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Sources and Uses of Non-Propriety Economic Data:
What Every Evaluation Engineer Should Know

Richard J. Miller, SPE, ASA
Richard J. Miller & Associates, Inc.

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Abstract
This paper builds upon previously reported prior work using data from fair market value sales of oil and gas properties and from capital market analysis to (a) examine the relationships among certain market valuation parameters and the ways in which those relationships may correctly or incorrectly influence evaluation practice and decision making and (b) to summarize and compare the results obtained from three recognized studies of evaluation data.

The examination of relationships portion will focus on two specific areas; (1) the relation of the discount rate to the rate of price and/or cost escalation used in an evaluation and (2) the relation of the discount rate to the performance of selected capital markets for debt and equity, and inflation. This part of the work examines some of the many questions and issues which are often raised regarding the use of market data for valuing properties and also regarding the selection of appropriate evaluation parameters.

The summary and comparison will contrast the construction, data analysis methods, and results obtained by three commonly used studies: (a) the SPEE Annual Parameter Survey, (b) the annual study done by the Texas Comptroller of Public Accounts for the appraisal of oil and gas properties, and (c) the Western States Petroleum Association annual study of oil and gas property sales and oil industry cost-of-capital. These studies are often cited in evaluation reports and in publication which discuss evaluation procedures. The three studies are found to have significant similarities of objective and results while starting from differing data sources and using different methods to achieve the reported results. The paper will show that the three studies, each with a 10-15 year history can be used together to define a continuum of evaluation information which provides a source of discount rate, price/cost escalation, and risk consideration data for knowledgeable persons involved in valuing oil and gas properties.

Introduction
Evaluation engineers whether in industry, government or private practice encounter a number of problems in the evaluation and appraisal of oil and gas properties. One of the largest problems is finding the necessary data be that production history, sales history, operating costs and conditions, and environmental/regulatory conditions that might effect the property and the evaluation. Some of this information such as production history and well data are readily accessible from public and commercial sources, while other data such as operating costs are not so readily obtainable. In fair market value appraisal one form of information that has been very limited is reliable data on actual transactions from which to gain insight into evaluation methods and parameters. One of those parameters that is under continual discussion is the discount rate. Evaluation engineers working for large oil and gas companies are usually provided with economic criteria by internal financial staff and/or management but those working in small companies or as consultants are often on their own. This paper examines and compares three sources of economic evaluation information which are non-proprietary, time-tested, and publically available. Used individually the sources can be valuable. Used in concert the three sources provide a reliable foundation for defining discount rates and other parameters such as price/cost escalation rates and risk factors.

One of the more interesting results of the comparison covered by this paper is that the three studies have, over time, provided very consistent results even though they originate from very different sources. The Western States

Petroleum Association ("WSPA") report is an industry sponsored study while the Texas Comptroller study is done by a state government agency and the SPEE Survey is done by an industry professional society.

Western States Petroleum Association Study

The WSPA study is intended to be a property specific market value analysis of actual oil and gas property transactions in California. Since 1985, Richard J. Miller & Associates, Inc. (RJM&A) has been contracted by WSPA on an annual basis to conduct this study. The data that is accumulated in the WSPA study provides information regarding (a) the state of the market for oil properties in California, and (b) the methods of evaluation and the economic parameters being used by buyers and sellers of oil properties in the marketplace, current and historical. WSPA had previously contracted with DeGolyer & MacNaughton (1969), H. J. Gruy (1976) and Babson & Shepard (1977-83) to do similar studies of sales data. Since RJM&A took over the work the focus has been on the analysis of actual market transactions to examine evaluation methods and to derive market value economic parameters, specifically discount rates and price/cost escalation rates. The sales study has been expanded over time as the accumulation of data made the use of more sophisticated statistical analysis possible, and as the climate for evaluation work in areas such as ad valorem tax appraisal raised issues that could be addressed as part of the study. A cost-of-capital analysis was added in 1988 to augment the sales results.

