APPRAISING OIL & GAS PROPERTIES

A Newsletter for Appraisal Professionals

Richard J. Miller & Associates, Inc. Vol. 3 No. 3 July, 1997

Reserves: You say Proved - I say Probable - Let's call the whole thing off.
A play in two Acts - Act the first

I started work on this newsletter back in February with the hope of getting it out in March - but that didn't work. My plan - as we noted in the last issue - was to discuss Reserves. But the text got more voluminous as I realized what had to be included. So here we are in June. Our discussion of reserves will end up in two issues - this one and the next. One major point of discussion will be the new SPE definitions of Reserves. These are buried deep in the inner recesses of the May, 1997 Journal of Petroleum Technology on page 257; two pages of small print with just enough changes to keep all us evaluation engineers in court (business) for the next 10 years. Yippee! But first - a story.

A "Chipmunk Story" or "Christmas in the Woods"

We have a "cabin" in the mountains north of Los Angeles. This rustic monument to Home Depot provides a restful retreat for some of us and an opportunity for me to relieve pentup frustrations through the use of hammers, post-hole diggers, and occasionally the old chainsaw. The first person has learned to capitalize on the latter so well that the whole process has become art form. We are at about 6,500' so during the winter we can get 4-5 feet of snow, which can make for pleasant weekend or short vacation of tobogganing and other life threatening sports interspersed with first-aid drills.

Of course, we have to share this idyllic area with other inhabitants mostly of the four-footed or winged variety. The farmer group includes a small tribe of Western chipmunks. We first became aware of these critters a few years ago when I was in the process putting up gutters. While up on a ladder inspecting a good-sized woodpecker hole I came nose-to-nose with a small furry face whose owner, in a somewhat agitated state, expressed a concern about my presence on his turf. The first chipmunk was joined by a second, and then by a third who perched on top of the other two. All three then proceeded to scold me in no uncertain terms. Apparently these guys, promptly named Alvin, Simon, and Theodore, had set up housekeeping in our roof. I tried to explain to them that the hole had to be fixed because winter was coming but they came right back with something about the Homestead Act. I decided to leave that repair for Spring. Recently, however a new territorial dispute has arisen. Early this past winter, charged by the Lady of the house to "Get wood - Build fire", I moseyed out to the woodpile and, after removing the tarp, proceeded to load up. Lo and behold, out from under some logs comes this chipmunk, who proceeds to read me the Riot Act about destruction of local habitat. Apparently A, S, and T were now living in the woodpile. There was considerable chattering and scampering about which could only be interpreted as objecting to the removal of any wood from the pile. I calmly pointed out that this was my woodpile, and whereas I had labored mightily to cut and stack the wood they had no grounds for complaint. When this failed to be convincing I pointed out that I still had the axe. This seemed to score some points and

the confrontation was, I thought, over. Well, as the winter proceeded they apparently moved over to the pile of rocks that I have been accumulating for a planter wall. So here I am getting ready to start on the wall and no sooner do I move the first rocks than here come A, S, & T, demonstrating about Chipmunk Rights, equal protection, and running up a little green flag with a picture of an apple core on it. I built the wall anyway. We don't want to run these guys off so I suppose we will soon be starting "Habitat for Chipmunks." Whether we have to pay moving expenses for whatever stores of nuts and berries that they have accumulated is another issue. We may try to list them as dependents since we appear to be providing shelter.

Whilst pondering the moving cost question, I provoked a thought: Do chipmunks actually collect and store nuts and other food items? Do they plan ahead based on accumulated knowledge about length of winter, temperature, depth of snow, the quality of the current piñon crop, and volume of storage space in the nearest 'pecker hole, woodstack, or rockpile? Do chipmunks have the ability to estimate nut usage during the winter, and forecast the number of nuts that would remain at the end of the season? Further, do they adopt a program to add to the surplus every year so that they have a reserve of nuts in case there is another Ice Age? I seem to recall that Chip and Dale did so. I have not had a chance to discuss these questions with A, S, & T, given the current state of our relations. But, it did occur to me that this was a good segue into our primary topic.

