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The Cost-of-Capital and Fair Market Value Discount Rates

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Abstract

Estimation of the fair market value of specific oil and/or gas producing properties, using an income valuation, requires the use of a present value factor, or discount rate, that reduces future cash flows to a value commensurate with that which would be offered for the property in the marketplace. The fair market value discount rate can be derived from several sources. Empirical data from actual sales of properties and Cost-of-Capital data derived from financial markets are the most accurate and commonly used. Previous studies have focused on either the market sales sources or the cost-of-capital (financial markets approach). This paper will review the results of empirical data studies based on fair market sales of California and Texas oil properties and will combine that information with oil industries cost-of-capital analysis to examine the link between the two discount rate sources. This combined analysis shows that the apparent differences in results from the two sources are rational and can be bridged using recent work in Pure-Play analysis, Size Effect adjustments, and the Fama French adjustments to the Capital Asset Pricing Model, particularly when full consideration is given to the inherent risks associated with acquiring and operating oil producing properties. The result provides a further understanding of the link between the empirical sales data and more readily accessible financial market data.

Introduction

The Income Approach to Value. Oil and gas properties are acquired, owned, operated and developed for the stream of future income that can be derived from the production and sale of the oil and gas found on the property, not for their location or physical amenities. For that reason, the only functional method of valuing oil properties, and of evaluating investment options regarding such properties, is the income approach to value commonly known as the discounted cash flow. This method is particularly useful because, when properly constructed, the evaluator of a project or property can include within the calculation, or in multiple variations, virtually every definable physical, operational, and economic characteristic of the property. Each of the components of the cash flow result from a mix of the objective and subjective - a combination of measurable fact and judgement based on experience.

The Discount Rate. A primary component of any discounted cash flow is the discount rate used to reduce the future cash flow stream to a present value. Only when reduced to present value can the anticipated returns from an oil property be compared to: (a) the investment required to obtain that income stream, or (b) the returns from other investment options. The discount rate receives a considerable amount of attention in the evaluation process because of its important role in making correct investment decisions, but also because depending on the size of the future cash flow, the duration of that cash flow and the shape of the cash flow, the application of the discount rate can have a very significant influence on present value. This influence can, in some circumstances, overshadow many of the other components in the calculation. It is therefore important to select a discount rate with care.

There are a number of different kinds of discount rates depending on their application and on the common usage of the evaluation. Discount rates can be mere present worth factors whose only purpose is to reduce a future income stream to present value. In this form, they represent the time value of money and a measure of liquidity risk. When used in an SEC appraisal, discount rates represent nothing more than an accepted standard of comparison. When an evaluation is done to estimate fair market value, the discount rate must be representative of the return anticipated by buyers and sellers in the marketplace. Even within this narrow band, the discount rate can be an After Income Tax (AFIT) and/or a Before Income Tax (BFIT) rate. In either of these latter formats, the discount rate can be risk-inclusive or risk-adjusted. Risk inclusive rates would include some measure of the risk of the property, project, or income stream being valued. A risk-adjusted rate would be a discount rate which does not contain project/property specific risk; such risk would be taken into account in the cash flow projections. This is an important distinction that can and often does cause serious debate and confusion among evaluators.

For the purpose of the following discussion references to fair market value discount rates will mean BFIT risk-inclusive rates. The relation of these rates to AFIT and/or risk adjusted discount rates will also be discussed.

Sources of Discount Rates. There are four sources of discount rates for use in FMV evaluations. These are:

- Empirical Data: Actual Sales in the Marketplace.
- Financial Data: Cost-of-Capital
- Experience: Limited to Real Buyers and Sellers
- Common Sense: Comparison to Other Options

The Empirical Source. Discount rates from empirical data have been discussed in a number of SPE and other papers over the past several years. The primary sources of data of this type comes from sales documented in California and Texas as part of the ad valorem tax process. The California studies have been conducted since the early 1970's by a series of consulting firms retained by industry and, separately, by county tax assessors. The industry funded studies have been prepared by DeGolyer & MacNaughton (1970), H.J Gruy (1976), Babson & Shepard (1976-83), and Richard J. Miller & Associates, Inc. (1984 Present). While the individual studies can be debated, and certainly some studies are more thorough than others, the conclusions of the several studies are consistent, and, further, there seems to be no substantive, informed disagreement with those conclusions. Empirical data, taken from actual sales of oil properties beginning in the 1960's, consistently finds average BFIT risk-inclusive discount rates around 25% and a statistical range of 6-7 percentage points about the mean or a workable range of 18-32% for all classes of Proved reserves.