As everyone in the oil business knows, obtaining information about property transactions is very difficult. The WSPA study is possible because of the nature of property tax law in California which requires that anyone who buys any type of property, including oil property, must provide the assessor in the county where the property is located with all the information used by the buyer in determining the value of the property, including the engineering and economic evaluations. The various assessors are quite diligent in encouraging a complete response. The WSPA Study benefits from this situation by obtaining, from the buyers of the properties, copies of the data that was filed with the assessor. In many cases, the tax agent who files the data on behalf of the buyer sends a copy to this firm at the same time. In other cases, we must contact the buyer after we find out about the transaction. California law treats this information as trade secret; it is not public data. RJM&A is required to maintain confidentiality over the data. While the source data is confidential the study report is not. The primary purpose of this study is to provide information for ad valorem tax appraisal in California but the data is reported as simply fair market value sales data and is therefore applicable to all evaluation uses.

The January, 2001 edition of the study contains data derived from 259 fair market value transactions over the period from 1983 through 1999. This number of sales accounts for a large percentage of all fair market value transactions occurring in California during in that period and is significant, in that the sales set is large enough to allow useful data to be extracted.

The first conclusion to become apparent was that the vast majority of oil properties were purchased using an income approach - a discounted cashflow (DCF) or undiscounted cashflow (Payout). This may not seem all that important to industry people who have grown up on DCF but in the property tax there have been attempts to apply Comparative Sales methods to the evaluation of oil properties. Having found that DCF, in particular, dominates evaluation practice, some basic data analysis could be done. But, first we need to step back and put the current (2001) study in context. The WSPA Study has not always had 250+ sales points. When RJM&A first started work in 1985, there were fewer than 50 sales to work with and some of those, because of poor data collection methods, turned out to be less than useful. One of the early issues to be defined was whether all of the FMV sales for which data had been accumulated could be used as a combined database or was the information from each sale related to the date of the sale? Put another way, is data which was extracted from a 1983 sale unique to 1983, or could that data be used to evaluate oil properties in 1986 or 1999?

The Date of Sale concern requires a discussion of purpose. If the only purpose of the WSPA study was to gather historical data, then 1983 data would be one thing and 1986 or 1999 would be another. The two data sets could be compared out of intellectual curiosity, but that's about all. One would be left to interpret the utility of relatively large samples in one year as opposed to small samples in another year where the sample size is a function of artificial calendar constraints which may or may not influence investment decision making. However, the underlying purpose of collecting and analyzing market data in the WSPA Study is to derive information that can be used to value oil properties today. To that end, the ability to apply parameters obtained from 1983 sales to 1999 evaluations is important. Therefore, is was necessary to test the relation of various economic parameters to the date of the sale. Over several years of work it was found that some parameters such as price and cost projections varied with time while other parameters have demonstrated no apparent relation to calendar date or the passage of time.

In the WSPA study, the primary evaluation parameter being extracted is the discount rate that equates a future income stream from an oil producing property to an estimate of the fair market value of that property. Linear regression analysis has found no relation between the Date of Sale or transfer of the property and the effective discount rate. If the discount rate is not a function of the Date of Sale then all the data points can be used to analyze other relation-

ships either prior to or after the date of sale. The discount rate/Date-of-Sale relation has been continually tested since the WSPA study began and no significant relationship has been found. This means that all 250+ data points from 1983 through 1999 can be used to derive a market value discount rate for use in valuing a property in 2001.

With time removed as a factor, the data base has been expanded as sales data has been obtained. This result allows testing of the relation of discount rates to price/cost escalation rates, volume of expected reserves or the dollar amount of the transaction, number of wells, property location and others. Over the 18 years of the WSPA study and as discussed below, correlation analysis has conclusively shown that the discount rate is a function of the perceived risk of an investment in the property relative to other potential investments and/or the cost of investment capital. In this respect, the valuation of oil properties is no different than the valuation of stocks, bonds or other forms of real estate: where investors (buyers) perceive greater risk they require a higher return as compensation. The study has found that discount rate increases as the perceived risk of the property, expressed as the Reserves Risk, increases from a base of about 19-20% Before Federal Income Tax (BFIT) for 100% PDP reserves to 30%± BFIT for 100% PUD reserves.