One of the objectives of this sometimes, occasional newsletter has been to present a point of view that may or may not agree with conventional wisdom - whatever that is - if for no other reason than to encourage some thought about the subject(s) and maybe even stir up an active response or two. In our last issue, we attempted to dissect the concept of Fair Market Value and the various definitions there of which are found in appraisal literature, court decisions, and general usage. We got some interesting responses from readers (see Letters). At the time we promised to do a similar exploration of another topic on which everyone agrees: Reserves. As noted earlier this topic will be covered in two parts. In the first part we will discuss the concept of Reserves with particular focus on the relation between physical volumes of oil and the "defined" volume of Reserves. In the second part, we will review some of the issues regarding Reserves and how the new SPE definitions may act to resolve or exacerbate those issues. But first, the Age-old question.

What are Reserves?

In the Beginning, Man drilled for and produced oil and proceeded to sell it as fast as he could with scant concern for the future. Get your oil out faster than your neighbor and, if you're lucky, get his too! Who has time to worry about how much there is? And it came to pass that such foolishness begot volatile oil supply which begot volatile oil price - which made Life difficult. Then Man decided, or more accurately, the Texas Railroad Commission decided, "This is Not Good!" and handed down "Proration," which put a hitch in everyone's getalong. But Man was soon joyful because over-production stopped, oil price went up, and Man made money. And , lo, there came from the East (and the West), Bankers, who gazed upon the scene and said, "Behold, there is money here, and we should lend against the future production," (now that production and prices are stable). There came to be among Men the production loan, followed by taxes, ABC loans, secondary recovery, and unitization; and before you knew it everybody and his brother was asking, "What are Reserves?"

Reserves, whether of oil or gas or piñon nuts, is a concept that evaluators and appraisers use as a central part of any estimate of value. But what is a Reserve? Show me one. Suppose a stranger appeared in your office one day and said, "Howdy. I'm from Mars. No, thank you, I have met your Leader. The House was nice, but I think $50,000 a night is sort of pricey to share a bunk with some Arkansas chicken farmer," and then he says, "but I really came to Earth to find out, What are Oil Reserves?." How would you answer the question? If a Man from Mars is a bit far fetched, how about: (a) Judge, (b) media person, (c) the Energy Department, or (d) clients whose primary business is not oil and gas. Pretend that the questioner already knows that oil exists in the ground and that he or she understands how the volume of oil-in-place and recoverable oil is estimated. Further, presume that they know that oil must be produced in order to have value, but is hung up on, "What are Reserves?" It is not easy - as we shall see.

On the other hand, you might ask, do I really need to understand what Reserves are or how many little reserves make a big Reserve? If, as we have discussed before, valuing oil properties is really valuing an income stream why clutter things up by worrying about Reserves. All it does is confuse everyone. Also, Reserves are important because, for one thing, all Reserves are not created equal and that fact alone has a direct impact on how you value the expected income stream. As we know, Reserves are central to the oil industry in providing a common measure of success. The amount, location, access, to, and change in ownership of Reserves is, right after $$$, the driving force of the whole ball-game. If you don't think to see Yergin, "The Prize." [(1)]

For all practical purposes (not to be confused with the Legal sense) Reserves are a volume of oil and/or gas [(2)] in the ground that is expected to be produced over time. In this respect, Reserves bear some similarity to inventory. For a producing company, the volume of reserves is the source of the production stream that will form the basis for income in future years. A production company without reserves is out of business; an integrated company without reserves must obtain refinery feed stock from other sources. Replacement of produced Reserves and net additions to Reserves are a major concern for both producing and integrated companies. In addition, Reserves often serve as a metaphor for the operational and/or financial success of the company as shown in the following examples:

- Keep Trying Oil Company doubled their Reserves in Goner field by (a) infill drilling, or (b) steam injection, (c) reducing operating costs, or, (d) all the above.
- Eastern Bay Company has tripled its Reserves by horizontal drilling in the Austin Chalk.
- The recent drop in oil price has severely reduced heavy oil Reserves in California.
- High Hopes Oil Company acquired 2 million bbls of Proved Reserves from Leaving Town Oil Company.

Reserves even get into the news, become political issues, and spawn giant new government agencies because (remember this one?) ..."We are running out of oil.."

Are Reserves Real or are they Artificial?

Probably the reason that many people have difficulty with the concept of reserves is that Reserves are both Real and Artificial. Stay with me on this because the distinction is important. Evaluators get into trouble when the difference is forgotten.