The most recently published California study' indicates that for 197 confirmed fair market value sales of specific properties occurring between 1983 and 1996 and totaling over $3.5 billion there is a mean discount rate of 23.8% and a median of 22.6% for properties with a range of Proved reserve classes and a standard deviation of only 6.6 percentage points from the mean (17.2-30.4%). These discount rates are calculated as the rate of return of the future cash flow on the acquisition investment. For those 81 sales which were of 100% Proved Developed Producing reserves, the mean and median discount rates are 21.4% and 21.5% respectively. These studies consistently show little or no relation between the discount rate and other factors such as date of sale, reserve volume, purchase price, price/cost projection or location. The studies do, however, suggest a relation between discount rate and the class of reserves with discount rate increasing from about 22% for 100% PDP properties to about 29% for 100% PUD properties.

The annual studies done by the Texas State Property Tax Board,[2] now part of the Comptroller's office, show similar results for Proved Developed Producing properties.

Empirical data is the best measure of the FMV discount rate just as actual sales of homes are the best measure of the residential real estate market. Unlike home sales, however, market sales data for oil properties is (a) difficult to obtain, and (b) difficult to evaluate unless there is a sufficiently large database. For most evaluators, a database of sales information is not available.

The Empirical data source is related to the Experience source since those who have engaged in the purchase and sale of properties will have some knowledge of the returns expected from acquisitions and sales. The problem with full reliance on experience is that it may derive from a narrow personal or corporate perspective which may or may not be similar to that of other individuals and companies in the marketplace. Empirical data should be a background against which experience can be compared and adjusted for application to the broader market.

The Financial Source. When empirical data is limited or lacking altogether, and experience is insufficient to define broad market expectations, the Financial source of data becomes useful. Unlike the empirical data, using financial data as a source for a FMV discount is indirect and requires adjustment to be fully applicable rate.

The Financial or Cost-of-Capital ("COC") approach provides a starting point for the development of BFIT Risk Inclusive discount rates and also provides a point of comparison to empirical data. The previously mentioned California and Texas studies include a cost-of-capital calculation along with the analysis of market sales. Indeed, the cost of capital analysis is the dominant part of the Texas study. In both these studies, the empirical results obtained from market sales are related to returns derived from cost-of-capital methods.

Many oil and gas companies routinely define a discount rate or range of discount rates for use in project evaluation and capital budgeting. This discount rate is a derivative of company policy and, as shown by Boyle and Schenck[3] and also by Dougherty and Sarkar,[4] is generally based on an estimate by management of the company's weighted average cost-of-capital. Finance-based discount rates are applied to the estimate of income from new projects, capital investments, and acquisitions/sales and are structured to allow comparison of those projects, etc. usually as part of the Net Present Value (NPV) method of capital budgeting. They are rarely, if ever, defined as FMV discount rates which can only be determined from actual sales.

According to financial theory,[5,6,7,8] a company or other investor should attempt to make investments of capital only in projects which will provide a rate-of-return at least equal to the cost of the capital, measured as required returns, used to make the investment. This is functionally known as a Minimum Required Return "hurdle" rate, or other term connoting a threshold rate. Campbell[9] refers to this as the Minimum Return Standard and notes, "Every project is compared against a threshold to determine if it meets corporate objectives. Companies arrive at threshold value differently and, regardless of the company, a certain arbitrariness occurs in defining the standard."

