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A COMPARISON OF COST AND MARKET BASED  
ACCOUNTING MODELS FOR A MAJOR  
PETROLEUM COMPANY.

The University of Oklahoma, Ph.D., 1976  
Accounting

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1976

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

A COMPARISON OF COST AND MARKET

BASED ACCOUNTING MODELS FOR

A MAJOR PETROLEUM COMPANY

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

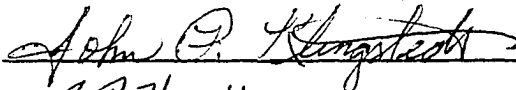

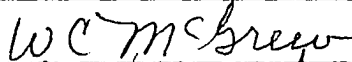
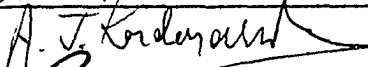

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Norman, Oklahoma

1976

A COMPARISON OF COST AND MARKET  
BASED ACCOUNTING MODELS FOR  
A MAJOR PETROLEUM COMPANY

APPROVED BY

DISSERTATION COMMITTEE

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Although I received assistance from many persons, I alone accept full responsibility for all errors of omission or commission and all misstatements in this work.

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A COMPARISON OF COST AND MARKET  
BASED ACCOUNTING MODELS FOR  
A MAJOR PETROLEUM COMPANY

CHAPTER I

INTRODUCTION

Statement of the Problem

One of the most, if not the most, significant asset that a petroleum company has, is its interest in and its right to the removal of underground hydrocarbon reserves. Stanley P. Porter groups these underground reserves of hydrocarbons into two main classifications: (1) crude oil and natural gas liquids reserves; and (2) natural gas reserves.<sup>1</sup> Arthur Andersen & Co. concurs. Their brief before the Committee on Extractive Industries of the Accounting Principles Board of the American Institute of Certified Public Accountants states, "The principle asset of an oil and gas producing company is its underground oil and gas reserves.

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<sup>1</sup>Stanley P. Porter, Petroleum Accounting Practices (New York: McGraw-Hill Book Company, 1965), pp. 298-299.

This asset is a relatively long-lived store of a basic raw material."<sup>2</sup>

In addition, the following three individuals have all recognized the importance of a company's underground reserves as a significant asset. At the Tenth Annual Oil and Gas Accounting Institute of the Southwestern Legal Foundation, E. V. Pearson, General Manager--Exploration and Production Economies of Shell Oil Company, made the following observations:

The first point to be stressed is that petroleum reserves have a relatively important value when one considers the worth of an oil company. Let us consider most any integrated oil company with an ability to supply, say, half or more of its raw material requirements from its own reserves. It is probably safe to say that such a company could value its developed reserves in today's market place in excess of the net valuation of all of the fixed assets of the corporation--including all functions. This is a large element of petroleum company 'worth' which escapes the process of systematic assets reporting . . . .

It is true that petroleum volumes are more systematically reported when they are produced and sold and income is received. However, petroleum reserves are a leading indicator of long-term profit-making potential, and this is of importance to their investor.<sup>3</sup>

Robert E. Field, in Accounting Research Study No. 11 "Financial Reporting in the Extractive Industries," also

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<sup>2</sup>Arthur Andersen & Co., Accounting for Oil and Gas Exploration and Development Costs. A brief before the Committee on Extractive Industries of the Accounting Principles Board of the American Institute of Certified Public Accountants. New York: Public hearing on November 22-23, 1971.

<sup>3</sup>E. V. Pearson, Reporting Underground Hydrocarbon Reserves, The Tenth Oil & Gas Institute, Southwestern Legal Foundation, (Dallas, Texas, September 18, 1974).

recognized the importance of the mineral reserves of extractive industries.

The variety of circumstances in extractive operations, the complicated accounting problems, and the existence of substantial mineral resources not reflected in the balance sheet indicate the need for careful consideration of disclosure requirements in financial reports on extractive operations.<sup>4</sup>

In his book Current Value Accounting, Morton Backer conducted interviews on the importance of unrecorded underground reserves. One interviewee, who appears to be an independent appraiser of hydrocarbon reserves, confirms the fact that there is not only often a substantial understatement, but at times overstatements of assets, when using a conventional cost basis. He is quoted as saying:

. . . in situations where we have made valuations of oil properties, we generally find a wide difference between the balance sheet and our appraised market value. In the great majority of cases book costs are substantially understated. However, on rare occasions we have also encountered overstatements, largely due to companies capitalizing dry holes or having retained depleted assets on their books.<sup>5</sup>

In summary, the foregoing show that conventional financial statements do not adequately reflect results of a petroleum company's operations or its financial condition.

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<sup>4</sup>Robert E. Field, Financial Reporting in the Extractive Industries, Accounting Research Study No. 11, (New York: American Institute of Certified Public Accountants, 1969), pp. 34-35.

<sup>5</sup>Morton Backer, Current Value Accounting (New York: Financial Executives Research Foundation, 1973), p. 172.

Non-reporting of reserves is singled out as a major deficiency in current petroleum company financial statements.

#### Need for the Study

There is a definite need for this type of study. This study is among one of the first to compare conventional, price-level, and value accounting in the petroleum industry. Some studies of this type have been done: John P. Klingstedt compared value and conventional methods in the petroleum industry;<sup>6</sup> Alan F. Smith evaluated the use of the economic valuation method in the petroleum industry;<sup>7</sup> and James C. McKeown compared conventional accounting methods with current cash equivalent, current replacement cost, specific price-level, consumer price index, and the GNP Deflator in a construction company for a one year period.<sup>8</sup> Although this study does in some ways replicate prior research, it differs as to the number of years used (McKeown) and the different methods applied (Klingstedt).

The need for this type of study is apparent in view of the increased attention directed towards petroleum

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<sup>6</sup>John P. Klingstedt, Value Accounting in the Petroleum Industry (Tulsa, Oklahoma: Arthur Young & Company, 1974).

<sup>7</sup>Alan F. Smith, "Valuation and Its Possible Application and Presentation in Accounting with Special Reference to the Production of Oil" (D.B.A. dissertation, University of Colorado, 1968).

<sup>8</sup>James C. McKeown, "Comparative Application of Market and Cost Based Accounting Models," Journal of Accounting Research, Vol. 11 (Spring 1973), pp. 62-69.

companies by consumers, various governmental regulatory bodies, Congress, etc. If there is some better method of portraying the operating results of this industry, then consideration should be given to that method. This study provides such analysis in an attempt to determine if one method or a combination of methods better portrays the results of operations over another.

### Objectives of the Study

The main objective of this study is to apply the GNP Implicit Price Deflator, specific price indexes, and discounted cash flow methodology to the revenues of an actual operating petroleum company and to analyze the differences in the results obtained by each. This objective will be accomplished with possibly more validity by the use of actual operating data as opposed to simulation of operating results.

### Research Question

To meet the objectives of this study the following hypothesis is investigated: The financial statements of a petroleum company adjusted for different accounting models can be compared and analyzed for a greater understanding of the effects of operations than is possible under conventional accounting methodology.

As this is a study of one company's actual financial data for a period of six years, there is not a sufficient

base for statistical testing of the above hypothesis. The hypothesis is thus investigated by consideration of the following questions:

- (1) Does operating income vary from year to year when the different models are compared?
- (2) What is the relationship of hydrocarbon reserves recorded under conventional accounting to those same resources recorded under each accounting model?
- (3) What is the correlation of the methodologies over the six year time frame?

#### Scope and Research Methodology of the Study

This research utilizes actual accounting data and other relevant information provided by one of the major integrated petroleum companies. (A major petroleum company is defined in the industry as being included in the Chase Manhattan Bank studies of major petroleum companies.) Only one company is used in this study for a number of reasons. Most importantly, with the problems petroleum companies are facing today (more stringent governmental regulations, loss of the oil depletion allowance, etc.), they are extremely reluctant to provide any inside information about segments of their operations other than what they are already required to provide by regulatory agencies. A second and equally important factor to consider is that only a segment of the company's operations is to be analyzed. This



required an extensive amount of work by the company's personnel to separate the required data from their records. The analysis covers only the years from 1969 through 1974; data retrieval from 1968 and the years prior was almost impossible due to the use of other accounting methods and different locations for the storage of this data.

Because of the international scope of operations of the company and the factors that this involves (such as possible nationalization of their operations), this study is limited to the contiguous United States. All of the company's offshore operations located around the 48 states are included, however.

This study is also limited to the exploration and production phases of the company's operations. In doing so, interaction of other variables that could significantly affect the results of the study were eliminated. Refining, petrochemical, marketing, and other activities would have resulted in numerous variables that could not be handled properly. Therefore, the only significant asset of the company is its underground reserves.

The first adjustment made is to adjust the revenue to reflect price-level changes. The Gross National Product Implicit Price Deflator is used and applied in accordance with the recommendations proposed in the Financial Accounting Standards Board Exposure Draft of December 31, 1974 on

"Financial Reporting in Units of General Purchasing Power."

