Valuing Oil & Gas Properties as (if they were) Closely Held Corporations

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<u>Introduction</u>

The appraisal of oil and gas mineral interests is a specialty that is comprised of about 75% engineering knowledge and experience, 20% business valuation expertise and 5% prophecy. Within the working petroleum industry, there is little real appraisal knowledge and even less use of many of the real estate and business valuations methodologies with which real estate appraisers are familiar. The emphasis is on the engineering portion of the evaluation and, while some economic conditions are considered and applied, economic parameters are usually decisions based on company policy or client requirements rather than true market data.

Because of the nature of oil and gas (hereafter "*oil*" will be used to include oil and gas except where gas is explicitly mentioned) there is only one useful and reliable method of appraisal - the Income Approach. This methodology has been in use in the oil industry virtually since inception and continues to be the only method used to value oil property for sale/acquisition, financing, regulatory filings and all manner of taxes, including estate and ad valorem tax.

One of the major problems faced by oil property appraisers is the definition and selection of an appropriate market rate for use in discounted cash flow calculations. There are few market sales of oil and gas properties that occur in a given period of time, particularly compared to the large number of properties in production. This small number of sales limits the availability of market discount rate information. With the exception of one or two annual studies of market sales, discount rate and other market data are in short supply.

This leaves only financial market data, in the form of Cost-of-Capital estimates for public companies, as a source of discount rate information. Cost-of-Capital ("COC") data are more readily available than market data and can serve as a useful starting point in defining a discount rate for valuing an oil property. However, observation of both data sources over nearly 20 years strongly indicates that, when market derived data are available, discount rates for specific property transactions consistently exceed representative COC data for the same period of time. Recognizing that there is a difference between market derived specific property rates and COC rates, there have been a number of attempts by analysts and evaluators to bridge the difference and, more importantly, define a methodology for adjusting calculated COC rates for use as discount rates to be applied to specific oil property cash flows. The most useful of these efforts have relied on Business Valuation methods to account for issues such as Return-of-Investment, Liquidity, Portfolio Diversification and Property Risk. Some advances have been made, but not enough. We need to obtain some ideas from Business Valuation appraisers about how to further fill in the gap.

Oil Property Valuation

Oil and gas producing properties, while not necessarily unique appraisal opportunities, are nonetheless distinct from most other types of properties. Many characteristics contribute to the difficulty of appraising oil properties, but two in particular stand out. First, the source of production from an oil property cannot be directly accessed or measured. It is literally buried in rocks thousands of feet below the surface of the earth. The only way to obtain production is by drilling wells into an oil reservoir, which will provide only a minute sample of the rock and of the hydrocarbons in place. While a large number of wells may be drilled, the wellbores can still only contact an infinitesimal percentage of the reservoir. Most of the direct information about the reservoir is gained by inference from these pinpoint samples, and all decisions made regarding current investment and future income is derived from interpretation of the inferential data. In many instances, the dimensions of a reservoir cannot be defined with certainty, and the estimated volume of oil and/or gas that could be produced is often a wide range of values depending on how the data is evaluated. This necessarily introduces an element of risk into oil property ownership, operation and appraisal.

Second, oil properties are finite sources that deplete over time. Once production from a property begins, the rate of production will start to decline until production eventually stops. While this decline or depletion can be, and often is, arrested and/or even reversed for a period of time by drilling more wells, starting injection operations, applying new recovery technology or changing economics, the energy available to cause oil and/or gas to come out of the rock and flow into a well declines with time and accumulated production until it is no longer sufficient to support economic recovery. At that point, production and profitable income stops.

Methods of Valuation

Before continuing, it may be useful to briefly review the nature of oil property appraisal and how oil property valuation is related to the three standard methods of appraisal commonly used by real estate and business valuation appraisers.

Oil and gas appraisal borrows many concepts and procedures from real estate. Oil and gas property evaluation developed separately and can stand alone without reference to real estate practice. It is only when we move from evaluation to formal appraisal that we have to consult the real estate world. For those of us in oil property appraisal, the concepts common to real estate are an exotic terrane stuck on the continental plate of oil and gas evaluation.

"*Appraisers estimate property value with specific appraisal procedures which reflect three distinct methods of data analysis - cost, sales comparison, and income capitalization. One or more of these approaches are used in all estimations of value; the approaches employed depend on the type of property, the use of the appraisal, and the quality and quantity of the data available for analysis*."[1]

[1] "*The Appraisal of Real Estate,*" Eleventh Edition, 1996, Appraisal Institute, Chicago, IL, pg. 90

Substitute "*evaluator*" for "*appraiser*," and the above applies to all who try to estimate the value of oil and gas properties. Many appraisers and most people working in the industry use the *Income Approach* virtually to the exclusion of the other two methods. There are good reasons for that situation. However, as professional appraisers we should at least consider all three methods. For appraisers certified by peer groups, such as American Society of Appraisers (ASA) and Appraisal Institute (AI), it is required. It is also required by Uniform Standards of Professional Appraisal Practice ("USPAP").

Appraisers consider all three methods for two reasons. First, the type of property and data available may not be amenable to evaluation using just one method. As an example, consider a 10-year old apartment building:

- An estimate of value could be based on the cost of reproducing or replacing the structure.

- An estimate could be based on obtaining data from recent sales of similar apartment buildings, making adjustments and applying that value to the subject property.

- An estimate of value could be based on the expected income to be earned from continued operation of the property.

Second, using more than one method may account for characteristics and value considerations that might be missed using only one method.

Assuming that values have been determined by each of the three methods, the evaluator must then reconcile the values to obtain "*...a dollar figure indication or a range into which the value will most likely fall...*" [2] Further, "*The relative dependability and applicability of each approach are considered in reconciling the value indications into a final estimate of defined value.*" [3]

The Cost Approach

The *Cost Approach* is a commonly used method of valuing many types of properties. The method assumes a relation between cost and value. "*In the cost approach to value, the cost to develop a property is compared with the value of the existing property or a similarly developed property.*" [4] Further, the method works on the *Principle of Substitution* in assuming that "*...no prudent buyer would pay more for a building or other property than it would cost to buy a similar*

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[2] Ibid, pg. 92

[3] Ibid, pg. 92-93

[4] "*The Appraisal of Real Estate,*" Tenth Edition, 1992, Appraisal Institute, Chicago, IL, pg. 313

site and construct improvements of equal desirability and utility without undue delay." [5] The appraiser estimates the cost to *Reproduce or Replace* the existing structure and then deducts all accrued depreciation in the property being appraised from the estimated costs as of the appraisal date.

This sounds relatively straightforward. Using the apartment building example, assume there are no sales of comparable properties that can be used to estimate value. The appraiser gathers the data necessary to estimate the cost of a new apartment building and then depreciates the value of the new building to the age of the existing building. Cost of construction less depreciation equals value. The extensive use of the Cost Approach in real estate appraisal has caused very clear procedures to be developed for stepping right through the calculation. There are even published tables that provide data on the relative obsolescence or "Percent Good" of the individual components of the structure. Unfortunately, there are no Percent Good tables for doing a Cost Approach appraisal for an oil property.

The Cost Approach and Oil Properties

The application of the Cost Approach to oil properties is best shown by example. Imagine that a gentleman places two advertisements in the real estate section the local newspaper.

Advertisement #1. *For Sale. New 100,000 sq. ft. commercial structure. Freeway access, zoned C-1, loading docks, partition to suit buyer. For sale at cost of construction - $5 million.*

The structure may well be valued at $5 million, if that is the cost of constructing a similar building. You can either buy it or build your own for the same cost. Here, the Cost Approach works reasonably well. Value appears to be related to cost.

Advertisement #2. *For Sale. Three new 10,000 ft. wells. Drilled for oil using latest technology. Fully cased. Pumps installed. New tanks and shipping unit. No oil. No gas. No log response. Sidewall cores contain excellent shows of basalt. Cost to drill and equip - $5 million.*

Mineral properties are not valued by the Cost Approach because they fail the basic assumption of the method - that cost of construction is related to value. The value of a developed oil property has little to do with the cost of that development (construction). The oil business does not work on an "*If you drill it, oil will come*" theory. If a well is drilled on a 40-acre lease for $1 million, there is no relationship between the $1 million and the value of the property after drilling. If the well is dry, there is no value aside from salvageable pipe and whatever geologic information was obtained. Drilling another well for $1 million in that location or a similar location may or may not have value. On the other hand, if that well had been drilled into the Woodbine formation of East Texas 60 years ago, it might still be producing and would have returned the cost of the well 100 times over. More likely, the property being valued would be somewhere in between, subject to the vagaries of geology, reservoir mechanics, the price of oil and all the other factors that affect value.

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[5] Ibid, pg. 313

The Cost Approach is not applied to land. Land is valued separately. It is generally accepted that you cannot reproduce or replace land. You can do a lot of things to land, but it is always there. Minerals are like land. They can be used up, frittered away or retained, but they cannot be Replaced except very, very slowly. Nor can they be Reproduced. There is only one Elk Hills field, one Coalinga field , one Spraybury field. Other fields may be found, but they are new fields not reproductions. Even new fields with similar characteristics would probably not be developed in the same manner, so they are not reproductions either.

The Cost Approach is only applied to so-called *Improvements*. Improvements are artificial, they are built by people who have need of their use. They can be constructed, repaired, torn down and replaced. Reproduction and Replacement of Improvements requires expenditures of Capital. It is these costs of Replacement or Reproduction that form the foundation for the Cost Approach.

