# Appendix B

## Technical Discussion of Discounted Cash Flow And Risk Premium Models

### General Stock Price DCF Model

The DCF model is predicated on the concept that stock prices are the present value or discounted value of all future dividends that investors expect to receive. In the most general form, the DCF model is expressed in the following formula:

$$P_0 = D_1/(1+k) + D_2/(1+k)^2 + ... + D_\infty/(1+k)^\infty \qquad (1)$$

where $P_0$ is today's stock price; $D_1$, $D_2$, etc. are all future dividends and k is the discount rate, or the investor's required rate of return on equity. Equation (1) is a routine present value calculation based on the assumption that the stock's price is the present value of all dividends expected to be paid in the future.

### Constant Growth DCF Model

Under the additional assumption that dividends are expected to grow at a constant rate "g" and that k is strictly greater than g, equation (1) can be solved for k and rearranged into the simple form:

$$k = D_1/P_0 + g \qquad (2)$$

Equation (2) is the familiar constant growth DCF model for cost of equity estimation, where $D_1/P_0$ is the expected dividend yield and g is the long-term expected dividend growth rate.

### Multi-stage DCF Models

Under circumstances when growth rates are expected to fluctuate or when future growth rates are highly uncertain, the constant growth model may not give reliable results. Although the DCF model itself is still valid (equation 1 is mathematically correct), under such circumstances the simplified form of the model must be modified to capture market expectations accurately.

Over the past several years, events in the electric utility industry have challenged the constant growth assumption of the traditional DCF model. Since the mid-1980s, dividend growth expectations for many electric utilities have fluctuated widely. In fact, over one-third of the electric utilities in the U.S. reduced or eliminated their common dividends during this time period. Some of these companies have reestablished their dividends, producing exceptionally high growth rates. Under these circumstances, long-term growth rate estimates may be highly uncertain, and estimating a reliable "constant" growth rate for many companies is often difficult.

When growth expectations are uncertain, the more general version of the model represented in equation (1) should be solved explicitly over a finite "transition" period while uncertainty prevails. The constant growth version of the model can then be applied after the transition period, under the assumption that more stable conditions will prevail in the future. There are two alternatives for dealing with the nonconstant growth transition period.

**Terminal Price Multi-stage DCF Model**

Under the "terminal price" multi-stage growth approach, equation (1) is written in a slightly different form:

$$P_0 = D_1/(1+k) + D_2/(1+k)^2 + ... + P_T/(1+k)^T \qquad (3)$$

where the variables are the same as in equation (1) except that $P_T$ is the estimated stock price at the end of the transition period T. Under the assumption that normal growth resumes after the transition period, the price $P_T$ is then expected to be based on constant growth assumptions. With the terminal price approach, the estimated cost of equity, k, is just the rate of return that investors would expect to earn if they bought the stock at today's market price, held it and received dividends through the transition period (until period T), and then sold it for price $P_T$. In this approach, the analyst's task is to estimate the rate of return that investors expect to receive given the current level of market prices they are willing to pay.

**Generalized Multi-stage DCF Model**

Under the general "multistage" growth approach, equation (1) is simply expanded to incorporate two or more growth rate periods, with the assumption that a permanent constant growth rate can be estimated for some point in the future:

$$P_0 = D_0(1+g_1)/(1+k) + ... + D_2(1+g_2)^n/(1+k)^n + ... + [D_T(1+g_T)^{(T+1)}/(k-g_T)]/(1+k)^T \quad (4)$$

where the variables are the same as in equation (1), but $g_1$ represents the growth rate for the first period; $D_2$ is the dividend at the beginning of the second period and $g_2$ is the growth rate for the second period; and $D_T$ is the dividend at the beginning of the third period and $g_T$ for the period from year T (the end of the transition period) to infinity. The difficult task for analysts in the multistage approach is determining the various growth rates for each period.

Although less convenient for exposition purposes, the multi-stage models are based on the same valid capital market assumptions as the constant growth version. This approach simply requires more explicit data inputs and more work to solve for the discount rate, k. Fortunately, the required data are available from investment and economic forecasting services, and computer algorithms can easily produce the required solutions.

**Equity Risk Premium Models**

Equity risk premium models are based on the assumption that equity securities are riskier than debt and, therefore, that equity investors require a higher rate of return. This basic premise is well supported by legal and economic distinctions between debt and equity securities, and it is widely accepted as a fundamental capital market principle. For example, debt holders' claims to the earnings and assets of the borrower have priority over all claims of equity investors. The contractual interest on mortgage debt must be paid in full before any dividends can be paid to shareholders, and secured mortgage claims must be fully satisfied before any assets can be distributed to shareholders in bankruptcy. Also, the fixed-income nature of interest payments makes year-to-year returns from bonds typically more stable than capital gains and dividend payments on stocks. All these factors demonstrate the more risky position of stockholders and support the equity risk premium concept.

The risk premium approach is useful because it is founded on current market interest rates, which are directly observable. This feature assures that risk premium estimates of the cost of equity begin with a sound basis, which is tied directly to current market interest rates. However, in regulatory practice there is often considerable debate about how risk premium data should be used and interpreted. Since the basic task is to gauge investors' required returns on long-term investments, some argue that the estimated equity risk premiums should cover the longest possible time period. Others argue that market relationships between debt and equity from several decades ago are irrelevant and that only recent debt-equity return observations should be used in estimating investor requirements. There is no consensus on this issue. Since analysts cannot observe or measure investors' expectations directly, it is not possible to know exactly how such expectations are formed or, therefore, to know exactly what time period is most appropriate in a risk premium analysis.

The important point in the equity risk premium analysis is to answer the following question: "What rate of return should equity investors reasonably expect relative to returns that are currently available from long-term bonds?"

**Summary of DCF and Equity Risk Premium Approaches**

The DCF and equity risk premium models have become the most widely accepted in regulatory practice. The DCF model and a review of equity risk premium data generally provide a reasonable estimate of the cost of equity. While estimating the DCF growth rate is controversial, the dividend yield is straightforward, and the model's results generally comport with capital market behavior. The equity risk premium approach provides further confirmation. While its inputs and the interpretation of its results require informed judgment, under normal market conditions the risk premium approach is a useful addition to the overall analysis.