In paragraph 74 of the exposure draft, the FASB states:

The Board selected the GNP Deflator . . . as the index of the general purchasing power of the dollar to be used in preparing general purchasing power financial information because that is the most comprehensive index available of the prices of all goods and services exchanged in all segments of the economy, including personal consumption, business investment, and government purchases . . . . Because the GNP Deflator is more comprehensive than the Consumer Price Index, it is a better indicator of the general purchasing power of the U.S. dollar. The use of indexes of the specific types or groups would be inconsistent with the objective of this statement--reporting financial information in units of general purchasing power.<sup>9</sup>

The revenues are also adjusted by specific price indexes that are published for crude oil price changes. This provides an analysis of the effects of both general and specific price-level adjustments to the conventional reporting of revenue.

The final major adjustment to the revenues is to adjust these to a value basis. While a number of methods are proposed for the determination of value, prior studies have indicated that the best method of valuation of underground reserves of hydrocarbons is discounting of future cash flows. Alan F. Smith refers to this method as the

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<sup>9</sup>Financial Accounting Standards Board, Exposure Draft on Financial Reporting in Units of General Purchasing Power (Stamford, Connecticut: Financial Accounting Standards Board, 1974), p. 23.

economic valuation<sup>10</sup> while John P. Klingstedt refers to it as discounted cash flow.<sup>11</sup>

In 1968 Smith completed his dissertation on valuation of reserves in extractive industries. He used two producing wells as the basis for his analysis; and his study was concerned with the method of valuation of the reserves, not with the effect that the various methods would have on the whole company. The following is extracted from the abstract of his dissertation:

Current financial reports sometimes give inaccurate information about the happenings of a period and the value of assets employed. Such a situation is likely in the extractive industries where the value of a newly discovered mineral deposit may exceed the costs of discovery. Increases in value are ignored until realized in some subsequent period. The critical event in many cases is not this later realization but the discovery of the mineral deposit, and financial reports should give some recognition of this fact.

The difficulty of identifying cash inflows with specific assets makes it impossible to advocate general acceptance of the economic valuation method. However, in those circumstances in which an asset has prime responsibility for the cash inflows, the economic valuation method is shown to be useful for initially recording and subsequently accounting for the asset . . . .

Selection of the economic valuation method presupposes that a reasonably accurate estimate of the future economic flows can be made. In extractive industries such an estimate is available. The analysis in this dissertation indicates that

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<sup>10</sup>Smith, "Valuation and Its Possible Application," p. 28.

<sup>11</sup>Klingstedt, Value Accounting in the Petroleum Industry, p. 3-6.

the economic valuation system can accommodate the probable errors in the estimating process . . . .<sup>12</sup>

Klingstedt analyzed one producing field and a producing company in his analysis of the valuation methods. The analysis of the field was similar to the analysis of Smith's in that both were the analyses of a self-liquidating venture. Because an entire firm will not be making any new discoveries, this presented somewhat of a limitation in that the firm cannot be considered a going concern. However, this limitation was overcome in Klingstedt's analysis of the data of an actual producing company. His study supports the one by Smith in the use of discounted cash flow as the appropriate value method to be applied to underground hydrocarbon reserves.

Reference to the discounted future net revenue of hydrocarbon reserves is particularly appropriate in attempting to establish their fair market value since such computations are quite often used as the basis for the purchase and sale of hydrocarbons in the ground.<sup>13</sup>

If a discounted future net revenue method of determining value is appropriate for valuation of hydrocarbon reserves as indicated for internal use, then it should also be the most appropriate method for external use. The underground hydrocarbon reserves are therefore valued using discounted cash flow.

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<sup>12</sup>Smith, "Valuation and Its Possible Application," p. iii-iv.

<sup>13</sup>Klingstedt, Value Accounting in the Petroleum Industry, p. 5-3.

### Contributions of the Study

The contributions of this study are threefold. It provides a better understanding of the effects of different accounting methods on the revenues of a company with large amounts of unrecorded assets. (As previously noted, some work has been done in this area; this study will confirm those studies.) This study can also serve as input to the Financial Accounting Standards Board in their deliberations as whether or not to adopt price-level accounting or some methodology that reflects current value. Further it will aid petroleum companies by showing the effects of the FASB proposal on their unique types of operations; this will help to prepare them for the results should these proposals be adopted.

### Organization of the Study

In order to place this study in a proper perspective, Chapter II is a review of prior studies relating to the problems of financial presentation in the petroleum industry. Here too is a brief discussion of the different accounting models that are applied to the data from the company's operations.

Chapter III presents the assumptions that were necessary to utilize the models, and outlines the methodologies employed for each of the models.

Chapter IV reports the results obtained from this study. The results of the application of each model are interpreted and then compared to each other.

This leads to Chapter V and the conclusions of this investigation along with recommendations for future studies.

## CHAPTER II

### THEORETICAL FRAMEWORK AND REVIEW OF RELATED STUDIES

The primary objective of this study is to evaluate the effects of different accounting models upon the financial statements of petroleum companies. In order to place this objective and the use of selected models in a proper perspective, this chapter presents a theoretical discussion of various proposed accounting models.

The second portion of this chapter is a review of two studies directly related to the study undertaken here. Both deal with the petroleum industry, specifically with the valuation of underground hydrocarbon reserves.

#### Conventional Accounting Statements

Conventional accounting statements are defined in this study as those prepared in accordance with generally accepted accounting principles. Statement No. 4 of the Accounting Principles Board states:

Generally accepted accounting principles encompass the conventions, rules, and procedures necessary to define accepted accounting practice at a particular time. The standard of "generally accepted accounting principles" includes not only

broad guidelines of general application, but also detailed practices and procedures.<sup>1</sup>

Generally accepted accounting principles, therefore, are quite numerous and do change over time in relation to the changing requirements of statement users.

### Accounting Principles

As pointed out by Robert E. Field in Financial Reporting in the Extractive Industries, there are three basic conventions of financial reporting that are especially relevant to the study of an extractive industry. These are (1) the cost basis of reporting assets, (2) the realization basis for reporting revenue, and (3) the concept of conservatism.<sup>2</sup>

Cost basis of reporting assets. "Cost is the amount, measured in money, of cash expended or other property transferred, capital stock issued, services performed, or a liability incurred, in consideration of goods or services received or to be received."<sup>3</sup> This definition of cost

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<sup>1</sup>Accounting Principles Board, "Statement of the Accounting Principles Board No. 4, Basic Concepts and Accounting Principles Underlying Financial Statements of Business Enterprises," APB Accounting Principles 2 (New York: American Institute of Certified Public Accountants, Inc., 30 June 1970): 9084

<sup>2</sup>Robert E. Field, Financial Reporting in the Extractive Industries, Accounting Research Study No. 11 (New York: American Institute of Certified Public Accountants, Inc., 1969), p. 24.

<sup>3</sup>Committee on Terminology, "Accounting Terminology Bulletin No. 4, Cost, Expense and Loss," APB Accounting Principles 2 (New York: American Institute of Certified Public Accountants, Inc., 1973): 9523.



implies that there is a direct, or at least a close indirect, relationship between resources given up and goods or services received. For example, the cost of a piece of equipment has some relationship to the future revenue that this equipment will help generate. If the future revenue generated by the equipment is not sufficient to cover costs of operations, provide a normal profit, and recover the cost of the equipment, it will not be purchased. Or, if this equipment is currently being used and cannot meet these objectives in the long-run, it will be sold or abandoned.

Discovery and development costs of a producing well have not been shown to bear any discernible relationship to the amount to be ultimately realized by the production of hydrocarbons from the well.<sup>4</sup> This is vividly pointed out by the fact that in 1973 of the 3,367 exploratory wells [exploratory wells as used here include: new-field wildcats, new-pool wildcats, deeper-pool tests, shallower-pool tests, and outpost (extension tests)] drilled, 2,735 or 81% dry wells. Through June 28, 1974 there were 4,067 exploratory wells drilled, of which 3,129 or 77% were dry wells.<sup>5</sup> The exploratory wells used in these statistics include a

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<sup>4</sup>Stanley P. Porter, "Full Cost" Accounting: The Problems It Poses for the Extractive Industries (New York: Arthur Young & Company, 1972), p. 22.

<sup>5</sup>"Total Wells Drilled in the United States--June 1974," The Oil and Gas Journal 72 (23 September 1974): 218.

number of different types of wells. If only new-field wells are included in the analysis the results are much different, as Porter found in his research.

In 1948, one commercial field (1,000,000 barrels or more) was discovered from the drilling of about 35 wildcat wells . . . . By 1966 the number of wells drilled had doubled to 70 for each 1,000,000-barrel discovery.<sup>6</sup>

The definitions of a dry well vary as different court cases apply somewhat different standards. The most common definition in the industry is ". . . a well completed as a dry hole; a well not capable of production of commercial quantities."<sup>7</sup> The costs incurred in the drilling of these dry wells will therefore yield no future revenue. The only possible benefits to be gained from this drilling are a more thorough understanding of the underlying geological strata and the knowledge that there are no economically producible hydrocarbons in that exact location.

In 1973 a total of 12,220 wells were drilled. This figure includes all wells and not only exploratory wells. Yet this total drilling effort yielded economically producible quantities of hydrocarbons in only 7,428 wells (or 61%).<sup>8</sup> Some of these wells would be marginal producers,

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<sup>6</sup>Porter, "Full Cost" Accounting: The Problems It Poses for the Extractive Industries, p. 24.

<sup>7</sup>Howard R. Williams and Charles J. Meyers, Oil and Gas Terms, 3d ed. (New York: Matthew Bender, 1971), p. 143.