Facilities

In some instances, the Cost Approach is used to separately value oil property production facilities such as treatment plants and gathering/shipping facilities. While each case has to be considered on its merits, the primary problem here is that production facilities rarely, if ever, have value as stand-alone units. When oil properties are bought and sold in the marketplace, the property is traded as a whole - the reserves, wells, pumping units, tank batteries, shipping facility, water plant - everything. The oil is worthless if it cannot be produced. There may be spare equipment that is separately valued or there may be purchases of properties for the proposed salvaging of equipment, but they are exceptions - not the rule - and would hardly apply when using a Cost Approach for an existing production property. Probably the only real use for a Cost Approach in oil property appraisal is to allocate or apportion the overall market value of a property.

Finding Costs

Various sources publish so-called *finding-costs* for new oil and gas reserves, which consist of the costs of drilling, exploration and leasing and are reported as \$/Barrel or \$/MCF of newly discovered reserves. Some evaluators have attempted to use these figures as part of a Cost Approach estimate of value on the theory that the value of existing reserves is equal to the cost of finding new reserves. This theory supposes that a Belridge field or Hugoton field property could be replaced at current finding costs. The fallacy here is obvious. The existing reserves are reasonably well known and may be fully developed with a 50-year history, in-place facilities, and available markets without all the uncertainty associated with exploration drilling. Further, finding-cost figures are rarely site specific - they are often nation-wide or regional at best. Finding costs for “attic traps” in Louisiana salt domes is not the same as for horizontal wells in the Austin Chalk of central Texas or multiple intervals in the Monterey formation offshore California. The finding costs must be adjusted (See Comparable Sales method) to reflect the replacement costs in the location of the property being appraised. Even then, it would be incorrect to apply that value to a known volume of reserves. For one thing, reserves cannot be determined by a Cost Approach, so where do you get the reserves number from other than an Income Approach? Second, the number of potential oil fields in a given geologic province has been shown to be a finite distribution of field size; therefore, the probability of actually "finding" something must be considered and included in the calculation.

It seems obvious from the foregoing, that the Cost Approach has little application to oil and gas property appraisal. The value of an oil property is in the future revenue to be obtained from the sale of produced minerals. Nothing in the Cost Approach addresses that issue.

The Sales Comparison Approach

The *Sales Comparison Approach*, or Market Sales Approach as it is variously known, is the process in which a value estimate is derived by analyzing the market for similar properties that have recently sold and comparing these properties to the subject property. This approach is commonly used in real estate appraisal for homes, land, farms and commercial/industrial buildings. It is simple in concept and is usually thought to give a good estimate of value for the types of property that are appropriate to value by this method. The process has several steps. The appraiser researches the market for sales of properties with characteristics similar to the property being appraised. After verifying the data regarding both the property and the sale, he defines the similarities and differences between the comparables and subject property and then makes adjustments to the value of the comparables to match the attributes of the subject property.

For the appraiser, most of the work in this method comes in the adjustments that have to be made to each of the comparables. These are termed *Elements of Comparison*. The "Appraisal of Real Estate" lists nine such elements. These are: real property rights conveyed, financing terms, conditions of sale, market conditions, location, physical characteristics, economic characteristics, use and non-realty components of value. Each of these elements may be broken down into sub-parts, i.e. physical characteristics might include building size, lot size, quality of construction. architectural style, building materials, age, condition, functional ability, attractiveness, amenities and on-site environmental conditions. Location might range from part of town or school district to whether the house is on a corner or in a cul-de-sac.

Assuming the appraiser has enough data, the adjustment process can start. This is essentially a process of determining which of the various characteristics of the *comparable* properties influence the value of each of those properties and by how much. After sorting out the differences in value attributed to each of the property characteristics, the appraiser adjusts the value of each of the comparables using those elements that bring the comparable closest to the subject property. A common *Unit of Comparison*, such as $/sq. ft. or $/acre, is than applied to the subject property to obtain a value estimate.

In residential real estate, the necessary data is relatively easy to obtain from public records and from realtors' listings and databases. Banks and other sources provide financing and market information. If necessary, the appraiser can go to each property and accumulate data directly - measure the house and the rooms; check the heating, the roof, the plumbing, etc. He can talk to the buyer and the seller, real estate agents, finance company and escrow agents.

Comparable Sales for Oil Properties

It would be simple to cite several reasons why the Comparable Sales method is not used to value oil properties. They are definitive and would not surprise anyone. But let us be positive and examine the process of valuing oil properties using a correct Sales Comparison approach.

First, assume that the subject property is a single oil producing property with all the necessary components of production. Next, locate as many recent sales of properties with characteristics similar to the subject as you can. Recent sales are important; otherwise you have to make more complex adjustments for changing market and financial conditions. The more similar the properties, the fewer and (possibly) smaller the adjustments. However, the number of comparables is limited, particularly when considered in a "recent" time frame. Oil properties do not sell very often - certainly not in the numbers and with the frequency of houses, condos or land. This condition has been recognized by the courts and by responsible appraisal bodies. [See *Roberts v. Gulf (1983) 147 Cal. App. 3d*]

But assume that we find a few transactions that are timely - what do we know about the properties? How can we determine the sales price? There are no realtors, no multiple listings, no public reporting. Even public companies only have to report transactions that are material. Property tax records are confidential and working backwards from deed stamps is approximate at best. From the newspaper or the Oil &Gas Journal? Even published prices for major transactions are rarely sufficiently detailed to know that was really paid, what other non-cash consideration was involved or how the deal was financed.

For the sake of argument, assume that a reliable purchase price can be obtained for each of several property sales and that some information about the properties is known. Now we have to adjust the comparable properties to the subject property. What are the similarities and differences? A list here could be endless. To begin, there are all the (a) physical differences and (b) operational differences that could occur between two oil properties. Another list could be made of all the economic differences - oil price, transportation costs and operating costs. Lastly, there are the circumstances of each transaction that could influence the amount that was paid for the property. One could compile lists of a couple of dozen physical differences starting with location, field, reservoir, oil gravity, depth, number of wells, etc. If lists of physical, operational, economic and transportational differences are laid side-by-side, many of the items are found to be related and some are duplicates - oil gravity influences price, etc. Once the lists are fine-tuned, the appraiser would have a matrix of physical and other factors that could influence the value of a property.

The appraiser must then determine how much confidence he has in the data. Next, he/she must determine how much influence each factor in the matrix has had on the sales price of the comparable property. How much of the sales price is due to Comp #1 having a sandstone reservoir while Comp #2 produces from limestone? How much difference is due to Comp #3 having a bottom-water drive while Comp # 1 is a steamflood? How much difference is due to Comp #1 having 13° API oil while Comp #3 produces 21° API?

For the sake of discussion, assume that the appraiser completes a rigorous sales analysis and has adjusted the comparables to resemble the subject property. The next step is to define a *Unit of Comparison*. The ratio of purchase price to reserves, denoted as *$/Bbl* or *$/BOE*, [6] is often mentioned here, but a little thought would reveal a few problems. The $/Bbl unit worked well enough 30-40 years ago when oil prices were relatively stable. Most reserves were Proved and production was predictable, oil price was unchanging and income valuations were not difficult. Using $/Bbl would require a definition of how many dollars and what kind of Barrels; only Proved reserves, or maybe only Proved Developed Producing (PDP) reserves. Just Bbls or BOE? Do you really know that much about the reserves of each comparable? Are reserves really the objective? Is not income the objective? So, would not a unit of comparison related to future income be more useful? But then, you would have to know the anticipated future income, and here again required data is generally missing.

We could go on and on with assumptions, but it should be apparent that Comparable Sales cannot be applied to oil properties:

- Oil properties are acquired for the income they produce not for the amenities
- There are not enough sales
- There is not enough available data even from reported sales
- There is no accepted Unit of Comparison

Serious Attempts

There have been attempts to adapt Comparable Sales to oil properties. The best of these was by Mr. William Strevig in the late 1980's. [7] This was a form of Comparable Sales method, which started from a $/BOE for each comparable and/or for a group of sales and made adjustments to the $/BOE before applying it to the subject property. Strevig indicated that there were <u>at least</u> 19 specific criteria for which adjustments should be made, and there was a direction to make as many other adjustments as necessary. This approach never really caught on because, aside from investment bankers and a few consultants, very few people had the data resources to make it work, and those resources were almost entirely Income Approach evaluations. Without the knowledge provided by the income evaluations, there is no starting point and no source for making adjustments. For all its difficulty, the Strevig method was at least a reasonable representation of a Market Sales approach. It could be done, BUT it had to be done right.

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[6] BOE is *Barrels of Oil Equivalent*, which is a measure of crude oil reserves plus the oil equivalent of any natural gas reserves. The gas equivalency can be estimated by use of relative heating value (6,000 cu.ft. = 1 Bbl of oil) or sales value ($X/cu.ft. = $Y/Bbl).

[7] Society of Petroleum Engineers, SPE #18907: "*Valuation of Oil and Gas Reserves By the Comparative Method,*" Strevig, William,, 1989, Dallas, TX

Income Approach to Value

It seems apparent that the Cost Approach and of the Comparative Sales Approach are most useful for the appraisal of commercial and residential properties, where costs of replacement and/or duplication can be readily determined or where there are a sufficient number of timely sales of similar properties that comparative analysis can be done correctly. 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. Where the primary objective of owning a property is the income that can be derived from that property, the standard real estate appraisal texts recommend the *Income Approach*. While other methods might, and in good practice should, be used (if possible) to supplement the Income Approach, there is no question that significant weight is given to income analysis.

Why the Income Approach?

Why is the Income Approach used for oil and gas appraisal virtually to the exclusion of all other valuation methods? Why is it that after appraisal theorists and practitioners have spent decades developing intricate Cost and Comparative Sales methods of estimating value, the oil industry and oil property appraisers rely solely on the Income Approach?

First, the purpose of owning a mineral interest is to produce and sell a commodity that has no intrinsic value with the objective of deriving income. This dependence on an income stream, combined with both the non-reproducibility of mineral properties and the lack of significant numbers of timely sales of oil properties, makes necessary the application of the Income Approach to value mineral interests.