In 1988, a weighted average cost-of-capital (WACC) calculation was added to the WSPA study. This was done for two reasons. First, WACC is an accepted method for estimating a required return or discount rate. Second, it provides a point of comparison to the discount rates derived from actual market sales. This work began as a fairly simple procedure straight out of corporate finance textbooks, using publically available information from annual reports, the Wall Street Journal, Ibbotson and others. Since the early 1990's, however, this relatively mundane effort has become more complex as increasingly sophisticated work in the financial community, such as the Market Capitalization Effect and the Fama-French expansion of the CAPM, coupled with Pure-Play analysis, has added new dimensions to WACC analysis.

The sophistication of WACC analysis is an opportunity to obtain some help in mitigating two important concerns in regard to the WSPA study. The first is that there has been a decline in the number of market sales as oil properties in California are consolidated, so that cost-of-capital must assume a larger role in estimating discount rates for valuation. Of course, in finance, one purpose of deriving a WACC is to obtain a discount rate for capital budgeting so using WACC to supplement market sales analysis is a logical extension. The second issue is to resolve the 4 to 6 percentage point difference that is found between the sales derived discount rates and the cost-of-capital where the former, when measured as an average over a period of time, always exceeds the latter for the same period. The improvement of WACC methodology, particularly as to the cost-of-equity, allows the difference and its components, to be measured and quantified. As a result, over the past few years cost-of-capital has assumed a larger role in the WSPA study.

As noted earlier, the basic purpose of the WSPA study is to provide information that will aid evaluators in the selection of discount rates for FMV purposes. Providing an average or range of rates over the entire period of the study, or parts thereof, is useful from a statistical standpoint, but is not particularly helpful to an appraiser except to suggest that the appropriate rate should be more in the neighborhood of 20% BFIT rather than 12% BFIT. So, a large part of the work in the WSPA Study has been to analyze the discount rate data to attempt to determine the criteria that go into selection of an appropriate discount rate for the evaluation of a specific property.

The analysis is done BFIT because income tax effects are a function of individuals and companies, not properties. People who are in the business of valuing real estate get confused between comparative sales and income evaluation and try to relate the discount rate to property characteristics. And those who advocate risk-adjustment of the income stream become concerned about the concept of a range of rates and the use of a discount rate that includes a property risk element. So, the WSPA database has been studied to try to determine if such things as number of wells, total reserve volume, escalation rates and reserves class - to name just a few - are useful indicators of whether the discount rate should be X% or Y%. This analysis has become more sophisticated as the data set has improved with time. Early work was limited to single linear regression but as the database has expanded and software has improved, single non-linear and multiple regressions of up to 4 or 5 different factors have become regular segments of the WSPA study. The results of all these analyses have been reported in the annual study published by WSPA and are being compiled into a statistical volume which is currently in draft form and will be published in early 2001. At one time or another the study has tested everything from the obvious to the ridiculous, and while the total compendium of data is too voluminous to recount here, it may be useful to present some highlights.

In the WSPA study, the market discount rate is defined to be “Risk-Inclusive” which means that, to the extent to which risk is definable for a property, that risk is captured in the discount rate. Discount Rate has been found to be a function of Reserves Risk. More specifically, it appears to be a function of the proportion of Proved Producing reserves in the total volume of reserves. That is, the discount rate for 100% PDP reserves (- 22%) is less than the discount rate for 0% PDP (PUD) reserves (- 30%). There should be no surprises there. It is common sense that investments with greater risk require a higher reward. The same thing is true of stocks, horse racing and various

forms of poker. PUD reserves are, by definition, higher risk than PDP reserves, so the discount rate should be higher.

It has also been found that the discount rate is not related to (a) the size of the transaction in terms of either dollars or reserves, (b) the property location, oil gravity or production method (except as the latter affects reserves class) or (c) the rate of price/cost escalation.

It should be noted that the WSPA Study has evolved over 16 years from a simple analysis of a small collection of sales to a relatively complex document that analyzes and discusses both sales and cost-of-capital data. The study now is expanding into the area of trying to quantify the apparent difference(s) between the two methods. The study report receives a wide distribution, it is cited by several tax and appraisal authorities and has become an established industry source for sales information.