<sup>8</sup>"Total Wells Drilled in the United States," p. 218.

while others could be considered major discoveries. Therefore, when a well is completed as a producer there is still considerable doubt as to the relationship between its cost and the ultimate benefits to be derived from the recovery of the hydrocarbons on this well.

According to the definition of cost, financial statements should provide information as to the future benefits to be received. It appears that this is not the case with financial statements for petroleum companies prepared on a cost basis, especially in the area of recorded pre-production costs.

Realization basis for reporting revenues. Under the generally accepted accounting principles, revenue and its realization is defined as follows: "Revenue is recognized when both of the following conditions are met: (1) the earning process is complete or virtually complete, and (2) an exchange has taken place."<sup>9</sup> Under this definition revenue is recognized in most instances at the time of sale of goods or services. In a manufacturing operation, normally no revenue is recognized upon completion of the product; revenue is instead recognized only upon sale of the finished product.

Exceptions to this rule are made in instances where, if strictly applied, the realization principle would not

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<sup>9</sup>Accounting Principles Board, APB Accounting Principles 2: 9086.

yield better periodic reporting of income. The best example of this is the construction industry; on long-term construction projects it is permissible to recognize revenue on the basis of a percentage of the contract that is completed. Another exception to this rule occurs where revenue is recognized at the time of completion of production, before a sale is made. Justification in this case is based on the fact that there is an assured market and selling price. Eldon S. Hendricksen lists three criteria for reporting revenue at completion of production: "(a) the existence of a determinable selling price or stable market price, (b) no substantial cost of marketing, and (c) interchangeability of units."<sup>10</sup>

The production and sale of hydrocarbons meets the conditions of no substantial cost of marketing and interchangeability of units. The criteria of a stable market price is met in the short run. Prices of petroleum products would be even more stable than they are now if a free market existed where the prices could seek their stable level.

Cost of producing hydrocarbons are nominal in relation to the costs incurred up to the time of completion of a producing well. Thus, the discovery of underground hydrocarbons for a producing well is a point at which recognition

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<sup>10</sup>Eldon S. Hendricksen, Accounting Theory, rev. ed. (Homewood, Illinois: Richard D. Irwin, Inc., 1970), p. 172.

of revenue perhaps should be reported. This particular aspect will be more fully explained in Chapter IV. The realization and recognition of revenue rules would have to be modified somewhat because of other factors which may be more important than the realization test.

Convention of conservatism. The convention of conservatism is also important when considering the reporting of discovered hydrocarbons. Accounting Principles Board Statement No. 4 explains this conservatism in accounting.

Frequently, assets and liabilities are measured in a context of significant uncertainties. Historically, managers, investors, and accountants have generally preferred that possible errors in measurement be in the direction of understatement rather than overstatement of net income and net assets. This led to the convention of conservatism, which is expressed in rules adopted by the profession as a whole such as the rules that inventory should be measured at the lower of cost and market . . . . These rules may result in stating net income and net assets at amounts lower than would otherwise result . . . .<sup>11</sup>

At the time of discovery and completion of an economically feasible producing well, there may be some amount of uncertainty as to the future production that can be expected. The volume of economically recoverable reserves is not known with certainty until the field has been depleted. And the time frame involved varies considerably: one field may be depleted in a few years, while others may still be producing hydrocarbons fifty years or longer after discovery.

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<sup>11</sup>Accounting Principles Board, APB Accounting Principles 2: 9089.

In view of the apparent inconsistencies in financial statements, this definitely appears to be the posture of the Securities and Exchange Commission, conservatism may be of lesser importance than full and fair disclosure. Accounting Principles Board Statement No. 4 also indicates as a qualitative objective that financial statements must give full and fair disclosure to all material events.<sup>12</sup> Due to the extreme significance of the discovery of hydrocarbons to the petroleum industry, this disclosure should be made in the financial statements.

#### Financial Statement Objectives

The preceding brief discussion of three of the more important accounting principles and conventions relative to this study and the discussion to follow on price-level and value adjusted financial statements cannot be fully evaluated without briefly taking into account the objectives of financial statements. The general objectives of financial statements are (1) to provide reliable information about changes in net resources of an enterprise that result from its profit-directed activities; (2) to provide reliable financial information about economic resources and obligations of a business enterprise; (3) to provide financial information that assists in estimating the earning potential of the enterprise; (4) to provide other needed information

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<sup>12</sup>Ibid., p. 9076.

about changes in economic resources and obligations, and, (5) to disclose, to the extent possible, other information related to the financial statements that is relevant to statement user needs.<sup>13</sup> These needs of primary users of financial statements provide for the development and continual revision of the general objectives of financial statements.

Whether or not these general objectives of financial statements are being met is dependent upon their being prepared on the basis of qualitative objectives. The Accounting Principles Board in Statement No. 4 identified the following seven qualitative objectives: (1) relevance; (2) understandability; (3) verifiability; (4) neutrality; (5) timeliness; (6) comparability; and (7) completeness.<sup>14</sup> Relevance, verifiability, neutrality, comparability, and completeness have been identified by Klingstedt as the most important in determining whether a particular accounting model or methodology provides the information necessary to meet the general objectives of financial statement users in the petroleum industry.<sup>15</sup> Discussion of these qualitative objectives in relation to conventional, price-level adjusted

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<sup>13</sup>Ibid., p. 9074.

<sup>14</sup>Ibid., p. 9076.

<sup>15</sup>John P. Klingstedt, Value Accounting in the Petroleum Industry (Tulsa, Oklahoma: Arthur Young & Company, 1974), p. 3-1.

and value financial statements will be reserved for the conclusion of this chapter.

### Full Costing

Full costing, as well as successful effort costing, depends primarily on the definition of what constitutes a property unit. To quote Robert E. Field:

"Full-cost" accounting defines the property unit in the broadest terms and attributes all costs--prospecting, acquisition, exploration and development--to whatever mineral reserves are discovered. The property unit chosen is usually the company as a whole, or the entire domestic and entire foreign operations separately.<sup>16</sup>

Thus with the property unit defined as the entire company any costs incurred in prospecting, acquisition, exploration, and development are capitalized regardless of whether or not any future revenue will ever be realized from these specific expenditures.

A number of proponents believe full costing is conceptually the most appropriate method of accounting for these pre-production costs. One of the strongest supporters of full costing is Arthur Andersen & Co. They defend and support full costing with the following argument:

The cost of drilling dry holes and of other non-productive exploration activities are a necessary part of the cost of discovering and developing the oil and gas reserves. There is no known way to

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<sup>16</sup>Robert E. Field, "Financial Reporting in the Extractive Industries--A Synopsis of the Research Study Prepared for the AICPA," Conference of Accountants, Accounting Papers (Tulsa, Oklahoma: The University of Tulsa, 23-24 April 1969), p. 48.



avoid such costs. They should be capitalized since they are just as much a part of the cost of the reserves found as are the lease and well equipment of producing wells.<sup>17</sup>

The upper limit of the total capitalized amount should not exceed the fair value of the total remaining recoverable mineral reserves for the affected property unit. By stating that costs should not be capitalized in excess of the remaining recoverable mineral reserves, Arthur Andersen & Co. is implicitly stating that the value of the recoverable reserves is determinable, verifiable, etc. They do not, however, give any indications as to how this value is to be determined. They also admit that balance sheets prepared on the basis of full cost will not reflect fair value.<sup>18</sup> Full costing, in other words, will not be a cost method in one sense, and will not be a value method either.

#### Successful Efforts

Robert Kendrick Eskew II explains successful efforts costing as follows:

For this accounting method the cost centers boundaries are normally only for a single oil field or for the land [sic] held under a single lease. Costs are collected at each of the cost centers. All costs relating to the lease acquisition, lease payments and the drilling of exploratory wells are capitalized until a determination can be made if

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<sup>17</sup>Arthur Andersen & Co., Accounting for Oil and Gas Exploration Costs (New York: Arthur Andersen & Co., January 1963), p. 18.

<sup>18</sup>Ibid., p. 19.

the lease or field is productive. If the cost center is determined to be productive, the capitalized costs are expensed in proportion to the production to reserve ratio. If, however, the cost center is found to have no productive wells, the costs collected at that cost center are expensed in the year the determination is made that the field or lease is unproductive.<sup>19</sup>

The variations between successful efforts costing and full costing are limitless; and with the wide diversity in methods for handling pre-production costs, there appears to be little comparability between firms in the industry under either method of accounting. The cost center size does not have to be as small as a single well nor as large as an entire company. The capitalize-expense decision can be made using any cost center approach the company desires; it may even differ within a company for offshore, on land, or foreign operations. As an example of the variations that may be present, a company may set each producing horizon in a single well as a cost center. Under this approach, if a well was drilled to a depth of 15,000 feet and at that point commercially producible reserves are discovered, the company would capitalize the costs to that point. Assume then a decision is made to drill another 5,000 feet in hopes of finding another producing horizon. If the company did not hit commercially producible reserves in this next

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<sup>19</sup>Robert Kendrick Eskew, II, "An Empirical Examination of the Interaction Between Accounting Alternatives and Share Prices in the Extractive Industry" (Ph.D. dissertation, Purdue University, 1973), p. 7.

5,000 feet, they would expense the costs from 15,000 to 20,000 feet as a dry hole.