Second, the Income Approach is readily adapted to the evaluation of oil and gas producing properties. The greatest strength of the Income Approach is that it allows the appraiser to construct a complex production and economic projection for a property or group of properties over any time period and, using any time frequency that the appraiser deems to be reasonable, to then derive a value that reflects the specific characteristics of *that* property and the economic and investment criteria selected by the appraiser at a specified point in time. It is this power to build a model that incorporates the anticipated size, shape and duration of the production and income stream that makes the Income Approach such an extremely valuable tool for oil property appraisers.

There is a third reason. The Income Approach is, as my granddaughter once said, "*...the way we always go*." Petroleum engineers are not trained as appraisers but as evaluators of how best to invest our employers' capital. The only method taught, in school or after, is the Income Approach - although no one called it that. Unlike persons trained to be real estate appraisers, PE's (and their functional equivalents) are not burdened with Comparable Sales and Cost Approach thought processes.

History

The Income Approach has historically been the primary method of valuing oil properties, both within the industry and in the financial markets that deal with the oil industry. The published literature reaches back to the late 1800's (Hoskold). The most common early form is the *Payback* or *Payout* method, where the value of a property is estimated as a function of the income to be received from the property within an certain time period. The Payout method requires a projection of future income and can therefore accommodate expected changes in production, prices and costs. While often used as an adjunct to more sophisticated analysis, Payout is an Income Approach and remains the most commonly used <u>non-discounted</u> cash flow valuation approach.

With the passage of time, and particularly since the advent of computers, undiscounted methods have been supplanted by discounted methods. In the modern oil industry, the only functional method of valuing oil properties, and of evaluating investment options regarding such properties, is the form of 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.

Discounted Cash Flow for Oil Properties

The overwhelming prevalence of and preference for the *Discounted Cash Flow* ("DCF") as the method for evaluating oil properties results from several useful attributes of the method. First, the DCF is, by definition, a projection of future income. Second, when properly constructed, the method duplicates as closely as possible the form(s) of expected operation and exploitation of the property being appraised. Oil properties generate income over a period of time, during which production, prices, costs and other factors can be expected to change continually; a DCF appraisal can model those expectations. The DCF has the ability to account for virtually every conceivable event and variable that might impact the income stream over the anticipated life of the property. If changes in production, prices, costs, and other parameters can be defined, they can be modeled in a DCF. Third, the DCF method is exceptionally flexible in allowing for multiple outcomes to be tested and weighed by simple alteration of expected conditions. Fourth, the introduction of the present value component reduces the future income stream to a common and comparable result. Fifth, the DCF construction can be broad and simple or detailed and complex, subject to the needs of the appraiser.

Taken together, these attributes make the DCF a powerful, dynamic and rather elegant method for estimating the future income and value of oil properties. When properly applied to a specific property, the method can result in a DCF that is not only unique to that property but is also unique to the effective date of the evaluation. Neither the Comparable Sales nor the Cost Approach have the ability to model future performance, and they provide none of the dexterity of the DCF.

Major Components

The Discounted Cash Flow has three directly related but distinct components: an *Income Stream*, a *Discount Rate* and a *Value*. The *Income Stream* is the income that is anticipated to be derived from a property. The size, shape and duration of the Income Stream is directly dependent on (1) the physical and operational characteristics of the property, (2) the economic conditions which currently exist and which are expected to apply to the property in the future, and (3) operational events and requisite expenditures that might be expected to occur over time to take advantage of property characteristics and/or to respond to economic conditions. The *Discount Rate* is a *financial* function, the primary purpose of which is to convert the Income Stream to a (present) *Value*.

The Income Stream

The purpose of the Income Stream is to attempt to model the flow of income that may be anticipated from a given oil property (with specific geologic, reservoir, and production characteristics) under defined operating and economic conditions. The Income Stream is an intricate model that produces a unique result. In attempting to reach a conclusion of value, the appraiser must try to determine how the geologic characteristics of the property may affect the volume of oil in the reservoir(s), and how the characteristics of the reservoir(s) may affect the ability of the property to produce oil and/or gas, and at what rate(s). The appraiser must also define the operating system necessary to obtain the production as well as the costs of lifting, gathering and processing produced fluids. Such costs may include current and/or future capital investments and other expenditures to meet regulatory requirements. Finally, the appraiser must determine the price(s) that may be expected for the oil and gas in the future. The construction of the income stream is a step-by-step function that forms an integrated whole. The end result is an estimate of monthly or annual income that is *unique to the property* and *specific to the date of evaluation.* Every physical or economic factor is related to the others. A change in the input data or in an assumption used in one part of the income stream may affect some other component and require further change at another point in the model.

There is one attribute of DCF that is often overlooked if only because it is so obvious. If an appraiser values a property using DCF, and does it correctly, the income projection is a model specific to that property. The production rate is a function of the geology of the reservoir(s) that can be produced on that property - not a property in another field or state. It is also a function of the physical factors, fluid characteristics, reservoir mechanism, and operating system on that property - not the lease next door. The same is true of product prices, one does not use West Texas Intermediate (WTI) 21° API oil pricing to value a Kern River property producing 13° API crude.

The Comparability of Cash Flows

If an appraisal is done for each of 10 properties using the Income Approach, the appraisal of each property would capture all the physical and economic characteristics that define that property and would convert those characteristics into a stream of income. The outcome would be 10 streams of dollars each with a (possibly) different size, shape and duration. Only the Income Approach can accomplish this feat. All of the differences between the 10 properties are boiled down to 10 streams of future income. For value purposes, the source of that income is almost irrelevant.

It should not be surprising that DCF is the foundation of capital investment analysis in the oil industry and in financial management in most industries. One reason, of course, is the ability of the DCF to evaluate complex properties. But the real reason is that the method produces estimates of future income which are directly comparable to each other and can therefore be evaluated using *Net Present Value* (NPV) and/or *Internal Rate of Return* (IRR) (or variants) as a budgeting/investment criteria. Think about that for a moment. If the cash flows were not comparable, then it would be meaningless to select A over B simply because A has a higher NPV or because B has a lower IRR. The only area where cash flows can be said to differ is in the *RISK* of not receiving the expected income stream. This is recognized and accounted for by applying a risk adjustment to one or more portions of the cash flow to make that cash flow compatible with the relative risk of the other cash flows before subjecting all the cash flows to NPV and/or IRR analysis.

The Discount Rate

Which brings us to the second primary component of DCF: the *Discount Rate*. The primary purpose of the Discount Rate is to reduce the expected Income Stream to a (present) Value. All discount rates are present value factors. Some discount rates, if derived and selected correctly, can be used to estimate specific results, such as Market Value. The discount rate is not a function of the property being appraised; it is unrelated to production rates, oil gravity, location, well count, oil price, or any other characteristic of the property. All that is in the income stream. The discount rate for an oil property is a *financial* factor, which is directly related to and is a function of the financial return that is required by an investor in an oil property, which is, in turn, a direct function of the tolerance for risk of that investor relative to the other investors in the marketplace. If we make the reasonable assumption that the marketplace is made up of knowledgeable, experienced and successful investors, the *range* of relative risk tolerance and, therefore, required returns should be definable and identifiable. Further, the range of required returns is bracketed and controlled by the range of returns that can be obtained from alternative investments in marketable items such as equities, bonds or real estate.

It remains only to fully address the *Risk* issue. Oil property appraisals are estimates of future events - some estimates are better than others. Each element in the projected cash flow carries some degree of risk or chance that it will not occur as expected. Some of these risks can be included in the cash flow by adjusting production projections or cash flows, while others are accommodated by running multiple cases at, for instance, different product prices. To the extent that risk is not reflected in the cash flow, it is included in the discount rate. Such a risk-inclusive discount rate would necessarily be higher than a discount rate that was applied to a risk-adjusted cash flow.

Value

After all the work of constructing a reliable income stream and selecting a discount rate, the appraiser puts the two together, discounts the cash flow, and arrives at the *Estimate of Value* - be it for purchase, sale, tax, eminent domain, civil damages or abject curiosity. An appraisal that estimates Market Value is unique to that property at the effective date and is a function of the Income Stream and the Discount Rate. Assuming that the appraiser (investor) has (a) put everything he knows of the property and his expectations for future economic conditions into the Income Stream, and (b) has incorporated his tolerance for risk and required rate-of-return into the Discount Rate, then the Value estimate obtained should be the maximum he would be willing to pay. There may be other parochial considerations, but those may not be "market" considerations. If the Income Stream and/or Discount Rate is changed, then the Value will be changed.

Fair Market Value Discount Rates

Estimation of the *Fair Market Value* (hereafter "FMV" or "Market Value") of an oil and gas property or project requires a discount rate that is representative of the return 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.

Sources of Discount Rates

Appraisers and engineers trying to estimate Fair Market Value face a particularly difficult task. There are only two sources for reliable discount rates. The first is empirical data from actual market transactions, or *Market Derived* discount rates. Reports and studies that provide this information are limited in both number and coverage. Some of these studies do not provide sufficient supporting information to allow the user to judge the quality of the conclusions. Nonetheless, market derived data does exist and that data has application to market value estimation for all oil and gas properties.

The second source for discount rates is to calculate or otherwise determine the *Cost-of Capital*, which would be appropriate for an investment in petroleum producing properties. The Cost-of- Capital is a commonly used term that is just as commonly confused with the cost-of-debt or, in the usual terminology, the "bank lending rate on oil loans." The use by some evaluators of the cost-of-debt in place of cost-of-capital is a fundamental error that causes serious misunderstanding of market valuation procedures. This distortion aside, the properly defined cost-of-capital is a powerful tool for *beginning* the discount rate selection process and is, in fact, the basis for many of the discount rate edicts contained in company policies and client preferences. When correctly calculated, the cost-of-capital for a company (or industry) is a measure of the return expected by an investor on both the debt and the equity of a company, weighted by the appropriate proportions of each in the total funding. There are several good sources for oil industry cost-of-capital information and for the foundation data that would allow an evaluator to derive a Cost-of-Capital rate.