There is no question that reserves represent a physical volume of oil that is expected to be recovered. Ninety percent of petroleum engineering ("PE") practice is concerned with estimating the Oil-in-Place (OIP) and the fraction of OIP that can be recovered. Unlike jars of Picante sauce in a grocery store. Reserves cannot be physically measured. They can only be estimated by using indirect measurements of rock and fluid data; by comparisons with other properties; by extrapolation of production history; or by using computer models. Regardless of how carefully done the estimation of physical reserves is subject to some error: This is the reason for all those books by Muskat, Craft & Hawkins, and others and all those classes on formation evaluation and fluid flow in porous media. The estimation of the physically recoverable volume is the province of engineers and geologists employed in serious investigations involving contours on maps, squiggly lines on well logs, and decline curves, all mixed together with higher mathematics.

This physically recoverable volume ("PRV" for short) is the basic component of Reserves. A large amount of effort and expense goes into estimating OIP and PRV. This work continues throughout the life of the production as information is accumulated and technology marches on. Regardless of how carefully done, the estimation of physical reserves is subject to some error. The actual reserves will not be known until the field has been abandoned. These are the Real Reserves.

But now we have to consider the Artificial aspect of Reserves. If 90% of PE goes to estimating OIP and recoverable oil, the other 10% goes into turning those producible volumes into an income stream. I was taught early - on that oil companies are not interested in producing oil; they would prefer to make money. So PRV cannot become a Reserve unless it is profitable to produce the oil. You cannot add the oil to inventory - as it were - unless it is profitable to do so. Profit is income minus expense. Therefore, we must now consider the price of oil and the cost of production plus investment in our determination of Reserves. And, since prices and costs have been known to change over time the time element has to be considered. When this is done, the PRV may stay the same but the Reserves, now subject to economic conditions, can increase or decrease as economic conditions change. And, since these last are rarely controllable they impart a certain artificial aspect to the Reserves. They can be literally be here today - gone tomorrow.

As we noted earlier someone always wants to know, "What are the Reserves?" of the (a) lease, (b) field, (c) company, or (d) all of the above. You want to know so you can tell your boss. Your boss wants to know so he can tell management. Management wants to know because they have to provide reserves numbers to (a) equity owners and underwriters to keep the stock value up; (b) the bank, to keep their credit lines and production loans current; (c) the Securities and Exchange Commission, ("SEC"), to inform investors; (d) federal and, state authorities, because they say so; and, last but not least, (e) the Tax Assessor if you are in California, Texas, or Utah. That is a lot of reporting and the amount of reported Reserves assumes exaggerated importance because so many people have come rely on them.

Of course, when all these interested entities request reserves data, they start to be concerned that the data is "correct". They fret that the Reserves reported by Blue Sky Oil are measured in the same way as the Reserves reported by Blue Sky Oil. Since no one can actually measure reserves, there must be agreement about how to estimate reserves. A "Standard of Measurement" ("SoM") must be imposed so that nobody gets snookered; so everyone in the room can hold a Reserve out at arms length, look at it, and say, "Yup, that's a Reserve all right." But then, to impose a ("SoM"), we have to describe the standard - you must define the terms of the standard so everyone will know what the standard is to be. Standards ultimately come down to a definition and that's where the fun starts. In the end, Reserves determination is dependent on to the ability to understand high school English.

Who Defines Reserves?

Reserves definitions are promulgated by three groups: professional societies, governments, and Management. Each group has a different purpose. For many years, industry professional organizations (API, AAPG, SPE) had definitions that differed only slightly. The earliest reference that I found was an API [3] definition from the 1930's which tends toward a description of Reserves as a physical volume. Over the last 30 years or so, these professional groups have worked together to create definitions that could be collectively accepted. The 1987 revision to the SPE [4] definition was a collaboration of several groups. SPEE [5] has published a comprehensive discussion of the SPE definition(s) including their application to the reserve estimation process. The latest (1997) revision by SPE is partially in response to the WPC [6] for an expanded definition. In addition, various levels of government have created, promoted, and otherwise caused to be used, definitions of reserves which are similar to the industry definitions but with important differences. The SEC[7] has a definition which is required for use in estimating reserves for public reporting. The California State Board of Equalization ("CSBE") has a slightly different definition of Proved Reserves for use in ad valorem tax appraisal.

The Definition of Reserves

So now we know that Reserves are created by taking a real, physical quantity of oil and circumscribing that volume with the terms of a definition. The SPE definition of 1987 is generally accepted as the industry standard. This definition says:

"Reserves are estimated volumes of crude oil, condensate, natural gas, natural gas liquids, and associated substances anticipated to be commercially recoverable from known accumulations from a given date forward, under existing economic conditions, by established operating practices, and under current government regulations. Reserve estimates are based on interpretation of geologic and/or engineering data available at the time of the estimate."