Having said that, potential users of the study have occasionally voiced concerns about the California source of data and/or the wide variety of properties included in the database. Citing the source of data, three issues are often raised: (1) the effect of heavy oil, (2) environment/regulation, and (3) well, it is California (swimming pools, movie stars, etc.). The latter concern is, of course, misplaced. California is the third or fourth largest producing state and remains an active area where the nature of the industry and the quality and quantity of oil in the ground requires continual testing of advanced production methods. Recent consolidations of companies and properties to achieve production and operating efficiencies assure that California will be around for a while. The heavy oil issue is valid, but oil gravity translates into oil price and lifting costs, both of which are components of the income stream, not the discount rate. The same is true of the environmental issue. There is a modest amount of political risk in parts of California that is not encountered elsewhere but, in reviewing evaluations for even the most heavily regulated areas, it is generally found that environmental and regulatory compliance included are considered a cost of doing business and are part of the operating costs and capital investment in the evaluation.

The WSPA reports have been published annually since 1985 and copies of all reports are available. Copies of the 2001 WSPA study report are available at cost from WSPA or this firm. The statistical volume will be made available later this year.

The Texas Comptroller Study

For many years, starting in the early 1980's, the Property Tax Division (“PTD”) of the Comptroller’s Office (formerly the Texas State Property Tax Board) has prepared an annual study of discount rates for the appraisal of oil and gas properties for ad valorem tax in Texas. The PTD has also produced and updated a manual on deriving discount rates for oil and gas property evaluation. Both the manual and the annual reports are public documents and are available from the PTD. The purpose of the manual and the annual reports is to fulfill a requirement of Texas law that the PTD provide information to local assessors and appraisers so that they will be able to reasonably value oil properties. Like California, Texas requires that all properties, including oil and gas properties, are to be appraised at Fair Market Value for assessment.

The PTD study is primarily a cost of capital analysis which calculates a WACC and recommends discount rates for application to properties being appraised for ad valorem tax. While the report is prepared specifically for application to ad valorem tax, the calculated rates are generic discount factors that are broadly applicable to acquisitions, divestitures, estate tax and other uses.

In defining appropriate discount rates, the PTD uses basic cost-of-capital analysis of publically traded major and independent companies derived from annual reports, Ibbotson and public data. The PTD work is thorough, and professional and provides a sound basis for development of a property specific discount rate. PTD accomplishes the latter by adding a 2% “Hurdle Rate Premium” to the WACC and by defining those aspects of properties that are considered to add risk, such as number of wells, operating system, etc, and then adding increments to the WACC discount rate to account for the risk over and above the risk inherent in stocks and bonds. This goes part way toward quantifying the difference which is noted between market sales derived discount rates and the WACC data. The fact that there is a difference is rational for the several reasons which include liquidity, diversity of income sources, and return of investment. While PTD does not explicitly investigate these issues, the PTD approach of adding risk increments to the WACC is one way of bridging the gap.

The PTD study relies on the WACC derived discount rate because market sales data are not systematically available for analysis as in the WSPA study. Texas does not have the data reporting regulations imposed on California property owners. However, PTD does have some experience with Texas market sales data. Several years ago, when the annual study was done by the late Mr. John Adair, PTD was able to solicit and obtain a small, but reasonable, sample of market sales data covering 1987 through 1993. This data was obtained from property buyers and sellers and provided enough sales information to allow derivation of discount rates and other economic information. Most of this data was for Proved Developed Producing (PDP) properties, which served the purpose of identifying representative discount rates for low risk oil and gas properties that could then be used as a base against which to measure the gap with the WACC derived rates.

The data set consisted of 73 sales and was probably not statistically significant, given the size of the Texas market for properties, however, the results obtained from the sales analysis showed that the derived rates were relatively consistent from year-to-year with an arithmetic mean of 21.2%.

This is important in establishing the use of the data as a base rate for PDP properties that could be compared to WACC for the same year. The PTD results matched the WSPA derived data quite well, particularly for PDP properties. The latter is very important in demonstrating that, as logic would or should tell you, FMV discount rates are the same in CA(TX) as they are in TX(CA).