Market Derived Discount Rates

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. Discount rates from empirical data have been discussed in a number of Society of Petroleum Engineers (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 to 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. Further, there seems to be no substantive, informed disagreement with the conclusions of those studies. 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 [8] indicates that for 239 confirmed fair market value sales of specific properties occurring between 1983 and 2001 and totaling about $5.3 billion there is a mean discount rate of 23.9% and a median of 22.6% for properties with a range of Proved reserve classes and a standard deviation of 7.1 percentage points from the mean (16.8-31.0%). These discount rates are calculated as the rate of return of the future cash flow on the acquisition investment. For those 97sales that were of 100% Proved Developed Producing reserves, the mean and median discount rates are 21.8% and 21.5% respectively. Additional empirical data is provided by studies done in Texas over the 1987-1993 period.

The Financial or Cost-of-Capital 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. 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

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[8] "*Fair Market Value Transactions, Cost of Capital, and Risk: California Oil and Gas Property Transactions 1983 through 2001*," Richard J. Miller & Associates, Inc. for Western States Petroleum Association, January 16, 2002.

and, as shown by Boyle and Schenck[9] and also by Dougherty and Sarkar, [10] 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.

According to financial theory, [11, 12, 13, 14] a company or other investor should attempt to make investments of capital only in projects that 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*, ("MRR") "hurdle" rate, or other term connoting a threshold rate. Campbell refers to the *Minimum Return Standard* ("MRS") 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*." [15]

In practice, the 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 Value discount rate*.

Comparing Data Sources

The problem with using the Market Derived and/or Cost-of-Capital sources is that they do not provide consistent answers, at least not on the surface. Except in certain circumstances, discount rates obtained from market sales do not match discount rates taken from cost-of-capital analysis.

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9 "*Investment Analysis: U.S. Oil and Gas Producers Score High in University Survey*," Boyle, Hugh F., and Schenck, George K., "Journal of Petroleum Technology," Vol 37, April 1985, pg. 680

10 SPE #25824: "*Current Investment Practices and Procedures: Results of a Survey of U.S. Oil and Gas Producers and Petroleum Consultants,*" Dougherty, E. L. and Sarkar, Jayati, University of Southern California, presented at Hydrocarbon Economics and Evaluation Symposium, March 1993, Dallas, TX

11 "*Principles of Corporate Finance*," Brealey, Richard A., and Myers, Stewart C., 4th Edition, 1991, McGraw Hill, New York, pg. 181

12 "*Managerial Finance,*" Weston, J. Fred and Copeland, Thomas E., 8th Edition, 1986, Dryden Press, New York, pg. 99

13 "*Financial Management for Decision Making*," Bierman, Harold and Smidt, Seymour, 1986, MacMillan Publishing Company, New York, pg. 139

14 "*Cost of Capital: Estimation and Application*," Pratt, Shannon P., 1998, John Wiley & Sons, Inc., New York

15 "*Analysis and Management of Petroleum Investments: Risk, Taxes, and Time*," Campbell, John M., Jr., 1987, John M. Campbell and Co., pg. 67

The Market Derived discount rates always exceed the Cost-of-Capital discount rates. This disparity is apparent regardless of the data source. The reason for such a relatively uniform and disparate relation between derived and cost-of-capital rates is obvious when one considers the purpose of the cost-of-capital and the application of the COC as a minimum return on capital investments.

If the COC is the minimum required rate-of-return on invested capital, then it should not be surprising if the returns from actual transactions consistently exceed the COC. This observation, while useful in assuaging concern over the difference in rates noted above, is not particularly helpful to the evaluator who must decide which rate to use for estimating the market value of the XYZ lease. Knowing that such a difference should and does exist is all the more perplexing when the evaluator does not have access to, or does not feel comfortable with, market sales data but must rely on COC information. If the COC is the *Minimum Required Return* and the market data is the actual return, the conscientious evaluator might then want to determine how to bridge the gap.

Measuring the Difference

Before the reasons for the disparity in rates can be defined, the degree of difference must be quantified and examined. In this analysis, we use two published and publically available studies as sources of information. The first of these is "Fair Market Value Transactions, Cost of Capital and Risk," (January 16, 2002) prepared for the Western States Petroleum Association ("WSPA"). This study is hereafter referred to as the *WSPA Study*. The second source is a series of annual studies done by the Property Tax Division of the Office of the Texas Comptroller from 1987 through 1993 and hereafter referred to as the *Texas Study*. These two studies are used because they are consistent with each other and from year to year.

The annual WSPA Report is actually two studies; a Market Sales study that derives discount rates from actual sales transactions and a Cost-of-Capital analysis. Over the past several years, a large part of the WSPA Report has been devoted to reconciling the results of the two parts, which has met with some success. The market sales discount rates reported in the WSPA Report and used in this paper are calculated from the buyer's evaluation of individual producing oil properties and have the following characteristics.

- **Before Income Tax -** Discount rates are derived using the Buyer's before income tax cash flow with no deduction of projected income tax or tax related items such as interest, depreciation, depletion and/or amortization.

- **Risk Inclusive** - Discount rates are derived as the *Internal Rate of Return* ("IRR") of the purchase price against the non-risk adjusted cash flow.

- **Proved Reserves Only** - With minor exceptions, only evaluations of Proved reserves are included in the WSPA study.

In the WSPA Report, the Cost-of-Capital is calculated as a textbook *Weighted Average Cost-of-Capital* ("WACC") using a sample set of 40-50 publically traded oil and gas companies. In order to compare the WACC data to the sales data, the WACC is converted from an After Income Tax to a Before Income Tax value by generally accepted methods. The calculation for year-end 2000 is shown as Table 1. As shown in Table 2, WACC for the period 1985-2000 averages 16.0% BFIT and ranges from 18.9% BFIT (1985) to 13.8% BFIT (1993).

WSPA Study Results

A comparison of the discount rates derived from (a) the Market Sales analysis, and (b) the Cost-of-Capital (as shown in Table 2) indicates that the annual Mean discount rate from all property sales differs from the annual Mean WACC by as little as 3.0% and as much as 10.4% (Figure 1). The values shown as Mean discount rate and Mean WACC are the arithmetic averages of Market Sales derived discount rates and WACC for each year. Comparisons of market derived rates and WACC rates for a single-year are not very useful, primarily because of the relatively small number of sales data points in any one year and the arbitrary nature of calendar year divisions. The discount rates from market sales include evaluations made up of all categories or classes of Proved reserves from low risk *Proved Developed Producing* ("PDP") to higher risk *Proved Undeveloped* ("PUD"). Over the 1985-2000 period, market derived discount rates exceed the WACC, on average, by 7.5%.

The analysis of market derived discount rates from property sales with only 100% PDP reserves is more informative. The difference between average annual Mean WACC of 16.0% and the average annual Mean discount rate from the 100% PDP sales of 21.8% is about 5.8 percentage points. A slightly different view of discount rate distribution is shown by Figure 2, where the cumulative percentage of sales at various discount rates indicates that about 89.5% of all market transactions in the 1983-2000 period were concluded at discount rates that exceed the mean BFIT Cost-of-Capital (- 16.0%).

Texas Study Results

The Texas Property Tax Division ("PTD") annual study found similar results to the WSPA Study and reached comparable, but not identical, conclusions (Table 3). The primary focus of the Texas Study [16] is the derivation of a WACC for a group of integrated and independent public oil companies. However, during the period 1987-1993, PTD also obtained market data from sales transactions in Texas involving primarily 100% PDP properties. The PTD discount rates were derived as BFIT and Risk-Inclusive returns in essentially the same manner as the WSPA study. The PTD published both the WACC and the sales analysis in the reports for 1987-93.

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[16] "*1997 Property Value Study: Determination of Discount Rate Range for Petroleum and Mineral Properties*," Texas Comptroller of Public Accounts, Property Tax Division, November 1997, Austin, TX

WSPA/CIPA PROPERTY SALES STUDY
BAND OF INVESTMENT SEGMENT
WEIGHTED AVERAGE COST OF CAPITAL
YEAR END 2000

MAJOR/INTEGRATED	LISTING MARKET	TOTAL CAPITAL $MM	TOTAL EQUITY $MM(1)	TOTAL LONG TERM DEBT $MM(2)	TOTAL EQUITY %(3)	LONG TERM DEBT %(4)	COST OF DEBT %(5)	AFIT COST OF EQUITY %(6)	STATUTORY BFIT COST OF EQUITY %(9)	STATUTORY BFIT WACC %	STATUTORY AFIT WACC %
AMERADA-HESS	NYSE	7,758.293	5,715.293	2,043.000	73.7	26.3	7.138	11.300	17.384	14.686	10.204
BP-AMOCO	NYSE	157,417.120	135,827.120	21,590.000	86.3	13.7	7.003	12.206	18.778	17.163	11.492
CHEVRON CORP.	NYSE	60,534.197	55,395.197	5,139.000	91.5	8.5	6.525	11.475	17.654	16.709	11.055
EXXON MOBIL	NYSE	306,752.682	299,473.682	7,279.000	97.6	2.4	7.476	10.131	15.586	15.394	10.068
KERR-MCGEE	NYSE	8,652.579	6,233.579	2,419.000	72.0	28.0	5.940	13.486	20.747	16.607	11.376
OCCIDENTAL	NYSE	14,415.320	8,957.320	5,458.000	62.1	37.9	7.256	16.131	24.817	18.168	12.771
PHILLIPS PETR.	NYSE	21,402.879	14,518.879	6,884.000	67.8	32.2	6.953	13.956	21.470	16.801	11.703
ROYAL DUTCH SHELL	NYSE	133,205.327	129,863.927	3,341.400	97.5	2.5	7.000	11.287	17.365	17.105	11.179
SHELL TRANSPORT &TRADING	NYSE	493,188.209	490,960.609	2,227.600	99.5	0.5	7.000	12.135	18.668	18.616	12.111
TEXACO, INC.	NYSE	39,636.406	34,246.406	5,390.000	86.4	13.6	6.728	5.734	8.822	8.537	5.869
UNOCAL CORP.	NYSE	11,765.114	9,259.114	2,506.000	78.7	21.3	7.215	9.800	15.076	13.402	9.249
TOTAL		1,254,728.125	1,190,451.125	64,277.000	913.247	186.753	76.233	127.638	196.366	173.186	117.077
ENTRIES		11	11	11	11	11	11	11	11	11	11
AVERAGE		114,066.193	108,222.830	5,843.364	83.022	16.978	6.930	11.603	17.851	15.744	10.643
STD. DEV.		155,855.176	155,530.123	5,555.099	12.975	12.975	0.416	2.651	4.079	2.819	1.865