Further, "Proved reserves can be estimated with reasonable certainty to be recoverable under current economic conditions. Current economic conditions include prices and costs prevailing at the time of the estimate."

The SPE definitions are fairly detailed in the explanation of the different categories of reserves and in the discussion of the conditions which cause reserves to be put in one category or another. They are well written and, when combined with the extensive discussion provided by Monograph 1[8] , should make it possible for estimators of reserves for the same property to reach the same conclusion, presuming identical and complete information. You would think so, but as we can all attest, they do not. The reason is that a definition, no matter how well crafted, is a collection of words and, as we discovered last time in our exploration of Fair Market Value, Words can be tricky.

Without going into a lot of detail, for now, the SPE definition of reserves clearly establishes the physical aspect of reserves; they are "estimated volumes..... anticipated to be..... recoverable.... by established operating practices....". In order to be Proved Reserves they must be recoverable with "reasonable certainty". All these phrases are functions of engineering and geology and, in a world without economics considerations, would be completely acceptable. Reserves defined in this manner could be estimated and re-estimated at any time based solely on volumes produced, new information, or enhanced technology. These are the real Reserves we discussed above.

But, there are economic considerations to everything we do and these are recognized in the terms "commercially recoverable.... under existing economic conditions.... under current government regulations." These added phrases impose constraints on the physical characteristics of reserves; they require profitable production at a point in time with the result that the Reserve may not be the same as the volume that could be physically covered. In addition, the term "under current government regulations" imposes restrictions that could range from production rate controls (proration) to taxes. Taken collectively these are limitations imposed by edict and they create the artificial Reserves that we met before. Note also that the economic constraints limit the volume of reserves so that artificial Reserves are always smaller then real Reserves.

This would not be of great concern if changes in the economic aspects of reserves occurred with the relative slowness of the physical changes but the economic factors of price and cost and regulation can be different from one day to the next so that reserves estimated on Monday could be different from reserves estimated on Friday. Not a recommended practice but it could be done. Therein lies the problem. Most of the disagreements involving reserves and their value, of which I am familiar, are caused more by the economic issues there by the physical ones.

A common reference from 1962 defines Proved Primary Reserves as:"...

Reserves which have been proved to a high degree of probability of production from the reservoir at a commercial rate of flow"

Where Primary reserves are: "....those reserves recoverable commercially at current prices and costs by conventional methods and equipment as a result of natural energy inherent in the reservoir."

Note the difference in economic emphasis in two definitions separate by 25 years. Except for the reference to "current prices and cost" and "commercial rate of flow," it is clear that the primary concern in 1962 was the physical volume of recoverable oil. There is a reason for this. The

1962 definitions were conceived at a time when prices were stable and there was no inflation. There is far more evidence of economic concern in the 1987 definitions than in the 1962 definition quoted above.

Even though these definitions are relatively well accepted, they are not rigid standards to which adherence in mandatory. The problem is that not everyone agrees with the definition. More precisely, not everyone interprets the words the same way (there's them Words again) and, even if they did, the polices and practices of individuals and companies are not necessarily constrained by a definition, no matter how widely accepted.

All Reserves Are Not Created Equal

Now (just to further confuse the issue,) would be a good time to recognize that there are different kinds of reserves. Reserves can be sub-divided into categories based on:

Energy Source	-	Primary, Secondary, Tertiary
Producing Status	-	Producing, Non-Producing
Degree of Proof	-	Proved, Probable, Possible
Development Status	-	Developed, Undeveloped

In general, the classification of Reserves by Energy Source presents few issues which provoke hostile reactions. As an example, Primary Reserves are those which are produced using only the natural energy of the reservoir such as gas expansion or water drive. This is the energy that causes the "gushers" that we see at Springdletop, Lakeview, in "Giant,"[9] and at Academy Awards shows. When this natural energy is depleted, a Secondary or Tertiary energy source such as water or steam injection must be introduced in order to recover more oil. The distinctions are important because Primary reserves are cheaper to produce than Secondary or Tertiary reserves which require far more care and feeding.