In practice, this MRR or MRS may exceed the actual cost-of-capital by a few percentage points in order to provide a margin of return over the minimum. For use in valuing the potential acquisition of a producing property, for example, the minimum return might be cost-of-capital plus 3-4%. The purchase price, however, may be based on other considerations of risk and, further, is the result of a negotiation with a seller which, if successful, may yield a total return of COC plus 5% or 6%, or greater. This latter is the market discount rate.

Components of Cost-of-Capital. The Cost-of-Capital can best be described as the price (in the form of a return) that must be paid (provided) to investors (in the company) in order to provide (and retain) the funds necessary for capital investment projects. Put another way, Cost-of-Capital is "...the expected rate of return that the market requires in order to attract funds to a particular investment."[10] The standard form of cost-of-capital has three basic components:

1. Capital Structure
2. Cost-of-Debt
3. Cost-of-Equity

Capital Structure. The Capital Structure is the mix of debt and equity used by the corporation to finance on-going operations including capital investments. The structure varies from company to company based on individual corporate financing policy. The typical capital structure for oil and gas companies can be shown to consist of about 30% debt and 70% equity. The capital structure of a company or industry may vary with time as a function of changing tax laws, corporate requirements, interest rates, and/or temporary imbalances due to leveraged buy-outs, etc. The maintenance of a balance equity is an important part of financial management in companies of all sizes. For cost-of-capital purposes, the capital structure is based on market values rather than book values so wide variations in equity values (stock prices) can have temporary effects of the relative proportion of debt and equity. At year-end 1996, a sample group of 40 public oil and gas companies had an average 22% debt and 78% equity. At year-end 1998, the 30%/70% relation has generally been restored

Cost-of-Debt. The debt component consists of (a) public and private instruments issued by the corporation, such as bonds and notes, and (b) borrowings from banks, insurance companies, and other institutions. Each debt instrument or borrowing is subject to specific terms and conditions not least of which is the interest rate to be paid to the holder of the debt. Interest payments are deductible for income tax purposes which provides some incentive for borrowing. Debt is also either secured or has a priority claim on revenue which acts to limit the amount of debt in the capital structure. The cost-of-debt is the return demanded by the holders of the company's bonds and the interest rates on outstanding loans. The overall cost of debt for a company is calculated as a weighted average of the interest rates and yield to maturity (YTM) on each debt instrument weighted by the dollar(US) amount outstanding.

Cost of Equity. The equity component is commonly defined as the total value of common and preferred stock of the company as measured by the market value of the outstanding shares of the company on the date of evaluation. It should be noted that some evaluators include Preferred Stock as debt rather than equity, however, it is usually immaterial. Retained Earnings are also equity since they are the property of the common shareholders. Retained earnings of the corporation are invested by company management on behalf of the shareholders for the purpose of increasing shareholder wealth.

The perception by stockholders of the trend of growth or decline in earnings and/or the wisdom of the investment of retained earnings forms at least part of the rationale for bidding up or selling down the company stock price. In that sense, the disposition of retained earnings is directly related to the variation in value of the equity component of cost-of-capital. The cost-of-equity is the return-on-equity, consisting of dividend payments and capital appreciation, required by stockholders. Return on equity is provided by management to stockholders by endeavoring to ensure a high percentage of income for every dollar invested.

Calculation of the Cost-of-Capital

The procedure for calculation of the cost-of-capital is the subject of every financial management text.[11,12,13,14] The common approach is known as the weighted average cost-of-capital (WACC) where:

WACC = (COD x %Debt) + (COE x %Equity)...............(1)

In this calculation, the %Debt and %Equity are calculated as a share of the total capital which is total outstanding debt plus the market value of the outstanding equity on the date of evaluation. For example; assume Giant Oil Company has $100 million in corporate bonds, $30 million in bank debt, and 10 million common shares outstanding at $30 per share on December 31, 1998 would have total capital of $430 million. The capital structure would be 30% debt and 70% equity.

The Cost-of-Debt (COD) is calculated as a weighted average of the individual bond issues and the institutional debt. For bond debt the yield-to-maturity (YTM) is used. YTM is published in the newspaper for publicly traded tradable bonds but it can also be calculated if necessary. Institutional debt is the interest rate which is often defined by the bank or other note holder as a function of prime rate or LIBOR. Assume that in our example that the bonds of Giant Oil Co. have a YTM of 9.5% and the bank debt has an interest rate of 10%. The cost-of-debt would then be 9.615%.