Statements Adjusted for Price-Level  
by the GNP Implicit Price Deflator

The Financial Accounting Standards Board issued an exposure draft on Financial Reporting in Units of General Purchasing Power on December 31, 1974. If adopted, this statement would have been effective for fiscal years beginning on or after January 1, 1976. However, at the 1976 Financial Conference of the Conference Board in New York City, Paul A. Pacter, Deputy Director of Technical Activities for the Financial Accounting Standards Board, reported that for every person in favor of the exposure draft, there were three or four opposed to it. He made no prediction but said the board would soon decide either to adopt the draft, defer action, or consider the project in conjunction with current value.<sup>20</sup> Therefore, the first required restatements apparently will not appear on December 31, 1976 annual financial statements. But because this proposal has not been rejected, it must be considered. This proposed statement of financial accounting standards required the following disclosure of general purchasing power:

When financial statements are issued that present financial position at the end of an enterprise's fiscal year or results of

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<sup>20</sup>"News Report," The Journal of Accountancy (April 1976), p. 10.

operations or changes in financial position for that fiscal year, they shall include certain information that is stated in terms of units of general purchasing power of the U.S. dollar.<sup>21</sup>

The exposure draft requires restatement only for year end financial statements and not interim periods. But it does require a comprehensive restatement; a partial restatement is not permitted.

As to which price index should be used, the draft states, "The Gross National Product Implicit Price Deflator shall be the index of the general purchasing power of the dollar used in preparing general purchasing power financial information."<sup>22</sup> In no uncertain terms, the use of specific price indexes is prohibited. The exposure draft is also very explicit about how to handle the presentation of comparative statements for prior periods:

If general purchasing power information for earlier periods is presented for purposes of comparison with general purchasing power information for the current period, the information for the earlier periods shall be updated ("rolled forward") to units of the purchasing power of the dollar at the end of the current period.<sup>23</sup>

A significant number of books, portions of books, articles, etc., have been written regarding the usefulness

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<sup>21</sup>Financial Accounting Standards Board, Proposed Statement of Financial Accounting Standards, Financial Reporting in Units of General Purchasing Power (Stamford, Conn.: Financial Accounting Standards Board, 31 December 1974), p. 8.

<sup>22</sup>*Ibid.*, pp. 8-9.

<sup>23</sup>*Ibid.*, p. 16.

of statements adjusted for general purchasing power changes.

Eldon S. Hendricksen evaluated general purchasing power reporting on the income statement:

When income is to be used as a predictive device, the reported net income of a firm should be adjusted for price-level changes for three reasons: (1) Prediction requires an emphasis on recurring events and an attempt to obtain signs of material nonrecurring changes in the future . . . . (2) Past income figures may be useful for predicting future income only if all income statement figures are expressed in the same terms . . . . (3) From the investor's point of view, it is much less meaningful to predict changes in the aggregate of historical monetary measurements than to predict the value of the firm from measurements expressed in terms of a constant purchasing power and from changes in this total purchasing power.<sup>24</sup>

The implication here is that the income statement will be used as a predictive device. When so used, the income statement figures that are unadjusted for price-level changes are less useful than adjusted statements.<sup>25</sup> Aside from major events that may affect a company, the stockholders' major source of information will be from the annual financial statements. This is so indicated in the Report of the Study Group on the Objectives of Financial Statements.<sup>26</sup>

On the income statement it is not difficult to adjust annual earnings to a common dollar base for comparison

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<sup>24</sup>Hendricksen, Accounting Theory, p. 214.

<sup>25</sup>Ibid.

<sup>26</sup>Report of the Study Group on the Objectives of Financial Statements, Objectives of Financial Statements, (American Institute of Certified Public Accountants, Inc., October 1973), p. 17.

purposes, nor is it difficult with most expense items. The major adjustment problem centers around items such as depreciation, amortization, and depletion. It is almost impossible for a statement user to make a reliable adjustment to depreciation without knowing the cost, life, salvage value, etc., of each piece of equipment, etc.

In his evaluation, Hendrickson also gives three reasons for adjustments for general purchasing power changes on the balance sheet:

The main objectives for restating the items in the balance sheet are: (1) to restore or elevate the usefulness of the balance sheet to provide meaningful financial information; (2) to provide for a more adequate basis for the computation of periodic net income; and (3) to disclose the effect of inflation or deflation on the various classes of equity holders.<sup>27</sup>

These three objectives may carry even more importance than those supporting an adjusted income statement. The balance sheet has been relegated to a rather nominal function in most of the analysis of financial statements and determination of the financial position of a company.

The balance sheet should not be placed in this lesser role. Howard Ross indicates it is the most important statement:

While I agree with everyone else that the most important aim of accounting is to measure income, the only proper way to regard income is as a measure of the increase in the value of an enterprise during a financial period. Thus, to measure income, in my

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<sup>27</sup>Hendricksen, Accounting Theory, pp. 215-216.

view, it is necessary first to measure asset values. If the balance sheet is properly drawn up, the income account will look after itself.<sup>28</sup>

Ross is then saying that the income statements are the connecting links between successive balance sheets, which should be the true measure of the value of a business.

The balance sheet involves items of widely diverse dollar purchasing power. Major equipment and building items may have some costs stated in dollars reasonably close to current dollars. These more current items are aggregated with costs that are significantly different from current dollars. For example, an asset (say, land) was purchased in 1968 at a cost of \$500,000. An identical piece of land (assuming no changes in the interim, other than a change in the general purchasing power of the dollar as indicated by the GNP Implicit Price Deflator) was purchased for \$726,500 in 1974. Under conventional accounting procedures, the apparent lack of usefulness is visible when these two parcels of land are shown on the balance sheet at an aggregate price of \$1,226,500. The utility of the balance sheet as a tool for decision-making purposes is questionable when similar items are portrayed in this manner. Users of the financial statements cannot make informed price-level adjustments to the financial statements and must accordingly rely on the company to provide this information. A major objection to

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<sup>28</sup>Howard Ross, "Is It Better to be Precisely Wrong Than Vaguely Right," Financial Executive, June 1971, p. 11.

the use of these statements, however, is that users may perceive the statements to be reporting the value of the company.

The financial statement users must be provided with information that is most relevant to their decision-making process with the least amount of uncertainty possible. As has been noted in the preceding pages, the use of General Price-Level adjusted statements may create more problems than it solves. To provide information which would cause more confusion than already exists would be a definite step backwards regarding the utility of financial statements. The optimum solution may never be reached but the more relevant the information provided by the financial statements, the greater their use will be in making informed decisions.

In an address at the University of California at Berkeley on May 30, 1974, John C. Burton, the chief accountant for the Securities and Exchange Commission, proposed that replacement costs be adopted instead of only adjusting statements for price-level.<sup>29</sup> His arguments against price-level accounting center around the costs of implementation (without much added benefit) and the variable effects of inflation upon different segments of the economy. He feels, therefore, it is unlikely that price-level adjusted statements will serve the purpose of providing more relevant

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<sup>29</sup>John C. Burton, "Financial Reporting in an Age of Inflation," The Journal of Accountancy (February 1975), p. 69.



information than is currently being disseminated in annual reports. Almost one year after the date of Burton's address at Berkeley, the Wall Street Journal reported, "SEC Nears Proposal to Require Concerns to Partially Disclose Inflation's Impact."<sup>30</sup> It reported a speech by Burton to corporate financial executives and accountants at Carnegie-Mellon University. Burton was discussing ways to adjust financial statements reflecting inflation's impact; the Journal reported, "The Securities and Exchange Commission staff is close to proposing that companies be required to partially disclose the impact of inflation on their operations, the agency's chief accountant said."<sup>31</sup>

As of March 1976, the SEC has adopted disclosure requirements for filings with the SEC in regards to replacement costs of inventories and productive plant.<sup>32</sup> The type of disclosure is not mandated nor does the information have to be audited, but the auditor is associated with it. These disclosure requirements are estimated to affect about 1,000 of the largest nonfinancial corporations which have a year end of December 25, 1976 or later. By now requiring the disclosure of replacement-cost the SEC is by their own

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<sup>30</sup>"SEC Nears Proposal to Require Concerns to Partially Disclose Inflation's Impact," The Wall Street Journal, 8 May 1975, p. 26.

<sup>31</sup>Ibid.

<sup>32</sup>"Accounting Series Release No. 190," The Securities and Exchange Commission, 23 March 1976.

admission requiring companies to provide information which they feel will be more relevant to financial statement users. The fact that they have allowed a one year grace period for extractive industry companies with respect to hydrocarbon reserves may be because they have not yet decided if this is the best methodology for this industry.

With the Financial Accounting Standards Board proposing (at least for the present time) the use of general price level indexes and the SEC requiring the use of replacement costs, the question still is unanswered as to which would provide the better disclosure for a petroleum company. Other alternatives are available; and these are discussed in the remainder of this chapter and analyzed in Chapter IV in relation to one particular petroleum company's operations.

#### Statements Adjusted for Price-Level by Specific Price Indexes

Because specific price-level indexes do not always increase or decrease at the same rate, or even in the same direction as general price levels, many proponents of price-level adjustments feel that the only price-level adjustments that should be made are for specific price-level changes.