NON-INTEGRATED/INDEPENDENT

ANADARKO PETROLEUM	NYSE	21660.174	17,676.174	3,984.000	81.6	18.4	6.816	9.73	14.972	13.472	9.196
APACHE CORP.	NYSE	10783.115	8,564.857	2,218.258	79.4	20.6	7.277	12.76	19.637	17.094	11.635
BARRETT RESOURCES	NYSE	2272.264	1,858.966	413.298	81.8	18.2	6.881	9.81	15.092	13.599	9.277
BERRY PETROLEUM	NYSE	307.681	282.681	25.000	91.9	8.1	7.430	9.92	15.259	14.623	9.716
BURLINGTON RESOURCES	NYSE	13187.558	10,883.558	2,304.000	82.5	17.5	7.064	11.58	17.809	15.932	10.788
CABOT OIL & GAS	NYSE	1192.150	923.150	269.000	77.4	22.6	7.856	11.48	17.665	15.451	10.664
CHESAPEAKE ENERGY	NYSE	2505.783	1,540.083	965.700	61.5	38.5	8.890	11.34	17.446	14.149	10.396
DEVON ENERGY	NYSE	9823.374	7,773.464	2,049.910	79.1	20.9	6.284	11.71	18.014	15.566	10.577
ENRON CORP.	NYSE	70019.476	61,422.476	8,597.000	87.7	12.3	6.946	14.38	22.125	20.261	13.468
FOREST OIL	NYSE	1623.280	1,001.046	622.234	61.7	38.3	8.551	17.01	26.175	19.420	13.770
FRONTIER OIL CORP.	NYSE	427.339	187.756	239.583	43.9	56.1	11.690	15.08	23.206	16.750	13.181
HELMERICH & PAINE	NYSE	2239.621	2,181.421	58.200	97.4	2.6	6.610	13.45	20.692	20.326	13.272
LOUIS DREYFUS NAT. GAS	NYSE	2570.541	1,963.632	606.909	76.4	23.6	6.723	13.45	20.686	17.389	11.859
MAYNARD ENERGY	NYSE	79.482	46.970	32.512	59.1	40.9	8.050	10.09	15.526	12.468	9.257
MITCHELL ENERGY	NYSE	3319.783	3,019.441	300.342	91.0	9.0	7.090	3.26	5.011	5.199	3.604
NOBLE AFFILIATES	NYSE	3104.068	2,574.068	530.000	82.9	17.1	8.337	11.85	18.229	16.540	11.249
NUEVO ENERGY	NYSE	720.139	310.412	409.727	43.1	56.9	9.330	13.99	21.526	14.587	11.340
PIONEER NATURAL RESOURCES	NYSE	3540.901	1,962.125	1,578.776	55.4	44.6	8.544	15.29	23.529	16.848	12.285
PLAINS RESOURCES	ASE	996.430	369.540	626.890	37.1	62.9	9.631	8.53	13.126	10.927	9.224
POGO PRODUCING	NYSE	1626.216	1,261.216	365.000	77.6	22.4	8.190	13.31	20.474	17.717	12.159
RANGE RESOURCES	NYSE	665.608	300.135	365.473	45.1	54.9	9.429	11.50	17.686	13.153	10.361
REMINGTON OIL&GAS	NYSE	361.781	279.253	82.528	77.2	22.8	9.330	10.01	15.406	14.020	9.858
ROYALE ENERGY	NYSE	32.567	27.615	4.952	84.8	15.2	10.500	13.29	20.446	18.934	12.866
SOUTHWESTERN ENERGY	NYSE	655.717	259.717	396.000	39.6	60.4	7.418	9.82	15.115	10.467	8.371
SWIFT ENERGY CO.	NYSE	941.183	806.454	134.729	85.7	14.3	9.631	10.09	15.526	14.682	10.026
TRITON ENERGY	NYSE	1622.436	1,117.740	504.696	68.9	31.1	8.678	20.85	32.072	24.795	17.061
VINTAGE PETROLEUM	NYSE	1814.451	1,350.222	464.229	74.4	25.6	8.621	19.15	29.456	24.125	16.453
WILSHIRE OIL CO. OF TX	NYSE	89.627	28.084	61.543	31.3	68.7	7.698	8.84	13.606	9.549	8.057
WISER OIL CO.	NYSE	172.098	46.998	125.100	27.3	72.7	14.311	6.58	10.126	13.168	12.200

TOTAL	158,354.842	130,019.253	28,335.589	1,982.848	917.152	243.808	348.167	535.641	451.212	322.171
ENTRIES	29	29	29	29	29	29	29	29	29	29
AVERAGE	5,460.512	4,483.423	977.089	68.374	31.626	8.407	12.006	18.470	15.559	11.109
STD. DEV.	13,318.202	11,643.919	1,720.486	19.990	19.990	1.317	3.450	5.308	4.152	2.621
TOTAL	1,413,082.967	1,320,470.378	92,612.589	2,896.095	1,103.905	320.041	475.805	732.007	624.398	439.248
ENTRIES	40	40	40	40	40	40	40	40	40	40
AVERAGE	35,327.074	33,011.759	2,315.315	72.402	27.598	8.001	11.895	18.300	15.610	10.981

(1) MARKET VALUE - STOCK PRICE AT 12/31 X OUTSTANDING SHARES
(2) INCLUDES (LONG TERM DEBT + CURRENT PORTION + CAPITAL LEASE OBLIGATIONS + SHORT-TERM DEBT CLASSIFIED AS LONG-TERM)
(3) % OF TOTAL CAPITAL
(4) % OF TOTAL CAPITAL
(5) CALCULATED FROM YIELD TO MATURITY FOR BOND DEBT AND CURRENT RATE FOR INSTITUTIONAL DEBT
(6) CALCULATED FROM THE AVERAGE OF (A) EXPECTED TOTAL YIELD AND (B) CAPM
(7) TAKEN FROM STANDARD AND POOR'S AND ANNUAL REPORTS
(8) AFIT COST OF EQUITY DIVIDED BY (1 - EFF. TAX RATE)
(9) AFIT COST OF EQUITY DIVIDED BY (1 - STAT. TAX RATE); TAX RATE = 35%

Table 2
WSPA Study Results

Year	All Properties Mean DCR%	100%PDP Mean DCR%	Cost-of-Capital Mean WACC, %	[a] All, %	[a]PDP, %
1985	27.6	25.7	18.9	8.7	6.8
1986	23.8	24.1	15.0	8.8	9.1
1987	22.1	23.0	15.1	7.0	7.9
1988	24.2	22.8	15.6	8.6	7.2
1989	25.5	27.6	15.6	9.9	12.0
1990	21.8	21.1	18.8	3.0	2.3
1991	22.8	22.2	18.5	4.3	3.7
1992	25.5	24.7	15.5	10.0	9.2
1993	24.2	22.4	13.8	10.4	8.6
1994	25.6	22.1	17.3	8.3	4.8
1995	22.4	22.4	14.8	7.6	7.6
1996	23.6	19.2	16.0	7.6	3.2
1997	20.6	19.9	14.1	6.5	5.8
1998	25.5	*	16.2	9.3	-
1999	18.6	*	15.6	3.0	-
2000	(	(	15.6	-	-
1985-2000	23.3	21.8	16.0	7.5	6.8

* Insufficient Data Points

Table 3
Texas Property Tax Division Studies

Year	Market Derived Mean DCR,%	Cost of Capital Mean WACC, %	[a]%
1987	22.9	13.5	9.4
1988	17.7	14.9	2.8
1989	21.7	15.0	6.7
1990	17.9	15.1	2.8
1991	20.0	14.5	6.5
1992	31.0	15.8	15.2
1993	21.3	14.4	6.9
Mean	21.2	14.7	6.5

The Dilemma for Oil Property Appraisers

Sources of the Difference

It would be relatively simple to dismiss the difference between market derived and COC discount rates as no more than a function of the negotiation process that leads to a purchase price agreement between Buyer and Seller. This conclusion would accept the financial theory that investors who have a defined cost-of-capital make investments with the expectation of obtaining a return at least equal to, and preferably greater than, that COC. This implies that the purchase price, and the discount rate derived therefrom, contains all the considerations of risk, liquidity, return-of- and return-on-investment, cost of money, portfolio diversity, and inflation, plus whatever else the buyer included in his/her negotiated price. This is entirely correct but not very helpful to the appraisal process.