The Cost-of-Equity (COE) is more difficult to determine than the Cost-of-Debt but the use of the correct procedures and data sources can provide consistent and useful results. The primary method for estimating cost-of-equity is the Capital Asset Pricing Model or CAPM.

Capital Asset Pricing Model. Like the WACC, the CAPM is discussed at length in numerous financial and appraisal texts which are included herein as references.[15,16,17,18] to The CAPM is a simple but powerful forward-looking model which attempts to estimate the future cost-of-equity that should apply to a company or industry when systemic risk factors are considered. In construction it is nothing more than the equation of a straight line which relates expected return to the risk inherent in an individual stock or group of stocks:

$$R_t = R_f, + (R_m - R_f) \quad \text{..........(2)}$$

where total return (R_f)equals a risk-free return (R_f) plus an adjustment for the risk associated with an equity investment where R_m is the return on the market and (R_m - R_f) is the equity risk premium. The equity risk element is further enhanced by including a factor to account for the difference in volatility between an individual stock or an industry group and the market as a whole. In this usage the model is written:

$$R_t = R_f, + (R_m - R_f)\,\beta \quad \text{..........(3)}$$

where ß is the "Beta" factor of the stock and measures the volatility of a stock, or group of stocks, relative to the market as a whole.

In using this model the risk-free rate (R_f)can be obtained from expected returns (YTM) on Treasury bills and bonds. For short-term analysis the T-bill rate is generally used with sufficient notice taken of its volatility from time to time. For use in valuing oil properties a risk-free rate more equivalent to the term of the risk is appropriate, therefore, the 20-year Treasury bond rate is more useful. Treasure bond and bill rates are published daily. The market equity risk premium R_m is obtained from market analysis which relates the return from equities in general to the returns from the risk-free investment.

Beta. Beta is based on historical performance data for each equity issue in the market. The Beta for the individual stock or industry group can be determined from published data compiled by S&P and various investor services such as Value Line.[19] Data regarding the equity risk premia are published by Ibbotson[20] and others.

The CAPM was originally developed for use in equity analysis, but it can be used to evaluate the return on any asset for which the requisite data can be developed. There has been considerable discussion of the application of CAPM to estimate returns for real estate. Oil and gas properties are real estate, so CAPM could be used to estimate the required return on the acquisitions of oil producing properties if there were a sufficiently large database of sales information and a reliable reference market - such as the New York Stock Exchange or the S&P 500. Such an application awaits only the development of the data and someone with enough initiative to do the analysis.

Limitations of the Cost-of-Capital

The cost-of-capital can be used as the baseline from which to build a property/project specific discount rate. Because of its source in the returns from publically traded debt and equity and the form of calculation, particularly of the cost of equity component, the WACC is deficient in several elements which are necessary before application can be made to a specific property. These deficient areas include but are not limited to:

- Liquidity
- Return-of-Capital
- Risk

Liquidity. Liquidity is an important difference between COC and specific property returns. COC is derived from the stocks and bonds of publically traded companies where the cost-of-debt and cost-of-equity are the returns that are expected by investors in that debt and/or equity. These debt and equity securities are highly liquid; they can be bought and sold almost instantaneously. The same cannot be said of individual properties or projects; they cannot be sold or acquired quickly. Nor can the returns based on the income streams from those properties be changed quickly. This illiquidity requires a premium on the cost-of-capital if it is to be used to value properties.

Return on Capital. The Cost-of-Capital represents only a return-on-investment. The COC assumes that the original investment is recovered when the debt or equity interest is sold. This is termed return-of-capital. In contrast, individual oil and gas properties and projects are generally produced to depletion. There is no remaining asset value from which to recover the original investment. Therefore, the income stream must provide both a return-on-investment and a return-of- investment, the combination of which would necessarily be greater than the COC return.