The PTD calculated value of WACC is consistent with the WSPA value from year to year, as would be expected since both use the same methodology. Actually, the PTD work predates the inclusion of WACC analysis in the WSPA report by several years and was used as the model for the WSPA cost-of-capital section. The contrast of the PTD study to the WSPA study is more than mildly interesting in one other facet. The PTD is done independently by a state government agency charged to, among other things, provide reliable data to taxing authorities in Texas. The WSPA study is done independently for an industry group where one of the purposes of the study is to provide reliable data to taxing authorities in CA. The fact that the results are so similar is not only interesting but demonstrates that when reliable data is analyzed creditably, knowledgeable people get similar answers.

The PTD study is well written and carefully documented. The results are cross-checked with the companies used in their database, and the methodology is easy to follow. The PTD study provides an excellent source for discount rate data.

The SPEE Parameter Survey

The third data source is the Society of Petroleum Evaluation Engineers (SPEE) "Annual Survey of Parameters Used in the Evaluation of Oil and Gas Properties," hereafter the SPEE Survey. The Survey is done by a committee of SPEE in April-May of each year and is presented at the SPEE Annual Meeting in June. Unlike the WSPA and PTD studies, which collect and analyze recent but nonetheless historical data, the SPEE survey attempts to determine forward-looking information in the form of (a) price/cost escalation rates, (b) discount rates and (c) the method and form of risk adjustment that are being used or would be used by knowledgeable and informed evaluators of oil and gas properties for appraisal of oil properties on the survey date. The Survey has been done by SPEE since 1983 and has been remarkably consistent for many years in terms of structure, format and results. Over the past few years there have been a number of changes in the questions asked in an attempt to improve the consistency of the responses and in the presentation of data.

The Survey endures most of the problems of any survey in terms of selection of the survey targets, quality control and data analysis, but these opportunities have been identified and handled well by SPEE. The largest group of data contributors are producing companies where evaluations of projects and acquisitions/sales are a common occurrence. The second largest group are consultants - most of whom are SPEE members and are involved in evaluation work as a profession. The result is a relatively consistent and reliable set of data that would be of use to any evaluator of oil properties who did not have access to other sources or wished to confirm those sources. The Survey does not pretend to be the absolute answer, but only to provide some useful guideposts. While one might quibble about various aspects of the Survey, the results provide a window into current evaluation practice. The Survey data is most useful when viewed over a period of time to observe the trend in discount rates, price projections, etc. To wit:

- Escalation rates for prices and costs have trended downward over the years, and an increasing number of evaluations are done using flat pricing.
- Base or Minimum discount rates range from 17% to 19% with the trend moving slightly lower over time.
- An increasing number of evaluators apply risk adjustment factors to either the production projection or the cash flow to account for risk related to class of reserves. The adjustment for PDP reserves has consistently averaged 96%, while the adjustment for PUD reserves is about 58%.

Aside from being a useful source of data in its own right, the Survey provides a convenient comparison point for both the WSPA and PTD studies. After all, if evaluators of oil properties actually do what they report to the Survey, then those results should bear a rational relationship to (a) the sales data in the PTD and WSPA studies and (b) to the cost-of-capital data in the WSPA and PTD studies. And, of course, they do. The minimum discount rate reported in the SPEE survey equals or exceeds the WACC reported in both WSPA and PTD. The discount rates for Proved Developed Producing reserves reported in the Survey and the trend, if not the end points, of the risk adjustment scale in the Survey, track very well with the trend of actual discount rates relative to reserves class found in the WSPA study. The relation between evaluators' intent as measured by the Survey and the result as measured by actual sales is not perfect - no one would expect that - because of the very large number of factors that affect the outcome of an acquisition or project implementation. But when all three studies are taken together the points where they

overlie each other and provide reinforcement indicates that economic parameters used for evaluation have a rational foundation that can be developed from more than one source.

Obtaining Reports

The WSPA Study reports for 1985 through 2001 are available from:

RJM&A
16152 Beach Blvd., Ste. 107
Huntington Beach, CA 92647
(714) 375-2790

Copies of the PTD Discount Rate Manual and the annual studies can be obtained from:

Texas Comptroller of Public Accounts
Property Tax Division
P.O. Box 13528
Austin, TX 78711-3528
(512) 305-9824

Copies of the SPEE Survey can be obtained for a modest fee from:

SPEE
811 Dallas Street, Ste. 1416
Houston, TX 77002
(713) 651-1639