Producing Status is another fairly benign category. A property or well is either producing or it's not; and if it is not, it may be shut-in or temporarily abandoned or just having a bad day. The Non-Producing category has economic consequences because some investment will be required before the reserves can be classed as Producing.

Development Status becomes a bit more subjective. Whether a reserve is development or not may depend on such things as quality of geologic data, length of production history, drainage radius and numerous other physical aspects of reserve analysis. Reserves classed as Developed are considered to be less risky than Undeveloped reserves which may also require capital investment. But even these two genera can be broken into species. Developed reserves can be Proved but may be shut-in (Non-Producing) or may be cased off pending later production (Behind-Pipe). Undeveloped Reserves can also be Behind-Pipe if there has been no testing of the zone.

Is there no end? But wait, there's more!

The Degree of Proof category is the most subjective and leads to the most spirited disagreements. The difference between Proved, Probable, and Possible is the likelihood that the

estimated volume of oil will, in fact, be recovered. This calls for a determination of risk, odds, or probability of recovery based on the interpretation of data and the application of experience and judgement on the part of the evaluator which is always colored by his perception of the reliability of the available data. Proved reserves are called "Proved" because someone has drilled a well and tested and/or produced oil from the reservoir. If there has been no development but indications are pretty good that there may be oil, then these reserves could be Probable but probably not Proved. Possible reserves are the volume of "Reserves" that are referred to as "upside potential." The line between Proved Undeveloped and Probable is not a bright one but must, nonetheless, be discerned and respected. There have been, and will continue to be, attempts to quantify the difference but this is an attempt to supplant judgement with mathematics.

Estimated volumes of reserves are identified and pigeon-holed by combining the categories. Thus, Proved Developed Producing (PDP) have been drilled, tested, and have been on production long enough to provide a high degree of confidence of continued production. All other categories from Primary Proved Behind-Pipe to Tertiary Probable Undeveloped are increasingly speculative and have corresponding by higher of associated risk. On the other hand, Secondary reserves which are estimated for a proposed waterflood but where there has been no drilling of wells or injection of water (let alone production of oil) could be considered Probable Undeveloped, but could also be Proved Undeveloped if there was a waterflood similar to the proposed project in the same field and reservoir. In order to avoid a lot of confusion, we will limit most of the remaining discussion to Proved Reserves. Even so, we will have enough material for several pages. Besides, if we cannot reach a reasonable conclusion about Proved Reserves there is no hope for Probable or Possible.

It is worth noting that these categories are all described by physical characteristics of the reserve and/or the reservoir from which it is produced. The Energy Source, Producing Status, and Development Status are all functions of physical efforts of drilling, producing, or adding energy to the reservoir. The Degree of Proof is a function of the physical information acquired and interpreted. None of these categories are influenced by economic considerations - the reserve volume may be but the category is not.

Why are the categories important? The class of the reserves is related to the risk that may be assigned to the reserves for discounting. Probable reserves have greater risk than Proved reserves. In the marketplace, Probable reserves may have no value and Proved Undeveloped may be heavily discounted. The annual SPEE surveys suggest that risk adjustment factors for Proved Undeveloped reserves are 25-40% and factors exceeding 50% for Probable and Possible are not uncommon.

End of Act I

In the next issue we will discuss the reasons for the differences that occur in Reserves estimation among appraisers, the nuances that occur in some other Reserves definitions including the SEC version, and we will look at the new SPE definitions to see if they offer any help to us poor, confused souls.

Preview of Coming Attractions - Rated PG13

Why are there Differences in Reserves?

Differences in estimated reserves occur for two reasons. The one which seems most obvious is the ***physical estimation process***. The estimation of the volume of reserves requires analysis of a large amount of data concerning rock and fluid properties, production decline trends, pressure changes, operating costs, etc. All of this data is subject to interpretation based on the ability and experience of the engineer doing the work and the quality of the data. It is not uncommon for equally knowledgeable engineers to reach different conclusions but the differences, all things considered, should not be all that great and should be reconcilable.

The major cause of differences in reserves, particularly those related to disagreement about value, comes from ***differing interpretations of the definitions***. Despite the best efforts of API, SPE and SPEE, no definition can be written that is both foolproof and universally accepted. The equally knowledgeable engineers we met above may disagree about both the volume of reserves and about whether it is Proved or Probable, or part Proved, part Probable and how much of the Proved is Developed and how much Undeveloped. The differences in category can effect every appraisal value (based on production and reserves) from bank loans to balance sheets to property tax. So we come back to the Words again.