Risk. Risk is a very broad consideration but can be narrowed into reasonable categories. The largest difference in risk between corporate cost-of-capital and the returns from investments in individual projects or properties is diversification. A company which owns a number of properties can expect an income stream from each, whereas a single property provides only one income stream. There is greater risk of loss in the single income stream than in the multiple streams where a failure of one stream has a limited effect which may be offset by an increase in another income stream. The income stream from a particular property may have greater or lesser risk than the other income streams in the portfolio as the result of any number of engineering, geologic, operational, or economic factors.

The return from a specific property must exceed COC to account for Liquidity, Return-of-Capital, and Risk in all its forms. The difference can be significant.

Fair Market Value Discount Rates

Estimation of the FMV of a property or project requires a discount rate which is representative of the return that an investor in that property would require to make the investment. Investors always have options and the property return must be sufficient to justify investing in that property and not in some other option.

Measuring the Difference. As noted above, empirical data[21] from FMV property acquisitions consistently indicates that, depending on the source, BFIT risk-inclusive discount rates are about 21.4% for specific properties with 100% PDP reserves. Since these properties would be expected to have the lowest risk, at least in comparison to less developed properties, the empirical rate for PDP properties would seem to be a good point from which to measure the difference in Risk and other factors between empirical data and COC data. The average for all Proved reserve properties is 23.8% indicating somewhat greater risk.

In contrast, the WACC for a sample group of oil and gas companies over the period from 1990 through 1996 is about 16% BFIT or about 5.4% percentage points less than the empirical data.[22] Obviously a direct use of the WACC would not produce a return commensurate with the property risk. The observation of this difference then begs the question of how to reconcile the difference between the expected returns from the acquisitions of producing property and the return to corporation as measured by the cost-of-capital of that company or for companies in an industry. The connection between the two returns should be not only apparent but measurable.

1. Corporate investors use cost-of-capital as a basis for capital budgeting and investment decision-making. Presumably individuals do the same.
2. The cost-of-capital often serves as the basis for the Minimum Required Return.
3. Presumably corporations and individuals follow the financial model to attempt to obtain a return on their investment in excess of the cost-of-capital used to make the investment.
4. If a corporation uses the cost-of-capital as an MRR, then presumably the maximum price that would be paid for a property is the price that would yield a return equal to the MRR.
5. Presumably the investor, be it corporation or individual, can reasonably estimate the risk in the property and translate that risk into a required increment of return - if not absolutely, at least relatively. By the same process, the investor should be able to assess a required return for liquidity and return of investment.
6. It follows then that the investor would or should attempt to negotiate a purchase price that provides a return based on the investor's expectation for future income from the property sufficient to compensate for his cost-of-capital, property risk, liquidity, and return of investment.
7. Based on the empirical data available, most fair market value property acquisitions appear to achieve that goal.

Adjusting the Cost-of-Capital. It is difficult to separate the FMV discount rate premium into discrete factors for Return-of--Investment, Risk, and Liquidity. It is very likely that there is no specific adjustment made by an investor. The empirical data is far too limited both in breadth and depth to allow detailed dissection even if that were possible. However, the knowledge that the differences exist is a sufficient starting point for further analysis.

As shown below, the empirical returns for PDP properties, aggregated on an annual basis, consistently show a margin of several percentage points over BFIT WACC for the same year. This result indicates that the COC is being covered by the expected returns from acquisitions.

Size-Decile Portfolios of the NYSE

Decile	Recent Market Capitalization, M$	Arithmetic Mean Return,
1. Largest	$5,329,014,202	11.98
2.	1,113,737,447	13.69
3.	570,342,252	14.29
4.	332,180,564	15.00
5.	208,397,662	15.75
6.	148,168,080	15.82
7.	101,028,590	16.39
8.	63,084,869	17.46
9.	39,011,173	18.21
10. Smallest	12,720,499	21.83
Mid-Cap 3-5	1,110,920,064	14.76
Low-Cap 6-8	312,281,487	16.33
Micro-Cap 9-10	51,731,657	19.17

Return-of-Investment. As noted above, returns calculated from actual sales are total returns which include return of and on investment while COC returns are return of investment only. It should be possible to measure this difference.

