, the most striking feature is the downward trend in equity duration; that is, equities have become less sensitive to interest rates. Of course, this is related to the striking market and interest rate cycles of the previous three decades. In addition, however, there is perhaps a structural factor is this reduction in duration, with non-rate features becoming more important. It is also interesting to note that duration of the equity market had reached 15-year highs toward the end of the bull market of the 1990's. This is related to the first property of duration discussed earlier: higher growth implies higher duration. Therefore, as a monetary tightening policy took effect, the sensitivity of the equity market to rates was at 15-year highs. The downward pressure on equities was swift and sharp. A subsequent series of interest rate cuts did little to bolster equity prices. This is not surprising, because rate sensitivity, or equity duration, had fallen to a 10-year low.

Exhibit 1: Duration of the S&P 500
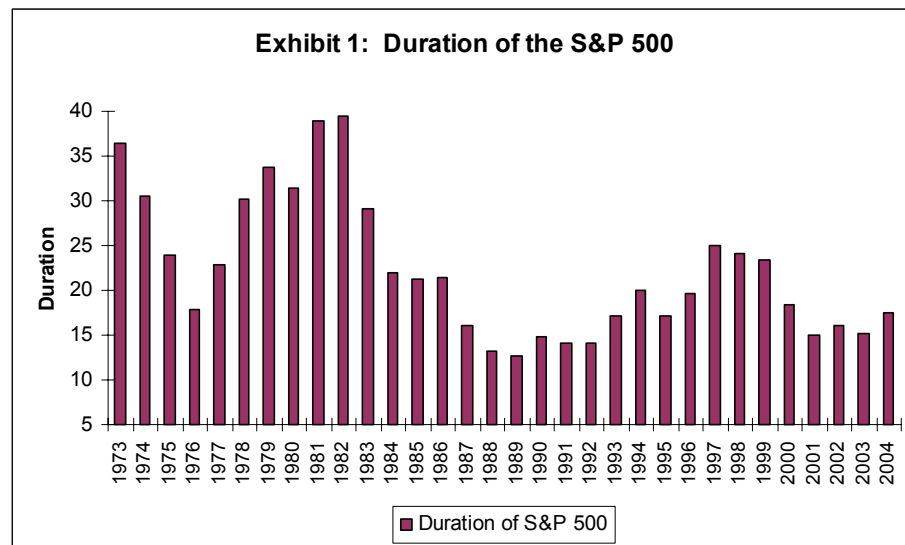
Source: Standard & Poor's. Estimates are for the middle of each calendar year.

We estimate the duration of the S&P 500 index to be 19 years at the end of third quarter of 2004. It has risen from its level of 15 years at the middle of 2003, suggesting that the market has become more rate-sensitive. However, duration of the index is still below the 22-23 years figure seen in 1999. This suggests that the market has become more rate sensitive, and the expected continuation of rate tightening will have a more adverse impact on equities than if it would have happened when duration was lower.

Our flow through duration estimate involves 10-year parameters and is inappropriate for short-term market timing. It is intended to suit the purposes of long-term asset allocation involving rebalancing every three years or more. This is consistent with asset allocation review cycles of most pension plans. Further, the trend should be considered as important as the point estimate. Therefore, in Appendix 1, we have added a three-year moving average column. In light of this, it would be inaccurate to interpret the estimate as "based on September 30, 2004 duration estimates, the S&P 500 would fall 19% for every 1% rise in rates." Rather, a more appropriate way of describing the estimate is that based on September 30, 2004 estimates, duration of the S&P 500 index is 19 years if it would have been a fixed income instrument discounted at it appropriate risk-adjusted rate, and therefore the market is more rate sensitive than it was over the previous three years. If one is looking for more direct metrics of interest rate versus equity returns, our latest empirical results based on regression of S&P 500 returns versus 10-year rates over the

previous 40 years suggests a sensitivity of 2.7, i.e., subject to model limitations, equity returns fall 2.7% for every 1% rise in the 10-year rate.[4]

Appendix 1: Annual Duration of S&P 500

	Duration of S&P 500	12 Quarter Moving Average of Duration
1973	36.4	
1974	30.6	
1975	23.9	
1976	17.8	26.0
1977	22.9	22.2
1978	30.2	22.7
1979	33.8	27.1
1980	31.5	30.8
1981	39.0	33.8
1982	39.5	36.2
1983	29.1	36.4
1984	21.9	32.4
1985	21.2	26.2
1986	21.4	22.5
1987	16.0	20.4
1988	13.3	17.9
1989	12.8	15.1
1990	14.9	13.7
1991	14.2	13.8
1992	14.2	14.2
1993	17.2	14.9
1994	19.9	16.3
1995	17.1	17.3
1996	19.6	18.2
1997	25.0	19.7
1998	24.2	21.9
1999	23.4	23.3
2000	18.5	22.5
2001	15.0	19.7
2002	16.0	16.9
2003	15.2	15.4
2004	17.5	15.8

Source: Standard & Poor's. Estimates are as of the middle of each year.

The duration estimate is obtained from the formula given in equation (4), with equity duration being equal to $-1/(k-g)$ $(1-\delta g/\delta k)$. We take quarterly dividend growth of the S&P 500 for g. For k, we choose to use the Moody's Baa yield series. We use averages for the past 40 quarters (10 years). For the $\delta g/\delta k$ term, we use the correlation of change in g to change in k for the previous 40 quarters.

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[4] Please refer to our previous paper on the limitations of the empirical estimate.