Footnotes and References

1. Yergin, Daniel S., "The Prize," Simon & Schuster, 1991
2. We will only talk about oil reserves but there are, of course, reserves of gas in gas fields. Reserves of gas associated with oil production in oil fields are often combined with the oil reserves based on a ratio of their respective heating values. For example, low BTU gas is often converted to "equivalent" barrels of oil at a ratio of 6000 SCF per barrel. This volume is referred to as Barrels of Oil Equivalent (BOE).
3. American Petroleum Institute
4. Society of Petroleum Engineers
5. Society of Petroleum Evaluation Engineers.
6. World Petroleum Council
7. Securities and Exchange Commission
8. Currently in revision, SPEE, Houston, TX
9. Edna Ferber, Doubleday, 1952 Warner Bros., 1956

Studies and Reports

"Fair Market Value Transactions, Cost-of-Capital, and Risk: California Oil Property Transactions 1983 Through 1996," Richard J. Miller & Associates, Inc., January, 1997, prepared for Western States Petroleum Association (WSPA).

This is the 13th edition of the annual study prepared for WSPA and CIPA to determine evaluation parameters, primarily discount rate and price/cost escalation rates, being used in the marketplace to value oil and gas properties for acquisition and sale. The study collects data from buyers and sellers in specific property transactions and attempts to extract Fair Market Value discount rates and price/cost escalation rates along with other data. A cost-of-capital (WACC) analysis for a representative sample of the oil industry is also done.

While the study retains the primary purpose of analyzing actual property transactions, the format and content of the report have been changed, along with the title, in recognition of the shift in emphasis of the study to the measurement and explanation of the differing results obtained from market sales when compared to calculations of cost-of-capital. A further expansion of effort is also directed toward defining the intermediate points in the range of expected returns between debt and equity and the yield rate on an individual property. Preliminary results suggest that a quantification of the return-of-investment and liquidity components is possible. Some considerable help in this has been provided by research done by Ibbotson Associates, (see below) and the broadening discussion of Capital Asset Pricing Model (CAPM).

The study has also expanded to include (1) derivation of discount rates for certain categories of properties and (2) the use of statistical analysis to construct an algorithm for selection of discount rates based on the characteristics of the property including risk. Some results were found to be rather interesting:

Sales of properties with 100% Proved Developed Producing (PDP) reserves account for 70% of all sales in the database and have an average discount rate of 21.4% with a 3.64 standard deviation.

The statistical analysis in the study has been expanded to explore the relationship between discount rate and other appraisal parameters. Moderately good relations, in comparison to other factors, were found for the Reserve/Production Ratio and, to a lesser extent, the rate change in expected oil price.

Discount rate is shown to have a reasonably good correlation to Reserves Risk which is measured as the percentage of PDP reserves credited to the acquired property by the buyer. This part of the study uses transactions where the derived discount is considered to be risk - inclusive; that is, all risk is accumulated in the discount rate. When the derived discount rate is regressed against %PDP reserves an inverse relation is obtained which has an R^2 of 0.2874. While not exceptional in statistical terms, the R^2 is much better than the correlation of any other evaluation parameter to discount rate. The regression equation is $Y= 28.8595-0.07556X$ where X is the %PDP reserves. These results are consistent with the results of the annual SPEE survey

A total of 107 sales (57%) deducted property tax equivalent to 3.63% of gross revenue as a cost of production. For use in ad valorem tax appraisal where deduction of estimated tax is not allowed, as in California, the restoration of the deducted tax results in an average increase of 3.68 percentage points in the discount rates for the 107 sales.

For a group of 41 oil and gas companies, the study found a Weighted Average Cost-of-Capital (WACC) at year-end 1995 of 14.8% Before Income Tax (BFIT) which is an decline from the prior year. The AFIT Cost-of-Capital for the same group of companies is 9.64%.

Comparison of the WACC to the mean DCR for 100% PDP properties indicated a relatively consistent difference of 6.6 percentage points with a 1.511 standard deviation. The difference is interpreted to include (1) a Return-of-Investment component that is not, by definition, a part of WACC calculation and (2) the relative risk between the WACC and single property market

transactions.

"WACC for Pure-Play Oil and Gas Extraction and Refining Entities;" Ibbotson, Roger G., Ibbotson Associates, Chicago, IL presented at Ventura, CA; January 15, 1997.

