Equity duration: Why investors should think small
August 2010

Equity duration — the sensitivity of equity prices to interest rate changes — is notoriously difficult to measure. But getting it wrong can leave portfolios exposed to losses if rates move adversely. DB Advisors Pension & Portfolio Solutions Americas group explains why pension funds are better off taking a short view of equity duration.

Interest rates can have a strong influence on the prices of many financial assets. As a result, pension plan sponsors may seek to eliminate — or at least reduce — the interest rate exposure of their liabilities, often as part of a Liability Driven Investment (LDI) solution.

The sensitivity of the price of a financial asset to interest rate movements is measured by duration. To protect a portfolio from interest rate risk, therefore, plan sponsors will seek to match asset duration with the duration of liabilities — so that an increase in the value of liabilities due to a decrease in rates will be offset by a corresponding increase in asset values.

Plan sponsors implementing this approach must estimate duration accurately because a false calculation can result in a deterioration of funded status should interest rates move adversely. For liabilities and fixed income assets, the duration calculation is fairly straightforward. However, since pension portfolios typically contain a sizeable equity allocation, sponsors also need to estimate the interest rate sensitivity of equities — i.e., equity duration — which is much more challenging. In the academic literature, estimates for equity duration vary enormously: some researchers have given a figure of just two years, while others put it as high as 40 years.

With interest in LDI-type solutions growing as plan sponsors grapple with the challenge of generating sufficient asset returns to cover liabilities, it is a useful time to consider how best to treat equity duration.

Relevance to LDI solutions
An LDI solution involves identifying the risk factors associated with a pension fund’s liabilities and then designing an asset portfolio that hedges those risk factors. The liability risk factor that sponsors seek to hedge most commonly when structuring an LDI solution is interest rate risk. The hedge is typically accomplished by buying long-term government bonds and strips, long-term corporate bonds, bond futures and / or interest rate swaps.

Fixed income represents just 30% to 40% of a typical U.S. plan’s asset mix, with most of the remainder in equities. Calculating equity duration is therefore critical for understanding the overall interest rate sensitivity of a pension fund’s assets.

Since equity cash flows extend in perpetuity, it might seem reasonable to assume that discounting equity cash flows at the firm’s cost of capital would make their present value highly sensitive to changes in interest rates. Consequently, some researchers have estimated equity duration to be akin to that of very long-term bonds, ranging from 15 years to 40 years1. However, other research — based on the beta of equities vs.

---

1 Equity Duration – Updated Duration of the S&P 500, D. Blitzer, S. Dash. January 4, 2005
bonds — has estimated equity duration to be about 2.5 years to 3 years\(^2\). For this paper we calculated equity duration empirically. We found that it is:

- Small: approximately 1 year to 3 years
- Unreliable: there are other more dominant factors driving equity returns than interest rate changes
- Unstable — historical equity returns during periods of rising, declining and stable rate environments have been both largely positive and negative, depending on the period

The range of results generated by the different approaches highlights how, when structuring an LDI solution, the methodology and underlying assumptions used in estimating equity duration can result in substantially different portfolios.

**Differences between bond and equity duration**

Figure 1 shows how bond returns have changed over more than 30 years in response to changes in interest rates. This observation shows that there is an inverse and fairly direct relationship between rates and bond returns. The data points are not in a perfect line because the Barclay’s Aggregate Index (which we have used to represent bond returns) also includes constituents that are subject to other influences in addition to interest rates, such as high grade corporate bonds (which are influenced by credit spread changes) and mortgage securities (influenced by pre-payments, which result in negative convexity).

Absent these factors — which in any case only have a marginal impact — the return on bonds is entirely dependent on interest rates since the cash flows, i.e. the coupons and principal, and the maturity are known; and no exogenous factors can impact the bond’s price other than a change in rates (we should note that this assumes no call provisions, defaults and non-parallel shifts in rates). Mathematically, this makes things fairly straightforward: to derive a formula for bond duration, we take the bond’s price function and work out the first derivative with respect to interest rates (i.e., the slope of the price curve).