Surveys of oil and gas companies, and a review of acquisition evaluations, suggest that Payout remains a useful, if subordinate, investment criteria. The Payout approach simply determines the time required to recover the original investment from the anticipated cash flow of the project or property. Payout provides for the return-of-investment by estimating the time necessary to accumulate the original investment from cash flow. *All* income received after Payout contributes a return-oninvestment. In common industry practice, Payout is calculated as the accumulation of all cash flow from the start of receipt of income until the original investment is recovered. Depending on economic and other conditions, an acceptable Payout might be 3 to 5 years. The shorter the better. If the Payout were 5 years, then one could infer an average annual return-of-investment of 20% for those five years.

In real estate evaluation, property acquisitions are commonly mortgaged for a term which may approach the useful life of the property. If an oil property with an expected life of 25 years is acquired, the same approach could be used to estimate return-on-investment. If Payout is calculated as a percentage share of total expected cash flow over the life of the property, then some measure of return-of-investment is obtained. Over a 25 year life, the average annual return is 4%, rather than 20%, but Payout or return-of-investment is achieved.

This is a very simple approach. There are relatively complex calculation methods in real estate appraisal which can be used to calculate the return-of-investment by treating it as payment of mortgage principal. Even using our simple approach we would say that part of the difference between the COC and market discount rates is the return-of-investment equivalent to scheduling Payout over the economic life rather than the first

Specific Property Risk. Industry surveys and the empirical data suggests a strong relation between reserves risk, measured as the percentage of Proved Developed Producing reserves in the total reserves acquired and the FMV discount rate where the risk represented by undeveloped reserves requires a higher discount rate than does PDP reserves. Since, according to the annual SPEE surveys, even PDP reserves require a risk premium, the increase over the PDP discount rate is a measure of property risk.

Liquidity. The compensation for liquidity is difficult to separate from the other factors, and there is no simple measure provided by the empirical data.

Pure-Play Analysis

Another approach to evaluating the difference between the Cost-of-Capital discount rate and the empirical results obtained from market sales is to consider discount rates derived from a so called Pure-Play analysis. This is an adaptation of a methodology commonly used in business valuation. The theory is that the discount rate for producing properties can be approximated by determining the cost-of-capital for companies whose business income is entirely, or in large part, from production. If a sample group of publically-traded companies whose business is 100% oil and gas production with no downstream business is assembled, the cost-of-capital for those companies could be used as an estimate, not a surrogate, for specific property discount rates.

In 1997, Ibbotson Associates[23] completed a study for the Western States Petroleum Association entitled, "WACC for Pure-Play Oil and Gas Extraction and Refining Entities." In that study, Ibbotson estimated the cost-of-capital for companies whose business was (a) 100% production or (b) 100% refining. The COC was calculated using a standard WACC approach where the cost-of-equity was derived using CAPM.

Ibbotson used Standard Industrial Classification (SIC) codes to focus on two industries: SIC 1311 (Crude Petroleum and Natural Gas) and SIC 2911 (Petroleum Refining) and then determined the number of companies within each industry which had at least some participation in that industry. Starting with the CAPM calculation, pure-play betas were derived from the betas of publically traded companies based on the degree to sectional regression was used to relate the percentage of each company's participation in Production or Refining to the beta for those companies. The result is an estimate of a beta of 0.63 for companies which are 100% in crude oil and natural gas production, and a beta of 0.73 for companies whose business activity is 100% petroleum refining.

These estimated pure-play betas are then used to calculate a cost-of-equity using CAPM for each pure-play entity. The cost-of-equity is then combined with the cost-of-debt and a typical capital structure to calculate an AFIT weighted average cost-of-capital of 9.51 % for a hypothetical pure-play producing company and 10.87% for a pure-play refining company. After adjusting for liquidity using standard business valuation methods and adjusting for Income Tax, the Ibbotson analysis obtains a Before Tax WACC of 20.15% for Pure-Play producing companies and 23.04% for pure-play refining companies.