From an appraisal standpoint, the differences between the WACC derived discount rates and the market derived discount rates occur primarily because of the differing composition of the two rates. [17, 18]

1. **Liquidity**. The Cost-of-Capital, as derived for publically traded companies, is the return anticipated on an equity and/or a debt investment. These equity and/or debt investments are highly liquid and can be bought and sold on a variety of markets virtually instantaneously. In contrast, oil producing properties are real estate and are inherently illiquid.

2. **Portfolio Effect**. The WACC rate includes a measure of risk, but it is the risk of a portfolio of investments where risk is moderated by the diversity of the portfolio. Property sales data are generally derived from discrete individual properties, while the Cost-of-Capital of public companies is reflective of investors expectations for all the activities of the company.

3. **Return-of-Investment**. The Cost-of-Capital, by construction, does not include a return-of-capital component while the discount rate derived from sales explicitly includes a component for return-of-investment in addition to return-on-investment. The market derived rate represents the requirement on the part of the investor to receive (a) a return-of and return-on-investment, and (b) to be compensated for the inherent risk in the investment. The WACC derived discount rate consists of only a return-on-investment.

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[17] The difference between market data and Cost-of-Capital data or usage has been an issue in real estate. See "*The Use and Misuse of CAPM in Property Tax Valuation*," Schweihs, Robert P., Journal of Property Tax Management, Fall 1994

[18] See also, "*Valuing a Business*," Pratt, Shannon R., Reilly, Robert F., Schweihs, Robert P., Third Edition, 1996, Richard D. Irwin (Times-Mirror)

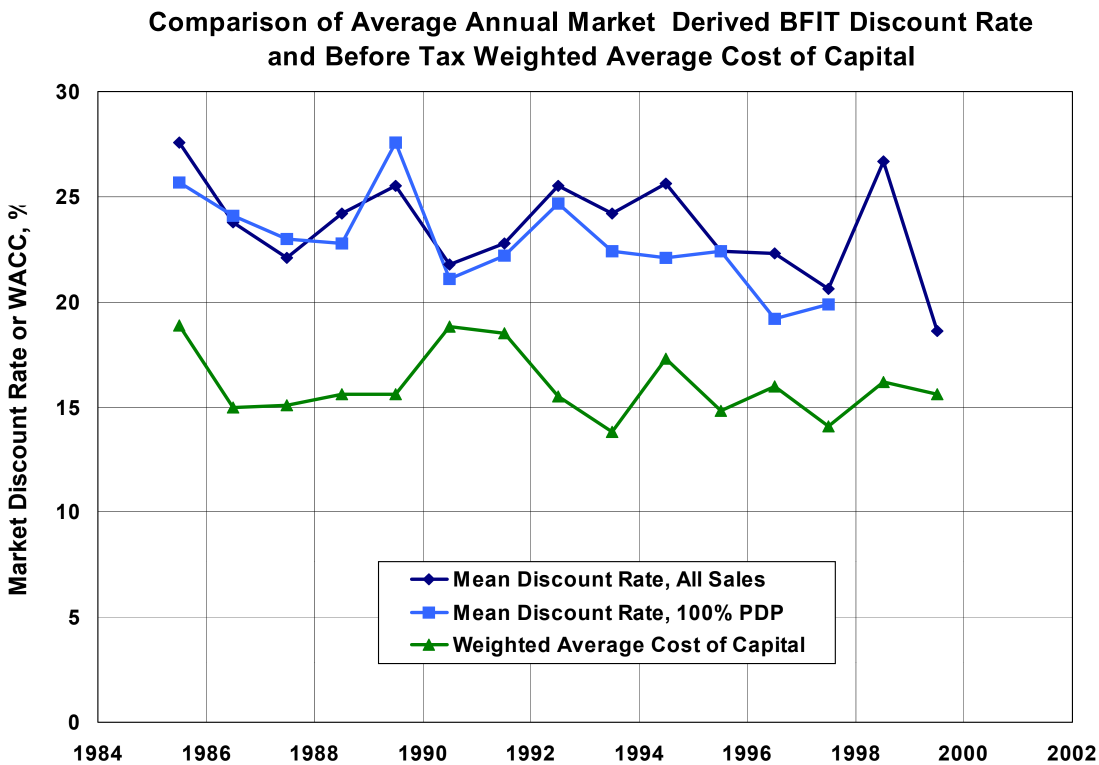

Figure 1

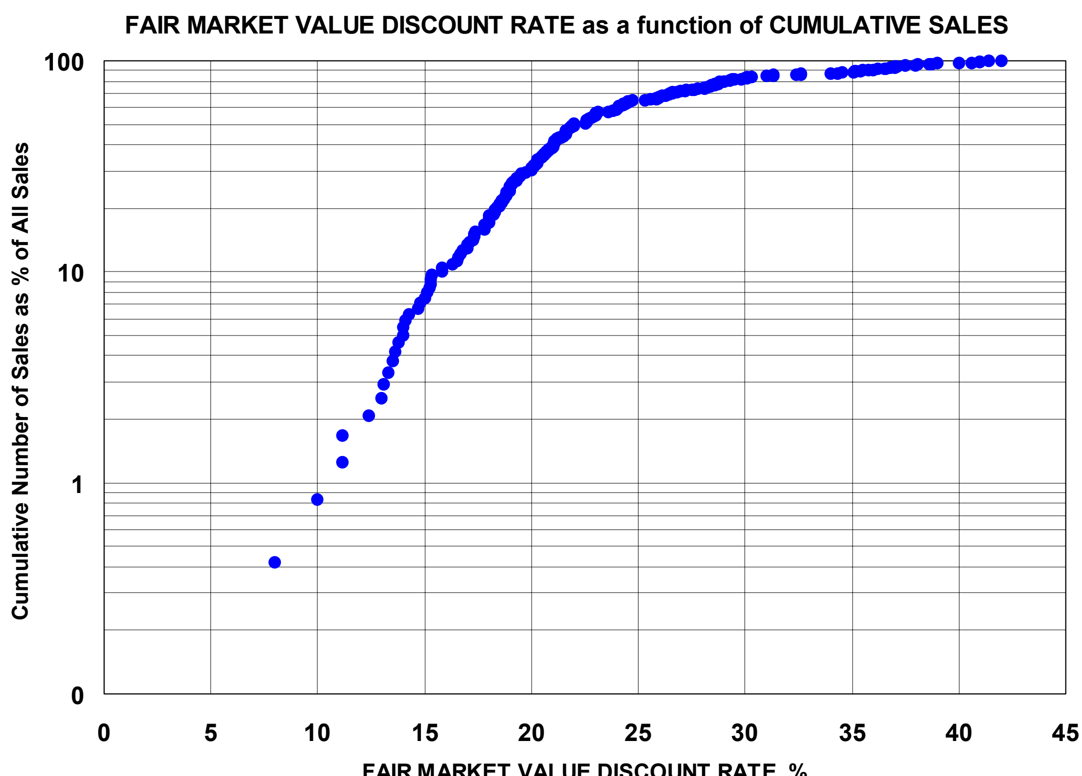

Figure 2

Having identified three sources for the differences between market derived and cost-of-capital discount rates, it is often necessary to bridge the gap between the results of the two methods, either because the number of actual sales is small or to provide a second source of reliable data to support market derived data. Oil property appraisal has taken a few steps to bridge the gap between the readily available COC rates and the specific property discount rates needed for appraisal use. This process has essentially tried to move from cost-of-capital for large publically traded companies to the discount rate that might be used for small, single purpose closely-held companies that could serve as a surrogate for a specific property source.

Liquidity

The most obvious difference between Market Derived discount rates and WACC rates is the liquidity of the underlying assets. Liquidity is defined as, *"The amount of time required to convert an asset into cash....For noncurrent assets liquidity generally refers to marketability."* [19] Marketability is the "*...relative ease and promptness with which a security or commodity may be sold when desired...*" [20] These terms are often used interchangeably and we do so here.

The WACC is a function of the returns from a mix of equity and debt instruments issued by publically traded companies. They are highly liquid investments. In contrast, oil properties are a special form of real estate for which there is a limited market and, like houses and office buildings, even under the best of circumstances can require weeks to conclude a transaction. This difference in liquidity is easy to state but very difficult to measure. Some success has been achieved by equating oil properties to the equity returns of closely held or privately held corporations which are subject to liquidity adjustments. The practice of business valuation of private firms must address this issue with some frequency. As noted by Pratt et al and incorporated by Ibbotson and Kaplan, [21] "*This is appropriate since... '[w]hen the business and the real estate it occupies are virtually inseparable, as in the case of a single-use property... the intertwined business/real estate entity will have more of the economic characteristics of a business entity than the economic characteristics normally associated with real estate. When that is true, approaches normally associated with business appraisal are likely to lead to a more reliable appraisal result than approaches normally associated with real estate appraisal.' This mirrors the characteristic of an oil and gas or a refining property*."

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19 "*Valuing a Business: The Analysis and Appraisal of Closely Held Companies*," Pratt, Shannon R., Reilly, Robert F., Schweihs, Robert P., Third Edition, 1996, Richard D. Irwin (Times-Mirror) Page 333

20 Ibid, pg. 333

21 "*WACC for Pure-Play Oil and Gas Extraction and Refining Entities,*" Ibbotson, Roger G. and Kaplan, Paul D., Chicago, IL, prepared for and presented to Western States Petroleum Association, January 15, 1997, page 11

Accounting for Liquidity

The companies that are used in the WSPA sample to derive an industry WACC are all large, publically-traded companies listed primarily on the NYSE. In contrast, oil and gas producing properties are not liquid, as witnessed by the lengthy process of any significant sales transaction. There is no particular method for measuring the difference in liquidity between stocks, bonds and producing properties or of equating that difference directly to discount rate. However, business valuation practice allows some insight into adjusting the WACC to compensate for liquidity issues.