Prior to stating the advantages for specific price-level adjustments, consideration should be given to a point made by R. S. Gynther:

It is contended that most people who enter the general versus specific index argument do so not because of the indexes themselves but because of the basic accounting theories to which they consciously or subconsciously (most likely the latter) subscribe. Most of those who support the one general index are basically proprietorship theorists, and those who argue for several specific indexes are basically entity theorists.<sup>33</sup>

His feelings are further indicated when he summarizes the effects of three accounting models: (1) conventional accounting maintains money capital only; (2) the use of one general index maintains capital in purchasing power units; and (3) the use of several special indexes maintains capital in physical units.<sup>34</sup> Gynther is a proponent of the entity theory; it is his contention that the only valid measure is based upon specific price indexes:

If the concern is going to survive (and surely this must be the aim of all those concerned), accounting for the concern must be carried out in costs which are real and specific to it, and not in costs which are intended to reflect the general purchasing power of money.<sup>35</sup>

Those who are proponents of price-level accounting adjustments will invariably divide into the two camps of a general index versus specific indexes. It has not been proven, nor may it ever be, which of the adjustments is the better. A case can be made for either method depending upon

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<sup>33</sup>R. S. Gynther, "Accounting for Price Level Changes --One General Index or Several Specific Indexes?" Accountancy 73 (July 1962): 561.

<sup>34</sup>Ibid.

<sup>35</sup>Ibid., p. 562.

the particular industry or segment of the firm under consideration. The question of which type of price-index adjustment is more appropriate is not the goal of this research; the purpose, as stated earlier, is to make comparisons between the different accounting methods as they relate to one company in the petroleum industry.

Another contention must be presented. The basic notion behind all price-level adjustments is the lack of a stable monetary unit. Whether an individual believes in a general or specific index, all price-level advocates agree on the instability of the dollar. R. J. Chambers questions that this should be the way to adjust for this instability:

One presumption underlying the common-dollar notions of ARS No. 6 is that the "cost principle" is valid (p. 29), but this principle is in defiance of all practical experience. No one who wishes to improve his present position pays any serious attention to the cost of what he wishes to sell. If he judges he will be better off, he will sell; what he paid is paid, there is nothing he can do about it; all he can sensibly do is to seek to improve his position at a point of time, and continuously from time to time.<sup>36</sup>

Therefore, not only is there dissention as to the appropriate index or indexes to be used for adjusting price-level changes, but as Chambers points out above: Is this really going to solve the problem of making financial statements more relevant? This question cannot be answered by a

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<sup>36</sup>R. J. Chambers, "The Price Level Problem and Some Grooves," Journal of Accounting Research (Autumn 1965): 249.

positive yes or no. Another method may prove to be better than price-level adjustments.

Financial Statements Prepared  
on a Value Basis

There is little agreement as to which adjustment method should be used for price-level adjustments. Further, there is even less agreement about which method of valuation to use, assuming the statements are to be presented on a value basis. Hendricksen states, "Valuation in accounting is the process of assigning meaningful quantifiable monetary amounts to assets."<sup>37</sup> Valuation methodologies are normally separated into two major categories: (1) Input or entry values, and (2) output or exit values. Within these two major categories, some of the more important methods will be examined briefly as to their applicability to the petroleum industry.

Entry Values

Historical cost. The best known entry value is historical cost. Although today's financial statements are theoretically based on an historical cost system they are in fact a conglomeration of different figures that bear little relationship in many cases to historical cost.

In Accounting Research Study No. 7, Paul Grady lists over 25 instances where alternative methods of accounting

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<sup>37</sup>Hendricksen, Accounting Theory, p. 260.

are available.<sup>38</sup> He shows that generally accepted accounting principles are extremely varied and the use of the term historical cost is subject to interpretation. A few simple examples will show that historical cost is not the predominant figure in the financial statements: (1) in certain instances long-term receivables and payables are to be reported at their present value of the consideration given or received in an exchange;<sup>39</sup> (2) inventories are reported on the basis of first-in, first-out; last-in, first-out; or lower of cost or market; and (3) marketable securities are shown at the lower of cost or market in many cases, and cost in many others. When examined in detail, there are few items on the financial statements that reflect historical cost in its pure form.

Current entry cost. Another entry value concept is that of current entry or input costs. Current entry values or replacement costs have a number of advantages over historical cost and historical cost statements adjusted for general or specific price-level changes. Among these advantages are: (1) it represents the amount necessary to obtain a like asset today; (2) it matches current costs

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<sup>38</sup>Paul Grady, Inventory of Generally Accepted Accounting Principles for Business Enterprises, Accounting Research Study No. 7 (New York: American Institute of Certified Public Accountants, Inc., 1965), pp. 373-379.

<sup>39</sup>Accounting Principles Board, Interest on Receivables and Payables--APB Opinion No. 21 (New York: American Institute of Certified Public Accountants, 1972).

against current revenues; and (3) the summations of current entry costs are more valid than summations of historical costs from different time periods.<sup>40</sup> (This is the identical argument used for price-level adjustments.)

The use of current entry values does meet the criteria of verifiability if there is a market against which these values may be compared. The American Accounting Association indicates that in many cases replacement costs are in fact relevant, quantifiable, and as noted above, verifiable.<sup>41</sup> Philip W. Bell, who is closely identified with current entry values, defends this methodology in this way: "Accounting must measure past events, and to be useful, it must measure those which actually happened, not those which might happen if a firm does something other than that which was planned."<sup>42</sup> Bell is against any type of valuation procedure which utilizes possible future occurrences. Even though he insists that reliance must be placed on past transactions, he does in fact advocate the assigning of current costs to these transactions as opposed to having them remain on an historic cost basis.

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<sup>40</sup>Hendricksen, Accounting Theory, p. 268.

<sup>41</sup>American Accounting Association, A Statement of Basic Accounting Theory (Evanston, Ill.: American Accounting Association, 1966), p. 31.

<sup>42</sup>Philip W. Bell, "On Current Replacement Costs and Business Income," Asset Valuation and Income Determination --A Consideration of the Alternatives, ed. Robert R. Sterling (Lawrence, Kansas: Scholars Book Co., 1971), p. 30.

The use of entry values does provide an alternative to historic cost in many instances. Are entry values relevant to a given industry? For purposes of this study, are they relevant in extractive industries, and in particular to pre-production segments of their operations? Klingstedt noted that the "replacement costs is not verifiable or relevant with respect to the hydrocarbon reserves of any specific oil company in the world today."<sup>43</sup> The primary reason for this is the lack of any reasonably accurate measure of how much must be spent on pre-production activities prior to the locating of commercially producible hydrocarbons. Therefore the use of current entry costs or values cannot be advocated for application to the petroleum industry as a whole.

#### Exit Values

Current cash equivalent. One of the more prominent proponents of exit values is Raymond J. Chambers. He describes his method of valuation as:

Excluding all past prices there are two prices which could be used to measure the monetary equivalent of any nonmonetary good in possession, the buying price and the selling price. But the buying price, or replacement price, does not indicate capacity, on the basis of present holding, to go into a market with the cash for the purpose of adapting oneself to contemporary conditions, whereas the selling price does. We propose therefore, that the single financial property which is uniformly relevant at a point of time for all possible

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<sup>43</sup>Klingstedt, Value Accounting in the Petroleum Industry, p. 3-12.



actions in markets is the market selling price of any or all goods held. Realizable price may be described as current cash equivalent.<sup>44</sup>

Chambers is proposing one uniform measurement concept that can be applied to all assets. Under this system all assets are valued at what they could be sold for at the end of the year, assuming an orderly sale. It is difficult to simulate or even comprehend an orderly sale for one of the large automobile firms, petroleum companies, or multinational organizations. A contemplated sale of all of the assets of a major corporation would probably require the use of liquidation values. Liquidation value also is another exit value concept, and probably should be used in only two cases: (1) when the asset has lost its usefulness and thus lost its normal market, and (2) when the firm plans on ceasing operations in the near future.<sup>45</sup>

Hendricksen noted that, "One of the major difficulties with the current cash equivalent concept is that it provides justification for excluding from the position statement all items that do not have a contemporary market price."<sup>46</sup> This elimination of certain assets presents a real problem for companies in the petroleum industry. Costs are accumulated and capitalized for all pre-production

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<sup>44</sup>Raymond J. Chambers, Accounting Evaluation and Economic Behavior (Englewood Cliffs, N.J.: Prentice-Hall, Inc, 1966), p. 92.

<sup>45</sup>Hendricksen, Accounting Theory, p. 266.

<sup>46</sup>Ibid., p. 265.

efforts under full costing; but only those costs that result in commercially producible reserves are capitalized under successful efforts. These costs and certain non-vendible durables would be written off under Chamber's theory.<sup>47</sup> Klingstedt noted that, "In the oil and gas industry lease and well equipment would often have to be classed as a nonvendible durable by not being marketable in its installed state. Yet, such are very real assets and essential to the conduct of business. The same situation would apply to many other assets that are common in the industry."<sup>48</sup>

Chamber's theory does not appear to meet the reporting needs of the petroleum industry. It may be applicable to certain segments of the firm's operations, but it does not apply to the pre-production phase of operations. Apparently current cash equivalents cannot be advocated for use in the petroleum industry as a whole.

Discounted cash flow. Discounted cash flow as an asset valuation concept is also classified as an exit value concept. As the following discussion will show, out of all the currently proposed methodologies, discounted cash flow is most applicable to the valuation of underground hydrocarbons. It will provide a more representative presentation

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<sup>47</sup>Chambers, Accounting Evaluation and Economic Behavior, p. 243.