These are useful results. The pure-play producing company result of 20.15% BFIT suggests that, when liquidity is taken into account, a company which receives all of its business income from oil and gas production has an effective discount rate of 20.15%. This is quite close to the results achieved from the empirical data. The Ibbotson result is also close to the results reported by the annual SPEE[24] survey of producers and others. In that survey, respondents provide, among other data, their minimum return requirements for investment. This is not limited to acquisitions but provides a benchmark nonetheless.

But publically-traded companies are not individual, specific properties. Even pure-play companies have multiple income streams. As noted, the Ibbotson analysis took account of the liquidity issue, but two others, Risk and Return-of-Capital, remain. In regard to Risk, Ibbotson cautions that the pure-play rates only apply to "...expected future cash flows which ... have been calculated taking all sources of risk into account through probability-weighing." That is, Ibbotson assumes that the pure-play discount rates will be applied to risk adjusted cash flows so the pure-play rates are comparable to risk-adjusted discount rates, not the risk-inclusive rates which make up most of the empirical data.

Further, discount rates estimated from cost-of-capital, whether pure-play or otherwise, assume that the invested capital is recovered when the investment is sold or redeemed. This does not occur with depleting assets such as oil producing properties. Therefore, as discussed above, an additional increment must still be added for return-of-investment.

Small Capitalization Stocks : Size v. Return

Another approach to reconciling cost-of-capital with discount rates from market sales is to consider the relation of the company's total equity capitalization (market share price times number of shares) to the equity return expected and received. Work by Ibbotson,[25] Grabowski,[26] and others[27] has shown a decided relationship between company size, as measured by market capitalization, and equity returns. This relationship is known as the Size Effect.

Work on the Size Effect indicates that observed market equity returns increase as the market capitalization decreases. That is, small capitalization companies, which are presumed to have higher risk, are expected to have higher returns than the Exxon's, Mobil's, and GE's of the world. This size relation results from a mass of statistical work that is referenced but not discussed here. However, the Size Effect is interesting particularly when combined with the pure-play results. Ibbotson reports the Size Effect in deciles of NYSE listed companies and presents a table and graph of equity return vs. capitalization which shows a range of returns from 11.98% for the largest capitalization group increasing to 21.83% for the smallest.

This result can be refined even further by using the work done by Grabowski, et al, where the market capitalization was divided into 25 categories with related returns. Using this data set, the smallest actual property sale would have a return-on-equity of 11.49% while the largest would be 23.47%.

The arithmetic average of the acquisition price of all the sales in the California empirical database is $17.1 million. If translated to market capitalization, this would be in the lowest decile of NYSE companies and, based on Size Effect adjustments, would have a discount rate of about 21.8%.

Use of either the Ibbotson or Grabowski data results in a cost-of-capital discount rate that has taken into account some of the risk component so that a discount rate derived from cost-of-capital and adjusted for Size Effect could be a useful starting point for valuation. However, a Size Effect adjusted COC discount rate must still be adjusted for Return-of-Investment and for liquidity. The Return-of-Investment adjustment can be borrowed from above, and the Liquidity adjustment can be borrowed from the Ibbotson pure-play treatment to give a composite COC discount rate. There is a real question, however, whether these adjustments are additive or are compounded.

Fama-French (Three-Factor) Model

Exploring further into the cost-of-capital is helpful in rationalizing the differences between cost-of-capital rates and empirical data. A primary component of the cost-of-capital is cost-of-equity, and the primary method of estimating COE is the CAPM. In recent years, work at University of Chicago Center for Research in Security Prices and other academic centers has resulted in an alternative or expanded model known as the Three-Factor or Fama-French Model after its principal authors. While suggested by some as a replacement of CAPM, the ThreeFactor model is really an expansion that builds on the basic CAPM by introducing two additional components. Note: As the authoritative reverences on this work would fill several pages, only the more influential are referenced here. [28, 29, 30, 31, 32]

The two new factors are intended to account for variances in CAPM which are not thought to be captured by the CAPM beta. One of these is the Big vs. Small factor which is a size factor similar to, but not the same as, the Size Effect discussed above. The second is a Book vs. Market factor which is intended to account for the relative difference between the Book Value and the Market Value of a company.