The WACC calculated in both the WSPA and the Texas Study is a classic textbook form, which is correct insofar it goes but, in practice, it is not at all uncommon for companies and individuals to adjust the WACC to account for forward risk or to reflect the opportunity cost-of-capital as opposed to a historical weighted calculation. This is particularly true when the purpose of the WACC is to serve as a tool for setting minimum return requirements for project selection and capital budgeting. In this regard, an additional component of 1-3% added to the WACC is often considered a valid approach and is recognized even by taxing authorities [22] as reasonable. Pratt et al [23] refer to this component as *Investment-Specific Risk*. The addition of a 2% Investment-Specific Risk component to the calculated WACC would result in an estimated cost-of-capital applicable to a particular income stream of 17.6% BFIT for year-end 2000 or 18.0% BFIT for the 1985-2000 period.

But there is more to the liquidity issue. Pratt et al note that the "*...market for securities in the United States is the most liquid market... in the world*." [24] and that "*Empirical evidence demonstrates that investors are willing to pay a high premium... or ...extract a high discount relative to actively traded securities for stocks or other investment interests that lack this high degree of liquidity*." [25] Pratt is referring here to securities in closely held companies as compared to those such as the 40 oil and gas companies used in the WACC calculation whose shares are continually traded on the NYSE and other exchanges. A closely held company is one that may have tradeable shares, but they are so "closely held" by a small group of investors and are so infrequently traded that there is no established market for the shares and hence no liquidity.

Assume that *Pure-Play Company* ("PPC") is a private company and that the sole business of the company is producing and selling crude oil and natural gas. There are no shares of PPC listed

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22 *"2001 Property Value Study: Determination of a Discount Rate Range for Petroleum and Hard Mineral Properties*," Texas Comptroller of Public Accounts, Property Tax Division, August 2001, pg. 5.

23 "*Valuing a Business: The Analysis and Appraisal of Closely Held Companies*," Pratt, Shannon P., Reilly, Robert F., and Schweihs, Robert P., Third Edition, Irwin

24 Ibid, pg. 333

25 Ibid, pg. 333

on any exchange in 2000. In contrast to shares in a publically-held company, the only liquidity available to PPC shareholders are sales among the current shareholders. This is not sufficient to establish a market value of a corporate WACC at year-end 2000.

Pratt discusses "*Marketability Discounts Evidenced by Prices of Restricted Stock*," which is a publically issued stock that is restricted from trading for a period of time. [26] The valuation of such stocks has been studied extensively and is covered by SEC regulations. [27] A compilation of the results of 10 separate studies covering the past 30 years suggest discounts of restricted stock ranging from 23% to 45% and averaging 32.9%.[28] The average is consistent with most of the individual study results. Applying the average discount to estimate a Cost of Equity for Pure-Play Co. could be done as follows:

Average AFIT Cost of Equity [29]	=	11.895%
Adjustment for Liquidity	=	11.895%/0.671 = 17.727%
Conversion from AFIT to BFIT	=	17.727%/(1-0.35) = 27.27%
WACC [30]	=	((0.27598)(8.00)) + ((0.72402)(27.27))
	=	2.20% + 19.74% = 21.94%

However, the above is only applicable for issued and tradeable shares. Pure-Play Company shares are not tradeable. Pratt also reports the results of marketability discounts for privately held shares before public offerings. One study of 173 transactions in the 1980-93 period found a mean discount rate of 47%. [31] A second study of 879 transactions from 1975 through 1992 found a Median discount of 62.1%[32] The two studies employ differing methodologies. Without judging one compared to the other, a discount of 55% would seem to represent the data. Applying a 55%

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26 Ibid, pg. 335

27 Securities and Exchange Commission, Accounting Series Release No. 113: Statement Regarding Restricted Securities (Chicago: Commerce Clearing House, Federal Securities - etc.)

28 "*Valuing a Business: The Analysis and Appraisal of Closely Held Companies*," Pratt, Shannon P., Reilly, Robert F., and Schweihs, Robert P., Third Edition, Irwin, pg. 343

29 "*Fair Market Value Transactions, Cost of Capital, and Risk: California Oil and Gas Property Transactions 1983 through 2001*," Richard J. Miller & Associates, Inc. for Western States Petroleum Association, January 16, 2002, Exhibit 1.

30 For this calculation the industry average cost of debt (8.0%) and the average capitalization (27.598% Debt and 72.402% Equity) are taken from the WSPA Study, 2002, Exhibit I.

31 "*Valuing a Business: The Analysis and Appraisal of Closely Held Companies*," Pratt, Shannon P., Reilly, Robert F., and Schweihs, Robert P., Third Edition, Irwin, pg. 343

32 Ibid, pg. 348

discount to the 11.895%AFIT cost of equity results in an adjusted WACC for Pure-Play Company as follows: [Data from Table 1]

Average Cost of Equity [33]	=	11.895%
Adjustment for Liquidity	=	11.895%/0.45 = 26.43%
Conversion from AFIT to BFIT	=	26.43% (1-0.35) = 40.66%
WACC	=	31.640%

This adjustment would account for the liquidity issue.

Portfolio Risk

The corporate debt and equity returns that are used to calculate the WACC at a certain date derive their value to investors, in large part, because they represent the income and potential growth in value from all of the sources of income available to the company. ChevronTexaco, for example has literally thousands of individual income streams from each producing property, refinery, service station, Star Mart and uncounted other sources. Even a modest independent company has several hundred income streams providing revenue. This diversity of income sources means that, at least in theory, the loss or failure of performance of any one, or even several, income stream(s) does not have any significant effect on the bottom-line return. Of course, not all income streams are equal, so even among the streams there are varying risks, but the concept is still valid. In comparison to ChevronTexaco, the independent producer may have a higher risk because a downturn in income from production cannot be recovered through offsetting refining and/or marketing returns. This "*Portfolio Risk Effect*" is shown as the difference between owning only the XYZ lease or, conversely, owning 100 leases similar to the XYZ lease. In the first case, loss of the lease income could be extremely damaging and there is substantial associated risk. In the second case, loss of one property similar to the XYZ lease might be noticed, but the risk of failure of the company or major loss is mitigated by the remaining 99 leases in the portfolio. The returns expected by investors in the stocks and bonds of the companies used in a WACC calculation reflect this lower portfolio risk. The result is a cost-of-capital that is less than the return expected for a single property. In the same sense, the discount rate used to value a single income stream from the XYZ lease should reflect the risk associated with the potential loss of that income stream with no Portfolio Effect to cushion the damage.

Quantifying Liquidity and Portfolio Risk

The return premium necessary to mitigate Liquidity and/or Portfolio Risk issues is difficult

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[33] "*Fair Market Value Transactions, Cost of Capital, and Risk: California Oil and Gas Property Transactions 1983 through 2001*," Richard J. Miller & Associates, Inc. for Western States Petroleum Association, January 16, 2002, Exhibit I.

to identify and to quantify in property transactions. One approach to the issue is the use of a variation of the WACC known as the *Pure-Play Analysis*. By this method the WACC is calculated for companies whose sole business is oil and gas production.

Pure-Play Analysis

A useful method of 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 completed a study for the Western States Petroleum Association. [34] 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 the Capital Asset Pricing Model ("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 that 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 which the companies were engaged in upstream production or refining. Regression analysis 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 that 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 a 25% factor 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

[34] "*WACC for Pure-Play Oil and Gas Extraction and Refining Entities,*" Ibbotson, Roger G., Kaplan, Paul D. Chicago, IL. prepared for and presented to Western States Petroleum Association, January 15, 1997.

annual SPEE [35] survey of producers and others. In that survey, respondents provide, among other data, their minimum return requirements for acquisition investments.

Regardless of the purpose of an evaluation, each property should be valued individually based on the characteristics and income producing capacity of that property; that is, as a stand-alone entity rather than as an asset of a company. It is a short conceptual step to think of each property as a Pure-Play company whose only business is to produce that property. If each property is considered to be a Pure-Play company, then the Pure-Play discount rate extracted from capital market data, such as done by Ibbotson, could be applicable. Further, the Pure-Play WACC can serve as a check on the Market Sales data. But a Pure-Play discount rate derived for an entire SIC code is only a starting point and is incomplete. This approach reduces the Portfolio Risk and Liquidity Risk and moves closer to a valuation of primarily small company stocks where all the return is derived from production.

Publically-traded companies are not individual, specific properties. Even Pure-Play companies have multiple income streams. The Ibbotson analysis addressed the Liquidity and Portfolio issues, but two others, *Property Risk* and *Return-of-Capital*, remain. In regard to Risk, Ibbotson cautions that this BFIT WACC would only be applied to Risk-Adjusted cash flows. *"The WACC/CAPM approach presented here treats systematic risk and illiquidity as the only aspect of the subject entities that investors take into account when formulating expected rates of return. This is appropriate if the expected future cash flows which are to be discounted have been calculated taking all sources of risk into account through probability-weighting. In the case of oil and gas extraction properties, sources of risk that must be taken into account in expected future cash flows include, but may not be limited to, the complexity of the reservoir, the recovery method to be employed, and the regulatory environment."* [36] 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.

If the cash flow from a 100% PDP property is properly adjusted using the average risk adjustment factor of 97.2% noted in the 2001 Society of Petroleum Evaluation Engineers (SPEE) Survey, [37] the 20.15% could be applied to the BFIT cash flow to obtain an estimate of market value. Similarly, the 20.15% could be used to estimate value for a cash flow from a 100% PUD property if an appropriate adjustment factor (47.5% in the 2001 SPEE Survey) is first applied to the cash flow. In the absence of generally accepted risk adjustments, the single value Pure-Play WACC is not adequate and must be adjusted to account for the risk associated with a specific property (reserves). The Pure-Play WACC rate provides a floor discount rate that must be adjusted for property risk.