<sup>48</sup>Klingstedt, Value Accounting in the Petroleum Industry, p. 3-9.

of the results of operations and the financial position in the pre-production phase of operations.

Because cash flows generated from the production of a well will be received over a period of years, it is necessary to calculate the present value of a series of cash flows. A simple formula for this calculation is presented by Hendricksen as:

$$P_0 = \sum_{j=1}^n \frac{R_j}{(1+i)^j}$$

where  $P_0$  is the present discounted value of the expected cash flow at time  $t_0$ ;  $R_j$  represents the expected cash to be received at the end of year  $j$  (representing each of the years  $t$  through  $t_n$ ; and  $(i)$  is the opportunity rate of interest.<sup>49</sup> There are, as Hendricksen points out, a number of factors that the formula does not contain, or are implicit in the formula and must be considered: (1) the receipts,  $R_j$ , are net cash receipts and if additional cash outlays are made these must also be considered; (2) there is no provision made for tax effects; and (3) there is no provision for risk factors.<sup>50</sup> Tax effects may be ignored

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<sup>49</sup>Hendricksen, Accounting Theory, p. 262.

<sup>50</sup>Ibid., pp. 262-263. The risk factor is an inherent part of the estimation process used in determining what time period cash flows will be generated in each future year. There is also a certain amount of risk in the determination of  $(i)$ . If the selection of the wrong discount factor were to lead to an erroneous decision, then the risk becomes even greater the more sensitive  $(i)$  is to the decision.

in this research as all of the models studied are compared on a before-tax basis. The tax effects would not bias the study; in all cases the petroleum company here is in the highest marginal tax bracket. A risk factor is implicitly incorporated into (i) and the estimate of future cash flows with its possible effects is noted in footnote 50.

Giving consideration to the amount of uncertainty involved in discounted cash flow analysis, Klingstedt concluded ". . . that discounted cash flow will probably not meet the objectives of verifiability, neutrality, and comparability."<sup>51</sup> But even though not all of the objectives are fully met, he still believes the use of discounted cash flow is the appropriate value method to be applied to underground hydrocarbon reserves:

Reference to the discounted future net revenue of hydrocarbon reserves is particularly appropriate in attempting to establish their fair market value since such computations are quite often used as the basis for the purchase and sale of hydrocarbons in the ground.<sup>52</sup>

The conclusion to be reached at this point is that if the management of the petroleum companies utilize discounted cash flows in establishing a value for the purchase and or sale of underground hydrocarbons, the method should also be appropriate for financial statement purposes.

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<sup>51</sup>Klingstedt, Value Accounting in the Petroleum Industry, p. 3-7.

<sup>52</sup>Ibid., p. 5-3.

Another point favoring discounted cash flow is its use to determine whether or not certain drilling ventures will be undertaken. The following information was taken from an "Authorization for Expenditure" form of a major petroleum company. The data here relates to a decision of whether or not to drill a 12,000 foot development well at a location in the United States.<sup>53</sup>

Life, years	21
Gas Reserves, MMCF	3,539
Total Investment	\$371,937
Net Cash Recovery	\$599,135
Disc. Present Worth @ 10%	\$256,287
Net Profit / \$ Invested    \$/\$	1.61
Present Worth Ratio @ 10%    \$/\$	0.69
DCF Rate of Return    %	35
Payout, years	2.6

No indication is given of how the 10% discount rate was decided, or of any other assumptions made in the calculations. It is apparent, however, that the petroleum company did use discounted cash flow projections in its decision to drill a development well in that location.

Alan Frederick Smith's dissertation in 1968 dealt with the application of discounted cash flow analysis to the valuation of underground hydrocarbon reserves in the petroleum industry. Although more will be said about this study in the next section of this chapter, his chapter five

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<sup>53</sup>The "Authorization for Expenditure" form is utilized in the petroleum industry to get authorizations for proposed drilling activity. The company from which this data was received has requested to remain unknown. However, this is not the same company as the one whose primary empirical data was used.

"Reporting for Oil Properties with Imperfect Knowledge" concluded, ". . . that the economic valuation method proves to be a superior technique to current accounting practices in the oil producing industry."<sup>54</sup> This economic valuation method as used by Smith is synonymous with the discounted cash flow approach to valuation.<sup>55</sup>

The Smith Study--Valuation and Its  
Possible Application in Accounting  
with Special Reference to  
the Production of Oil

Smith's study of the valuation of underground hydrocarbon reserves was the first to extensively evaluate a discounted cash flow approach in the petroleum industry. His hypothesis stated that: "financial statements can be prepared on an economic valuation basis for certain kinds of assets and that these financial statements are more useful than those prepared according to traditional accounting practices."<sup>56</sup> He further clarifies this by stating that he is restricting the application of discounted cash flows to those assets that have a primary responsibility for net cash inflows--the underground hydrocarbon reserves.

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<sup>54</sup>Alan Frederick Smith, "Valuation and Its Possible Application and Presentation in Accounting with Special Reference to the Production of Oil" (D.B.A. dissertation, University of Colorado, 1968).

<sup>55</sup>Ibid., p. 14.

<sup>56</sup>Ibid., p. 36.

In order to test this hypothesis, Smith selected as the accounting unit a lease with two producing wells on it. Costs and revenues were prorated to each well on the basis of production from each well. He then applied different discount rates, varied estimates, and used different methods of reporting under two basic assumptions: perfect knowledge and imperfect knowledge. He stated his first assumption as: "Perfect knowledge is assumed for a simple example of an oil property so complications are minimized in the introduction of the suggested system."<sup>57</sup> Under this perfect knowledge system he tested his results using discounted cash flow methods with what would have been recorded using full costing, successful efforts costing, and a third method which was similar to full costing but took into account the deferral of income taxes resulting from the differences in tax and financial reporting. The conclusion he reached was:

The economic valuation method is more realistic and useful to the reader of the financial statements. Expected values of the oil properties are immediately reported and not delayed with the result that the income statement and balance sheet figures become more meaningful through the inclusion of the impact on the corporation of the most important operational event--the discovery of an oil property. At the time of discovery, the oil property is similar to an investment, and subsequent reporting by the economic valuation method conforms with this concept. Therefore, it is suggested that the economic valuation method is superior to the accepted accounting methods.<sup>58</sup>

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<sup>57</sup>Ibid., p. 94.

<sup>58</sup>Ibid., pp. 108-109.

Since a situation involving the use of discounted cash flows is uncertain, the analysis by Smith could be questioned. To avoid this, he introduced the second major assumption of uncertainty into the study. In addition to providing him with a more realistic situation, it also enabled him to make extensive comparisons between conditions of certainty and uncertainty in evaluating the accepted methods and his discounted cash flow analysis:

The accepted accounting practices are inadequate for statement presentation in the early life of the property. A large proportion of the life of the property must have elapsed before the statements give reasonably accurate information; even so, assets are understated and reported income is overstated in these later years . . . .

The advantage of the economic valuation method is its consistent recognition of value as the basis for financial statements. In contrast to the current accounting practices, the economic valuation method is not dependent on whether this value is equal to or less than the costs of acquisition. It is an unbiased measuring system insofar as the intention is neither to undervalue nor to overvalue the property, although either error is a possible outcome owing to a lack of knowledge. Fortunately, any errors in the estimation of the quantity or the rate of oil production will tend to be offset by other factors included in the calculations of value.

A conclusion may be drawn that the economic valuation method proves to be a superior technique to current accounting practices in the oil producing industry.<sup>59</sup>

Using imperfect knowledge he concluded, "It is evident that the pattern of the presentations based on imperfect knowledge is the same as that found with perfect

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<sup>59</sup>Ibid., pp. 127-128.



knowledge."<sup>60</sup> Therefore his findings of no major differences using either method indicate that use of discounted cash flow procedures are preferable to any other value methodology when the shortcomings of the others mentioned are considered.

Due to the extensive analysis in Smith's study, it is difficult to refute the applicability and usefulness of discounted cash flow presentations of value for the hydrocarbon reserves in the financial statements. A minor criticism may be levied against the study in that it was an analysis of only one lease with two producing wells on it. This constitutes a self-liquidating unit and one which most operating petroleum companies hope they will not encounter for a number of years. The self-liquidating unit is not consistent with the going concern concept. Whether a company is discovering more than it is extracting or vice versa, all petroleum companies (with the possible exception of some very small independents) are continually adding new discoveries to their reserves. To use currently accepted accounting practices would tend to exaggerate the understatement of assets and overstatement of income, as Smith concluded in his study of two wells.

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<sup>60</sup>Ibid., p. 126.

The Klingstedt Study--Value Accounting  
in the Petroleum Industry

In his study of value applications in the petroleum industry, John P. Klingstedt utilized discounted cash flow techniques to determine the value of underground hydrocarbon reserves. The basis for this study was an oil field that had been in production for about thirty years and had produced approximately 150 million equivalent barrels of oil.<sup>61</sup> To overcome the same problem of a self-liquidating situation faced by Smith, Klingstedt applied the same value concepts that he used on the study of one oil field to a producing company over a fifteen year period.<sup>62</sup> During that period the company was both producing reserves and making new hydrocarbon discoveries.