**Fig 1: Return of Barclay’s Aggregate Index vs. Percent Change in 10-year Rates (1976 - 2010)**

\[
y = -4.5183x + 0.0065
\]

Source: DB Advisors

Equity duration is more complicated. Figure 2, which shows how equity returns have changed with interest rates over the past 40 years, reveals why. The widely scattered data points indicate that the relationship between interest rate changes and equity returns is much less clear cut than the relationship between rate changes and bond returns.

**Fig 2: S&P return vs. % change in U.S. 10-year rates (1970 - 2010)**

\[ y = -2.2x + 0.0096 \]

*t-stat = -3.7; R^2 = 0.03.*

In contrast to bonds, equity prices are influenced by a range of factors. In a simple equity pricing model like the Dividend Discount Model, these factors may include interest rates, the equity risk premium and earnings growth.

The risk premium and growth vary over time and may be much stronger influences on equity prices than interest rate changes. Looking again at Figure 2, the slope of the regression line suggests an inverse relationship between equity returns and changes in interest rates. However, the R-squared is 0.03, which means that changes in rates explain only 3% of the variability of equity returns. In practical terms, this means that, when interest rates change in either direction, equity returns may go up, down, or remain the same. What is more, both the risk premium and growth are correlated with nominal rates. This introduces the problem of multicollinearity, which occurs when some or all of the explanatory variables in a regression are highly correlated. The effect of multicollinearity is that, while the model may be a good predictor overall, it is difficult to disentangle how each variable within the model is influencing the outcome.

**Equity duration in different interest rate environments**

Drilling down a bit deeper into the data, for this paper we examined the relationship between equity prices and interest rates in three different rate environments. We found that equity duration varies with the interest rate environment, as follows:

- Declining rate environment: equity duration = 2.4 years
- Rising rate environment: equity duration = 1.9 years
- Stable rate environment: equity duration = 1.0 year

Again, the equity durations in the different rate environments were not statistically different from zero. The R-squared values for these regressions were also very small, indicating that interest rates explain only a very small portion of variation in equity returns.
Summary & conclusions

Duration measures the interest rate sensitivity of an asset. It is most commonly applied to bonds to measure the bond’s price sensitivity to changes in interest rates. Since pension portfolios contain equities as well as bonds, equity duration must also be estimated when constructing a duration-matching portfolio.

Various methodologies have been used to measure the duration of equities. These have resulted in durations ranging from that of very long-term bonds (15 years to 40 years) to that of intermediate term bonds (2.5 years to 3 years). For this paper, we used nearly 40 years of equity and interest rate data to measure equity duration empirically in various interest rate and economic environments. We found equity duration to be small, but also unreliable and unstable.

Given this spurious relationship between changes in interest rates and equity returns, we would therefore advise that pension managers seeking liability driven investment solutions should use the more conservative estimates of equity duration when hedging liability interest rate risks such as duration and convexity.

DB Advisors is the brand name for the institutional asset management division of Deutsche Asset Management, the asset management arm of Deutsche Bank AG. In the US, Deutsche Asset Management relates to the asset management activities of Deutsche Bank Trust Company Americas, Deutsche Investment Management Americas Inc. and DWS Trust Company; in Canada, Deutsche Asset Management Canada Limited (Deutsche Asset Management Canada Limited is a wholly owned subsidiary of Deutsche Investment Management Americas Inc); in Germany and Luxembourg: DWS Investment GmbH, DWS Investment S.A., DWS Finanz-Service GmbH, Deutsche Asset Management Investmentgesellschaft mbH, and Deutsche Asset Management International GmbH; in Denmark, Finland, Iceland, Norway and Sweden, Deutsche Asset Management International GmbH; in Australia, Deutsche Asset Management (Australia) Limited (ABN 63 116 232 154); in Hong Kong, Deutsche Asset Management (Hong Kong) Limited; in Japan, Deutsche Asset Management Limited (Japan); in Singapore, Deutsche Asset Management (Asia) Limited (Company Reg. No. 198701485N) and in the United Kingdom, RREEF Limited, RREEF Global Advisers Limited, and Deutsche Asset Management (UK) Limited; in addition to other regional entities in the Deutsche Bank Group.