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35 *Society of Petroleum Evaluation Engineers* annual survey of evaluation parameters

36 "*WACC for Pure-Play Oil and Gas Extraction and Refining Entities,*" Ibbotson, Roger G., Kaplan, Paul D. Chicago, IL. prepared for and presented to Western States Petroleum Association, January 15, 1997., pg. 2

37 "*Survey of Economic Parameters Used in Property Evaluation,*" June, 2001 Society of Petroleum Evaluation Engineers, Houston, TX, pg. 22

Return-of-Investment

In real estate appraisal, it is expected that an investor will want to obtain both a return of the investment being made and a return on that investment. It is no different in property evaluation. "*The notion that an investor anticipates realizing a complete recovery of invested capital plus a payment for the use of capital prevails in the real estate market just as it does in other markets. The term return of capital refers to the recovery of invested capital; the term return on capital refers to the additional amount received as compensation for use of the investor's capital until it is recaptured. Investors are concerned with both return of capital and return on capital. The rate of return on capital is analogous to the yield rate or the interest rate earned or expected.*

In real estate investments, capital may be recaptured in many ways....Investment capital may be recaptured through annual income or it may be recaptured all or in part through resale of the property at the termination of the investment. If the property value does not change between the time of the initial investment and the time the property is sold, the investor can recapture all the capital invested at its sale. Thus, the annual income can all be attributed to the return on capital. In this case, the indicated income rate - i.e. the overall capitalization rate - will equal the return on capital.

If, on the other hand, the property value is expected to decrease over time and the investor does not expect to recapture all of the original investment at the time of resale, some of the income stream must be used for the repayment of capital. In this case, the rate of return on capital will be somewhat less than the indicated income rate (i.e. the overall capitalization rate in direct capitalization). The difference between the rate of return on capital and the indicated capitalization rate will be the rate of return of capital. The recapture rate is considered positive." [38]

As noted above, discount rates derived from actual sales are total returns that include both return-of-investment and return-on-investment. Returns derived from cost-of-capital measure only return-on-investment. The difference is significant and can be measured.

Return-on-Investment: WACC as an Interest Rate

The WACC is, by definition and construction, only a form of interest rate. This is shown by the primary components. Cost-of-Debt is the interest rate or Yield-to-Maturity on outstanding debt. It does not include principal repayment. When a bank or other lender grants a loan and assigns an interest rate, it is done on the assumption that the principal will be repaid, either over the term of the loan or at maturity; it is no different than interest on a Certificate of Deposit, which can be redeemed for full value at maturity. Cost-of-Equity, as calculated by the CAPM and by all other methods, is a forward rate-of-return on an equity investment. Returns on stock investments are composed of future dividend payments plus anticipated growth in value (share price). CAPM calculates the additional risk-related interest rate required, over and above a safe rate of interest to

[38] "*The Appraisal of Real Estate*," Eleventh Edition, 1996, Appraisal Institute, Chicago, Ill, pg. 457-458

attract funds to higher risk equity investments.

Both the debt return and the equity return assume that the principal can be recovered at any time by the investor by redemption of the bonds (debt) or sale of the stock (equity). The WACC model assumes that the investment is held for a long time. This makes the projected return from WACC the return from a perpetuity, which in turn produces a uniform return.

Financial analysts will argue, quite correctly, that return-of-investment is taken into account in the WACC through the Depletion, Depreciation and Amortization ("DD&A") provisions of the income tax. This may be true to an extent and would be an important consideration if: (1) an AFIT discount rate were being derived, and/or (2) the WACC were being derived for/from internal corporate purposes/data. But, in this exercise, the objective is a BFIT WACC calculated using only the statutory tax rate adjustment with no consideration for DD&A or other deductions. This approach is necessary for four reasons. First, the returns being measured by CAPM and WACC are the forward rates to investors in the corporation, not to the corporation itself, so that the DD&A deductions do not apply. Second, the rate that is sought is a forward rate for a specific property - not a historical or even current rate for a company. Third, the property does not pay income taxes, the company does. Finally, the WACC is structured to calculate the returns to an investor in the company's debt and equity, not in the company's projects.

Why is Adjustment of the WACC Necessary?

In real estate terms, the WACC assumes that: (1) the income stream received by the investor is a perpetuity, and (2) that recovery of the original investment occurs as a 100% (or a substantial %) reversion at some time in the future. In the case of liquid stocks and bonds, reversion can occur at any time chosen by the investor. Unfortunately, the income from oil and gas properties is rarely, if ever, a constant stream at the same annual amount. Income from oil properties typically declines over time. Further, oil properties are depleting assets that have no reversion value at the end of the life of the property.

The Real Estate Approach

Real estate appraisal has long since resolved this issue. Three methods, commonly known as the *Ring Method*, the *Inwood Method* and the *Hoskold Method* are used to solve this problem. The Hoskold Method is discussed here as being most appropriate to oil and gas appraisal. The method was developed in the 1880's by a mining engineer to resolve the issue of capital recovery from depleting assets (coal mines). The method stipulates that capital recovery occurs at a "*safe*" interest rate and that this rate is added to the expected earning rate to create a total return rate that includes return-of and return-on-investment. As capital is recovered from the income stream, the funds are reinvested at a safe rate to accumulate to the recovery of the initial investment.

Payout as a form of Return-of-Investment

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. 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. All income received after Payout contributes to return-on-investment.

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 that can be used to calculate the return-of-investment by treating it as payment of mortgage principal. Even using our simple approach, we could say that part of the difference between the Cost-of-Capital and market discount rates is the return-of-investment equivalent to scheduling Payout over the economic life rather than the first few years of production.

Applying a Real Estate Approach

An exploration of the qualitative adjustment of the WACC to account for return-of-investment has been conducted as part of the WSPA Study. [39] In that analysis, investment rates of 15%BFIT and 20% BFIT were used to test the correction necessary for an average WACC (15-16% BFIT) and the Pure-Play result (20.15% BFIT). The analysis was done by creating a very simple income stream declining at 15% per year over a 10-year term. It was assumed that Return-of-Investment was obtained at a fixed rate per year and that Return-on-Investment was obtained from the balance of the income stream. This simple analysis showed that in order to obtain full recovery of the original investment in 10 years and earn a 15% BFIT return on the original investment, the income stream would have to be discounted at 28.624% BFIT to determine a value for the Income Stream. The Income Stream would have to be discounted at 37.825% BFIT in order to obtain a 20% BFIT return on investment.

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[39] "*Fair Market Value Transactions, Cost of Capital, and Risk: California Oil and Gas Property Transactions 1983 through 2001*," prepared for Western States Petroleum Association by Richard J. Miller & Associates, Inc., January 16, 2002, pg. 60.

These rates are substantially greater than the market discount rates derived from sales where the average discount rate for 100%PDP properties is 21.8% BFIT. The strong suggestion is that the market sales data represent anticipated return-on-investment, which incorporates some of the Liquidity and Portfolio risks, along with specific property risks that were discussed above, but that they do not include a component for return-of-investment which will be obtained by Payout. In other words, a derived discount rate of 21.8% for a 100% PDP property approximates the Pure-Play return of 20.15% BFIT and may contain some property risk. Using the SPEE risk adjustment of 97.2% for 100% PDP properties, the 20.15% would become 20.73% BFIT. A Hoskold approach could then be used to account for return of investment.

If a safe rate of interest of 7% over a 10-year term is assumed, the sinking fund factor is 7.24%, which if added to the 20.73% BFIT yields a total rate of 27.97% BFIT. This is almost 10% short of the calculated discount rate of 37.825% BFIT. There are two possible explanations for the difference. First, the simple 10-year income calculation does not consider reinvestment of recovered investment to aid in the return on investment. This adjustment would only apply, however, if the funds were invested in a savings account. Second, the real estate methods, including Hoskold, assume level income - not declining income as was projected in the calculation.

On the other hand, the problem could be in the 10-year term that was assumed in the calculation. Oil properties are commonly expected to produce and are valued on terms of 20 to 30 years. A 7% sinking fund factor for 20 years is 2.44%, while a 30-year factor is only 1.05%. Using the Pure Play rate of 20.15% BFIT as a starting point and a 20-30-year term results in a range of 21.21% to 22.59% BFIT. Adjusting for reserves risk (97.2%) results in a range of 21.82% to 23.24%BFIT. This range is consistent with the market derived rate of 21.8% for 100% PDP properties.

Bringing the Pieces Together

The discussion above suggests that a properly constructed WACC can be used as a discount rate for a single property but only if certain adjustments are made to account for discount rate components that are necessary for valuing a specific property but which are absent from the WACC. In theory, one could take a WACC of 15.6% BFIT (2000) where the Cost-of-Equity is 11.895%AFIT, add a factor for Liquidity and Portfolio Effect, and then add another increment for Return-of-Investment using a Hoskold approach. In the analysis presented above, this could lead to a discount rate of 21.2 to 22.6% BFIT with no adjustment for reserves risk. This rate is consistent with that shown for 100% PDP transactions from Market Sales.

It would be a mistake to treat this as a purely mechanical process of calculating and adding together increments to get to a final result. However, this discussion does indicate that evaluators who only have access to cost-of-capital information for use in selecting discount rates should keep in mind that the WACC does not apply directly to the evaluation of individual property income streams and that some consideration of the missing elements must be included in the selection process. The discussion further substantiates the validity of the California and Texas property sales data, which suggest that BFIT risk-inclusive rates in the 20-30% range are appropriate.

It should be apparent that much more work remains to be done. While oil property appraisers have gathered a lot of the puzzle parts and been able to define a framework, the bridge from COC to specific property value discount rate is far from complete. We need the vast resources of the Business Valuation community to make this bridge safe for regular traffic. Any and all suggestions are welcome.