Although other relationships appear to have been tested, Klingstedt reported on the differences in earnings per share and book value when comparing conventional with value accounting. In the analysis of earnings per share he applied three different income concepts: (1) Income under historical cost accounting; (2) Operating profit under value accounting; and (3) Total business profit under value accounting which included holding gains, discovery values, etc.<sup>63</sup>

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<sup>61</sup>Klingstedt, Value Accounting in the Petroleum Industry, p. 5-1.

<sup>62</sup>Ibid., p. 6-1.

<sup>63</sup>Ibid., p. 6-3. The second concept does not recognize any income from holding assets as Klingstedt utilized

He found that the operating profit under value accounting was consistently lower than under historical cost accounting, but it did display a similar trend.<sup>64</sup> On the other hand, total business profit under value accounting showed no relationship to either of the other two concepts. In fact in year nine when the company made a significant discovery of oil and gas reserves, the earnings per share were found to be \$1.50 on an historical cost basis and \$36.20 under concept three using value accounting.<sup>65</sup>

In comparing book value by historical cost and value accounting, the results followed the trend established in the analysis of earnings per share. Again selecting year nine for comparison, the book value change from year eight to nine was negligible under historical accounting; book value remained around \$52 per share,<sup>66</sup> but appeared to decrease somewhat. When the underground hydrocarbon reserves are recorded, the change in book value went from approximately \$100 per share in year eight to \$132 per share in year nine.<sup>67</sup> The change in year nine was due

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the presentation recommended by Edwards and Bell in The Theory and Measurement of Business Income.

<sup>64</sup>Ibid., p. 6-9.

<sup>65</sup>Ibid., p. 6-6.

<sup>66</sup>Ibid., p. 6-5.

<sup>67</sup>Ibid., p. 6-5.

entirely to the recognition of the value of the discovered hydrocarbons. The small decrease in historical cost book value in year nine was due to the lack of any recognition in the financial statements of the value of hydrocarbons discovered and to the expensing of a large portion of the pre-production costs incurred in locating the underground hydrocarbons discovered that year.

Klingstedt concludes his analysis of this company by stating:

In the area of prediction of the future, value accounting appears to offer considerably more than historical cost reporting in view of several factors including alternative practices available under conventional accounting. The use of trends of value (net equities per share) would appear to be the most reliable measure, but additional testing would be required before a definite conclusion could be drawn.

From an overall point of view, value accounting would definitely be more relevant than historical cost reporting for the statement user.<sup>68</sup>

### Conclusion

The presentation of financial statements in the petroleum industry has been and is currently subject to a significant amount of disagreement. In the past the controversy has revolved around the capitalize-expense decision regarding the pre-production segment of operations. This dilemma has not been resolved and has quite vocal advocates supporting each of two divergent views.

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<sup>68</sup>Ibid., p. 6-10.

One group advocates capitalization of all pre-production costs irrespective of the future benefits to be derived from these costs. These supporters of the full costing method feel that the appropriate cost center or accounting unit for the firm to utilize is the operations of the firm in one large geographic area, which goes from geopolitical boundaries to the entire operations of the firm. The only limitations placed on the aggregate amounts to be capitalized is the fair value of the combined underground hydrocarbon reserves of the cost center used. However, the advocates of full costing have not delineated a rational method to determine the maximum permissible amount to capitalize.

Advocates of the successful efforts method believe that only costs that are directly associated with commercially producible quantities of hydrocarbons should be capitalized. Advocates of successful efforts contend that full costing results in a deliberate overstatement of assets and income without the benefits that may be derived by use of value accounting.

Price-level adjusted financial statements, as presently proposed, are simply historical cost statements adjusted for the purchasing power changes in the dollar by use of the Gross National Product Implicit Price Deflator. These statements are most likely superior to unadjusted cost statements; but even though general price-level changes

have been made, the financial statements are still based upon cost. The main objection to all cost based statements is that they are historical in nature and may have no relationship to possible future trends--which the user of these statements is trying to predict.

Statements adjusted for specific price-levels take into account purchasing power changes in the dollar, changes in technology, and other changes. The major objection to specific price-level adjustments is that specific indexes are not available for all assets or asset categories. Therefore, it appears that the use of specific price-levels will not solve the reporting problems currently faced by industry.

A number of possible valuation methods for presentation of financial statements have been examined in this chapter. To determine their validity, these valuation methods were examined with respect to meeting the qualitative objectives of financial statements. None of the methods examined met all of the qualitative objectives listed.

Historical cost, or conventional accounting, appears to meet all of the objectives with the exception of relevance. When dollars of significantly different purchasing power are aggregated on the financial statements, the relevance of those statements drops precipitously. If financial statements are not relevant to the statement user, the fact that they meet other objectives becomes a moot point.

Current entry value or replacement cost has significant problems when related to the pre-production phase of a petroleum company's operations. Because there is no relationship between the cost of discovery of hydrocarbon reserves and the ultimate amount that may be realized from these reserves, it would be impossible to assign a replacement cost to the hydrocarbon reserves. Accordingly entry values would be no more relevant than historical costs.

As to exit value models, Chambers' "current cash equivalent" model is lacking in two basic aspects. First, entry values are assigned to inventories due to an inherent presumption that the realization principle is inviolate. In the petroleum industry this would not work because it attempts to assign replacement costs to hydrocarbon reserves, which is impossible. Second, nonvendible durables are assigned no value. In the petroleum industry there are a significant amount of nonvendible durables; accordingly this would distort the statements to an extent even greater than historical cost with its dollars of diverse purchasing power.

The discounted cash flow methodology, although it does not meet all of the qualitative objectives of financial statements, is most relevant to the valuation of underground hydrocarbon reserves, but not necessarily for other assets. The studies by Klingstedt and Smith have both shown that discounted cash flow should be used in valuing underground

hydrocarbon reserves. However, because of the importance of financial statements and the significant changes that would be required for implementation, both studies recommended a more thorough analysis of this problem utilizing somewhat different factual situations.

The Financial Accounting Standards Board currently has on its agenda for study during 1976 the subject of accounting and reporting in the extractive industries. This together with the studies of Klingstedt and Smith indicate the importance of the problem being researched here.

As this study is concerned with the analysis of the valuation problems, the next chapter will set forth the research design employed in this endeavor.



## CHAPTER III

### RESEARCH DESIGN

The research design employed in this paper is descriptive in nature and is limited to data gathered from one major petroleum company. The first section of this chapter explains the basic parameters of the data. Cost and value models are then discussed as to methods of adjustment employed, assumptions necessary to utilize the data, and certain constraints with respect to the data.

#### Parameters of Data Gathered

Some of the parameters of the data used in this study were enumerated briefly in Chapter I. These and certain data restrictions are explained in more detail in this section.

The data used in this study are the actual results of operations of a major petroleum company during the six year period covering 1969 through 1974. Data retrieval for prior years was virtually impossible due to the use of different methodologies employed and different locations for the storage of the data. To protect the identity of the

company the data had to be disguised by a factor which was uniformly applied to all of the quantitative information utilized. The application of this factor was such that no material differences in the relationships of the financial information resulted when compared with the company's actual operations.

In research in the nature of a descriptive-case-study, actual data from one major company is considered sufficient. Additionally in an environment where petroleum companies are coming under increased attacks from government, consumer action groups, environmental groups, and others, the obtaining of empirical data is fortuitous indeed.

Only the exploration and production phases of operations are to be analyzed concerning the effects of different accounting models on financial statements. This phase of operations was selected because it includes the accounting for underground hydrocarbon reserves, which are extremely significant unrecorded assets.

One aspect of this company's operations makes it particularly relevant to this study: it is producing more reserves than it is discovering. Exhibit I shows that the reserves are declining, while Exhibit II shows that revenue has been increasing. This is important in that the revenues of the company's exploration and production division are the result of production of these underground

hydrocarbons. When the company totally depletes its reserves, it will then have no revenue from this source.

By examination of only the revenue of the company, it appears that the company is doing a tremendous job and expanding at a high rate. In fact, the opposite could be considered to be true: the reserves are declining and the revenue will cease when the reserves are gone. This company therefore provides a unique example where the revenues show progress while the reserves show decay. Thus this research has a set of data to analyze and will come closer to answering the question of which of the data (revenue or reserves) is correct, if either.

The valuation of the underground hydrocarbon reserves in conjunction with the different proposed accounting models is a primary objective of this study. Other operations of refining, marketing, and transportation/distribution<sup>1</sup> have been eliminated from consideration since this would not materially bias the study. In addition the inclusion of these three other major activities would tend to: (1) not include any major unrecorded assets other than the underground hydrocarbon reserves; (2) increase the complexity of the study to the point of becoming unmanageable; and (3) include significantly different accounting problems

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<sup>1</sup>Exxon Company, U.S.A., Competition in the Petroleum Industry. Submission before the Senate Judiciary Subcommittee on Antitrust and Monopoly. (Washington, D.C.: 12 January 1975), p. 5.

(such as joint and by-product costing in refining operations, etc.) that would tend to distract from the objective of comparisons of results of different accounting models when unrecorded assets are considered to be significant.

No portion of the operations of the company in the international sector was included in this research. The inclusion of these foreign operations with the diverse variables, which would not be encountered in domestic operations, was felt to be a distraction from the objectives of this research. One could not ignore the probability that nationalization is, or may be, remote as to a material portion of foreign operations; but certain critical elements could be partially taken over as has happened in certain Middle East countries. Determination of the probability warrants a complete study in itself.