Rather than a simple straight line equation, the FamaFrench Model is a polynomial equation that describes a straight line.

$$R_t = R_f+(b_i * ERP) + (S_i* SMBP) + (h_i * HMLP) \text{..............} (4)$$

School is still out on the Fama-French model. CAPM has a 30-year history of usage, and it remains to be seen if Fama-French will hold up as long. If Fama-French is a more comprehensive model for estimating cost of equity, then using it to calculate COC may help to resolve some of the difference between market sales returns and COC. The Fama-French factors are based on SIC codes and are not currently available for individual companies. When the Fama-French factors are used for SIC 1311 for oil and gas producers, the result is a cost-of-equity that is 3-4% above the standard CAPM which increases COC by 2-3% BFIT. The effect of the Fama-French model expansion of CAPM is at the margin of the Cost-of-Capital from 16% to 18-19%.

If Fama-French is used in place of the traditional or Size Effect adjusted cost-of-capital, there must still be a correction for return-of-investment, liquidity, and the balance of property specific risk.

After-Tax Cost-of-Capital

The standard calculation of WAAC results in an AFIT (after-tax) value. The cost-of-equity, whether derived from CAPM or another model, is an after-tax rate. The cost-of-debt is a pretax rate which is converted to after tax by multiplying by (1-T) where T. is the composite state-Federal tax rate. Most valuations done by companies for investment purposes are done on an after-tax basis, and, therefore, the after-tax COC is appropriate. AFIT discount rates can be compared to AFIT market derived rates. But there are many uses for the BFIT COC including use as a baseline for FMV discount rates. There are many applications for BFIT discount rates including but not limited to financing, property tax, regulatory reporting and estate Tax valuation. In these uses and other applications a BFIT discount rate removes the variations in return that would occur between Company A and Company B due to their different income tax structures. The simple approach to converting an AFIT WACC to a BFIT WACC is to re-order the equation and divide the cost-of-equity by $(1\text{-}T_c)$.

The Role of Common Sense

There is a role for common sense in this process despite, or along with, all the market sales and cost-of-capital analysis. When all is said and done, the discount rates which are applied to FMV appraisals of oil properties must meet the common sense test. *Does this discount rate make sense given everything I know about the property, cost-of-capital, etc.?* This test is called Opportunity Cost which is defined as the rate an investor could receive from an alternative investment with similar or lesser risk. One useful Opportunity Cost is the return-on-equity received from oil company stocks over a reasonable time period. Another would be the return on a basket of equities such as the S & P 500 or similar index. As an example, return on equity for the 10 largest oil companies from 1990-1996 averaged about 17% AFIT. Common sense would require you to answer the following question: If an investor could obtain a 17% AFIT return-on-equity in oil company stocks, why would he or she invest in a single property with a single income stream and expect to receive a lesser return?

Conclusion

1. The corporate cost-of-capital, calculated as a weighted average of typical debt and equity, can be used as a starting point for the development of a market value discount rate when empirical data are not available or are inconclusive.
2. The cost-of-capital often serves as a minimum required return for evaluating properties and projects.
3. The weighted average cost-of-capital is derived from returns expected on highly liquid stocks and bonds issued by publically traded corporations. Individual oil producing properties are difficult to sell or buy and rely on a single income stream.
4. The WACC discount rate must be adjusted to account for (a) liquidity, (b) return-of-investment, and (c) property specific risk. Empirical data consistently shows a difference of several percentage points between WACC and discount rates derived from actual sales.
5. Some of the difference between WACC and sales derived discount rate can be bridged through the use of pure-play analysis and by the expansion of the WACC calculation to account for Size Effect and/or the use of a Fama-French model in place of CAPM.
6. Return-of-investment can be evaluated for actual sales by considering Payout to occur over the remaining economic life of the property or project being evaluated. Such full-life Payouts (return-of-investment) can be used to augment the WACC derived discount rate.

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