This is a very useful and interesting study which attempts to identify the weighted average cost-of-capital for a publicly traded company whose entire business is either oil and gas extraction or refining. The term "Pure-Play" refers to such a company where 100% of revenues and earnings and hence stock value comes from oil and gas production.

The study makes use of the standard WACC method and uses CAPM to estimate cost-of-equity. To approach the Pure-Play criteria, Ibbotson derives the *beta* for companies in the oil and gas extraction business, as defined by Standard Industrial Classification ("SIC") code and also derives the percentage of revenues which each company obtains from oil and gas production. The *beta* is regressed against the percentage of revenues to estimate a *beta* for 100% revenue from oil and gas production. This 100% *beta* can then be used in the CAPM estimate of cost-of-equity. For SIC Code 1311 (Crude Petroleum and Natural Gas) the pure-play *beta* is 0.63; for SIC 2911 (Petroleum Refining) a pure-play *beta* of 0.73 is obtained. The cost-of-equity(AFIT) estimated using pure-play *beta* is 11.38% and 12.12% for SIC 1311 and 2911 respectively resulting in AFIT WACC of 9.51% and 10.87% for the two SIC groups.

For application to individual property appraisal the AFIT WACC must be adjusted to account for the illiquidity of an oil property as compared to common stock equities and debt. An approach to this is based on business valuation practice which relates public companies to private companies for valuation purposes.

The study concluded that a before tax WACC for a pure-play oil and gas extraction company is 20.15%; a pure-play refining company is 23.04%. This result gets us to a very useful interim point. We still must account for (a) the difference in liquidity between companies, as represented by equity issues, and individual oil properties, and (b) the return-of-investment.

Legal Beat

Experts in the Courtroom Revisited. In our April, 1996 newsletter we went on at great length about recent court decisions regarding the treatment of expert witness testimony and how those decisions might effect the appraisal of oil properties. There has not been much published feedback on the latter point as yet. However, the Daubert and other decisions and the "considerations" which were recommended for use by judges have begun to have an impact in other areas - so it won't be long.

A front page article in the Wall Street Journal of 6/17/97 by Richard B. Schmitt describes several instances where judges, strengthened or emboldened by the Supreme Court actions in Daubert, have dismissed "experts" and cases where they did not either regard the expert as qualified or consider the "science" sufficiently advanced to allow it to be used for evidence.

"Until recently, judges hadn't done much to police experts, leaving it for juries to evaluate their credibility. The view from the bench has been, 'What the hell! He has a Ph.D from MIT!' says Joseph Sanders, a law professor at the University of Houston. 'It was very rare for a judge to rule an expert's testimony to be inadmissible.'

Now, though, judges are taking the law in their hands and taking aim at the hired guns. Lawyers shouldn't be allowed to 'dump on the jury,' says Robert E. Jones, a federal judge in Portland, Ore. Last December, Judge Jones threw out several dozen silicon breast-implant suits after he determined that the testimony from plaintiffs' experts - including a chief epidemiologist of the California Health Services Department and division heads from two area medical schools - wasn't reliable."

It remains to be seen where all this may lead. The WSJ suggests that the end result will be a return to the original Frey standard of evidence which requires "general acceptance" in the relevant scientific (or other) community.

Equal Rights for Predators. A significant case in which expert witnesses will be sorely tried (sorry about that) is taking shape in Arizona where Wile E. Coyote is suing ACME Company seeking *"...compensation for personal injures, loss of business income, and mental suffering caused as a direct result of the actions and/or gross negligence of said Company (ACME), under Title 15 of the United States Code, Chapter 47, section 2072, subsection (a), relating to product liability. "*

According to my sources, "*Mr. Coyote states that on eighty-five separate occasions he has purchased of the ACME Company (herein-after, "Defendant'), through that company's mail order department, certain products which did cause hint bodily injury due to defects in manufacture or improper cautionary labeling. Sales slips made out to Mr. Coyote as proof of purchase are at present in the possession of the Court, marked Exhibit A." As an example, "Mr. Coyote states that on December 13th he received of Defendent via parcel post one Acme Rocket Sled. The intention of Mr. Coyote was to use the Rocket Sled to aid hint in the pursuit of his prey. Upon receipt of the Rocket Sled Mr. Coyote removed it front its wooden shipping crate and, sighting his prey in the distance, activated the ignition. As Mr. Coyote gripped the handlebars, the Rocket Sled accelerated with such sudden and precipitate force as to stretch Mr. Coyote's forelimbs to a length of fifty feet. Subsequently, the rest of Mr. Coyote's body shot forward with a violent jolt, causing severe strain to his back and neck and placing hint unexpectedly astride the Rocket Sled. Disappearing over the horizon at such speed as to leave a diminishing jet trail along it's path..... "* Well, you get the idea.