This material was prepared without regard to the specific objectives, financial situation or needs of any particular person who may receive it. It is intended for informational purposes only and it is not intended that it be relied on to make any investment decision. It does not constitute investment advice or a recommendation or an offer or solicitation and is not the basis for any contract to purchase or sell any security or other instrument, or for Deutsche Bank AG and its affiliates to enter into or arrange any type of transaction as a consequence of any information contained herein. Neither Deutsche Bank AG nor any of its affiliates, gives any warranty as to the accuracy, reliability or completeness of information which is contained in this document. Except insofar as liability under any statute cannot be excluded, no member of the Deutsche Bank Group, the Issuer or any officer, employee or associate of them accepts any liability (whether arising in contract, in tort or negligence or otherwise) for any error or omission in this document or for any resulting loss or damage whether direct, indirect, consequential or otherwise suffered by the recipient of this document or any other person.

The views expressed in this document constitute Deutsche Bank AG or its affiliates’ judgment at the time of issue and are subject to change. The value of shares/units and their derived income may fall as well as rise. Past performance or any prediction or forecast is not indicative of future results. This document is only for professional investors. No further distribution is allowed without prior written consent of the issuer.

Any forecasts provided herein are based upon our opinion of the market as at this date and are subject to change, dependent on future changes in the market. Any prediction, projection or forecast on the economy, stock market, bond market or the economic trends of the markets is not necessarily indicative of the future or likely performance. Investments are subject to risks, including possible loss of principal amount invested. Certain Deutsche Asset Management investment strategies may not be available in every region or country for legal or other reasons, and information about these strategies is not directed to those investors residing or located in any such region or country.

For investors in the United Kingdom:

Issued in the United Kingdom by Deutsche Asset Management (UK) Limited of One Appold Street, London, EC2A 2UU. Authorized and regulated by the Financial Services Authority. This document is a “non-retail communication” within the meaning of the FSA’s rules and is directed only at persons satisfying the FSA’s client categorization criteria for an eligible counterparty or a professional client. This document is not intended for and should not be relied upon by a retail client.

When making an investment decision, potential investors should rely solely on the final documentation relating to the investment or service and not the information contained herein. The investments or services mentioned herein may not be appropriate for all investors and before entering into any transaction you should take steps to ensure that you fully understand the transaction and have made an
independent assessment of the appropriateness of the transaction in the light of your own objectives and circumstances, including the possible risks and benefits of entering into such transaction. You should also consider seeking advice from your own advisers in making this assessment. If you decide to enter into a transaction with us you do so in reliance on your own judgment.

For investors in Australia:
In Australia, issued by Deutsche Asset Management (Australia) Limited (ABN 63 116 232 154), holder of an Australian Financial Services License. An investment with Deutsche Asset Management is not a deposit with or any other type of liability of Deutsche Bank AG ARBN 064 165 162, Deutsche Asset Management (Australia) Limited or any other member of the Deutsche Bank AG Group. The capital value of and performance of an investment with Deutsche Asset Management is not guaranteed by Deutsche Bank AG, Deutsche Asset Management (Australia) Limited or any other member of the Deutsche Bank Group. Investments are subject to investment risk, including possible delays in repayment and loss of income and principal invested.

For investors in Hong Kong:
Interests in the funds may not be offered or sold in Hong Kong or other jurisdictions, by means of an advertisement, invitation or any other document, other than to professional investors or in circumstances that do not constitute an offering to the public. This document is therefore, for the use of professional investors only and as such, is not approved under the Securities and Futures Ordinance (SFO) or the companies ordinance and shall not be distributed to non-professional investors in Hong Kong or to anyone in any other jurisdiction in which such distribution is not authorized. For the purposes of this statement, a professional investor is defined under the SFO.

For investors in MENA region:
This information has been provided to you by Deutsche Bank AG Dubai (DIFC) branch, an authorized firm regulated by the Dubai Financial Services Authority. It is solely directed at market counterparties or professional clients of Deutsche Bank AG Dubai (DIFC) branch, which meets the regulatory criteria as established by the Dubai Financial Services Authority and may not be delivered to or acted upon by any other person.

I-018530-1.0 (8/10)