Mr. Coyote claims to have millions of witnesses to each of these incidents and has been humiliated by the reaction of these witnesses which include but are not limited to loud laughter, guffaws, back-slapping, side-splitting, and general hilarity.

The above is from, **"Coyote vs. Acme"** by Ian Frazier-, Farrar, Straus and Giroux, 1996. Highly recommended summer reading.

Interesting Publications

From the SPE Hydrocarbon Economics and Evaluation Symposium, Dallas, TX: March 16-18,1997:

SPE 37933, "How Technology Transforms Resources into Reserves", Caldwell, R.H. and Heather, D.I., The Scotia Group.

SPE 37941, "A BTU, by any other color, is still a BTU", Tobin, John C., The Energy Literacy Project, Inc.

SPE 37951, "Maximizing Field Value Using a Royalty Rate That Tracks Oil Price", Merrier, David; California State Lands Commission.

Letters

Responses to last issue regarding Fair Market Value.

Dear Editor,

In your last newsletter you raised the issue of "arms-length" and wondered from whence the term originated. Your engineer had it partially right. The term comes to us from merry old England and is the basis for the yard as a unit of measure. Just before having on the First Crusade, King Richard was inspecting his troops and was astonished to notice that all of the tunics were too short so that the Crusaders looked like they were wearing mini-skirts. Convinced that the Arabs would laugh at them. The King called the Royal tailors before him and demanded that the tunics be longer. When asked how long they should be he stretched out his right arm to the side and said "As long as the length of my arm," which since Richard was very tall was a long arm indeed.

The High Royal tailor was apparently hard-of-hearing and all he heard was "my arm" which in Old English must have sounded differently and came across as "myarde" which was eventually shorted to "yard". The other tailors simply measured the Kings arm and went back to cut the tunics to an "arms-length". What that has to do with appraisal I don't know but I thought you might be interested.

Fred in San Antonio

Dear Richard,

Could you tell us where that bar is that your guys met to discuss FMV. Please expedite.

Thirsty in Denver

Dear Thirsty,

You're in luck. That was Judge Baldwin's Brewing Company in Colorado Springs. Best Wishes.

Richard

Hey Y'all,

Just a little note to let you know that we haven't gotten lost. You remember I told you that me and the boys were planning to bid on the Elk Hills property? Well, you wouldn't believe what all happened to us because of that bright idea. I'll send you a big of letter in time for the next edition. Oh, by the way, I ran into Elwood here in D.C. (that's Dumb Congress) and he said to say Hello and that he will have " a submission of significant import to academics and practitioners alike.." or some such. See you soon.

Rocky

Richard J. Miller & Associates, Inc. is a petroleum engineering and economic evaluation firm specializing in the appraisal of oil, gas, and geothermal properties. The firm provides traditional reservoir and production engineering evaluation services for operators and investors, financial institutions, and for forensic purposes. RJM&A provides clients with evaluation and appraisal services for project planning and development, financing, trust and estate management and taxes, ad valorem taxes, and other purposes throughout the United States and Canada. Clients include major oil companies, financial institutions, and individuals. The firm does not do appraisals for acquisition of properties. RJM&A is a California corporation founded in 1977.

Richard J. Miller is a petroleum engineer with BS and MS degrees in petroleum engineering and an MBA in finance and economics. He has over 25 years of petroleum evaluation experience throughout the U.S. with Texaco, Inc., James A. Lewis Engineering, and United California Bank prior to founding RJM&A. Mr. Miller is an Accredited Senior Appraiser specializing in oil and gas properties. Member of SPE, SPEE, and ASA.

Appraising Oil and Gas Properties is a publication of the Petroleum Engineering and Appraisal consulting firm of Richard J. Miller & Associates, Inc. For further information, letters and continents, and/or additional copies, please write, call, fax or E-mail:

16152 Beach Blvd., Ste. 107
Huntington Beach, CA 92647
Phone (714) 375-2790
Fax (714) 375-2792
RJMANDA@AOL.com