In spite of geographical limitations, there is still a significant data base with which to work. The revenue from sales of oil and gas domestically were in excess of \$900 million for the 1974 reporting year. In addition, domestic crude and natural gas liquid reserves at 1974 year end were estimated at over 900 million barrels of crude, and natural gas reserves were estimated to be in excess of 5 trillion cubic feet. (Exhibit I) Estimates of underground hydrocarbon reserves were made for the domestic operations of this company by an internationally recognized

independent consulting firm; accordingly there exists a lack of bias in relying on their estimates.

Other revenues were not considered in the analyses as they are immaterial compared to the total revenue generated by the sales of natural gas, crude oil and natural gas liquids. In 1969, for example, 97.8% of sales were from these major categories. In 1974 sales of oil and gas accounted for 99.5% of total revenue. (Exhibit II)

#### Adjusting for GNP Implicit Price Deflator

Two assumptions regarding the data gathered were necessary to permit reasonably efficient adjustments for general price level changes:

1. All revenues from the sale of crude oil and natural gas liquids were received evenly throughout the year, as were revenues from natural gas sales.
2. No consideration was given to federal income taxes because comparisons on a before-tax basis are considered valid. The company whose data is being utilized is in the highest marginal tax rate bracket and tax effects would merely reduce all figures by the same percentage.

A number of additional assumptions are required for the use of application of price level adjustments, and must be addressed. These have to do with the actual application of price level adjustments to financial information for all

companies, not just for the company being analyzed here. These adjustments are applied as recommended by the Financial Accounting Standards Board in their exposure draft on Proposed Financial Accounting Standards Financial Reporting in Units of General Purchasing Power. Several recommendations are contained in the pronouncement, but the following have been singled out as most significantly affecting the data being used here:

1. The Gross National Product Implicit Price Deflator shall be the index of the general purchasing power of the dollar used in preparing purchasing power financial information.
2. General purchasing power information shall be stated in terms of the general purchasing power of the dollar at the most recent balance sheet date.
3. All items of revenue, expense, gain, or loss that are included in determining net income in units of money shall also be included in determining net income in units of the general purchasing power of the dollar at the most recent balance sheet date.
4. If general purchasing power information for earlier periods is presented for purposes of comparison with general purchasing power information for the current period, the information for the earlier periods shall be updated (rolled forward) to units of the purchasing power of the dollar at the end of the current period.<sup>2</sup>

The combination of the restrictions and assumptions regarding the use of the actual data for this particular company, and the assumptions above regarding the use of

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<sup>2</sup>Financial Accounting Standards Board. Exposure Draft on Financial Reporting in Units of General Purchasing Power (Stamford, Conn.: Financial Accounting Standards Board, 1974).

price level adjustments form the basis for the adjustment of revenues to reflect the changes in general purchasing power of the dollar.

#### Adjusting for Specific Price Indexes

There are a number of proponents for general price level adjustments; but because the specific classes of assets may not change with the Gross National Product Implicit Price Deflator, some advocate the use of specific price indexes. Also, many feel technological change is implicitly brought in to the index level; thus the use of specific indexes becomes a surrogate for some other method of valuation to arrive at value accounting.

Specific price level indexes are prepared by the U.S. Bureau of Labor Statistics; those pertinent to the oil industry are published in the Petroleum Independent. Four basic indexes which deal particularly with the exploration and production phases of operation include: crude oil price index, oil field machinery price index, oil well casing price index, and line pipe price index. The use of the crude oil price index will help to point out that the trend of prices in the petroleum industry is not consistent with the behavior of the Gross National Product Implicit Price Deflator. This is especially true when the data, as shown in Chapter IV, is examined with respect to the changes that occurred in the price structure from early in 1969 through 1974.

Adjusting Statements to Reflect Value

Adjustments of revenue for general price level or specific price increases do not present a major problem; both are primarily adjustments of historical costs. Value adjustments, on the other hand, are much more complex and do not lend themselves readily to adjustment. Certain assets cannot be valued by the use of replacement cost or any other cost based valuation method. Such is the case with underground hydrocarbon reserves, for which the use of a discounted cash flow approach has been found to be the most appropriate method of assigning value.<sup>3</sup>

Some theoretical difficulties are encountered in the use of discounted cash flow by the petroleum industry. One problem concerns the determination of the size of the accounting unit to be utilized. W. B. Coutts discussed the possible variations: from that of a single well up to and including the entire company in the accounting unit.<sup>4</sup> He concluded that the small size accounting units such as a single well or a field were too small since there is too much variability in the estimates of reserves. Including the reserves of the whole company as an accounting unit is

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<sup>3</sup>Klingstedt, Value Accounting in the Petroleum Industry, and Smith, "Valuation and Its Possible Application and Presentation in Accounting with Special Reference to the Production of Oil."

<sup>4</sup>W. B. Coutts, Accounting Problems in the Oil and Gas Industry (Toronto: The Canadian Institute of Chartered Accountants, 1963), pp. 26-27.



equally undesirable because of the diverse holdings of a large company. It would be erroneous to attempt to value all the reserves of an international oil company, such as the one being studied here, on a company-wide basis. The same price could not prevail throughout the company's worldwide operations; transportation costs affect the selling price of the oil in a normal market situation. For example, a refinery will be willing to pay more for crude oil produced ten miles from the refinery location, than it will for a similar quantity and quality of crude oil located or produced five thousand miles away when extensive transportation charges will also have to be paid.

Risk would be another widely diverse factor in international operations. As noted earlier, the risk of nationalization in certain foreign countries is presumed to be much greater than for domestic operations. Although the wells may appear almost identical, the risk differential is evident when a producing well is operated in Oklahoma, as compared to one in Canada or in the Middle East. Any upward or downward revisions in the currency rates would also affect the risk estimate and thus have an impact on a large international accounting unit.

Coutts' rejection of both small accounting units and company-size units resulted in his conclusion that an "areas of interest" concept should be applied.<sup>5</sup> The geographical

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<sup>5</sup>Ibid., p. 27.

size of the accounting unit used in this study was the domestic operations. This is a compromise between Coutts' extremes. The size of the operation is large enough to prevent severe fluctuations in reserve estimates that could occur on only one well or another fairly small area. In this geographical area the market is more centrally located and prices will not be so diverse. No crude oil will have to be shipped thousands of miles to a refinery with adequate capacity. The risk, although it may differ from one part of the United States to another, still would not be as diverse as from one country to another.

Another problem encountered in the application of discounted cash flow in the petroleum industry is the determination of an appropriate discount factor. The research of Alan Frederick Smith<sup>6</sup> studied the rates of nine, ten, eleven, and twelve percent. His findings were: "Errors in the rate of discount, within the limited range used, selected for the property do not cause too great a difference in the present value. Any one of the four discount rates provide a reasonably satisfactory valuation, and this suggests that a few discount rates . . . may be sufficient for valuing a range of properties with varying

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<sup>6</sup>Alan Frederick Smith, "Valuation and Its Possible Application and Presentation in Accounting with Special Reference to the Production of Oil" (D.B.A. dissertation, University of Colorado, 1968). Exhibit XXVIII.

risk factors."<sup>7</sup> Based on the results of Smith's study, a rate of ten percent has been selected for use in this study.

A final problem is the determination of future production and the period of time over which this production will occur. The production of a single well or lease can be more closely estimated than the production within the United States. New wells are being discovered each year; and the projection becomes even more difficult. This is true of almost every company in the petroleum industry. Some of the companies are discovering more in reserves than they are producing each year, while others produce more than they discover. The company being studied has, except for one year, shown a steady decline in production. The production each year was revised to reflect this decrease in production. No attempt has been made to forecast discoveries; if this were possible the petroleum companies would always drill producing wells. These techniques are not perfect, but are considered acceptable and the best alternative at this point in time.

No one method of valuation can be appropriate for all classes of assets. The underground hydrocarbon reserves

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<sup>7</sup>Ibid., pp. 115-116. Smith studied the effects of different discount rates (9%, 10%, 11%, and 12%) under conditions of perfect certainty and uncertainty. He found that any of the four provided a reasonable valuation. The 10% rate was selected for this study because it was near the center of the range he studied, and was the rate used by one company in 1974 to determine whether or not to proceed with the drilling of a development well.

are valued in this research by discounting the future cash flows generated by these revenues.

### Conclusion

The preceding sections have explained the assumptions and constraints under which each of the accounting models being tested in this study has been applied. Each is composed of both cost and adjustments to a value basis or price-level adjusted cost.

It is impossible to compose a complete statement for any one of the models in its entirety. These models, as they were developed from the original data, have been tested in a variety of ways. Chapter IV covers the analysis of the results of the data and includes a detailed explanation of the rationale used in the selection of each analysis method.

## CHAPTER IV

### RESULTS AND ANALYSIS

As noted in Chapter I, one of the primary objectives of this study is to provide empirical evidence regarding the effects of different accounting methodologies on the financial statements of a major oil company (in particular, the effects that would be noted with the inclusion in the financial statements of underground hydrocarbon reserves). This chapter presents the findings of this empirical research.

The analysis of the effects different accounting models have on the financial statements of a company can proceed along more than one route. The overall financial statements might be analyzed, or each item might be analyzed to ascertain the effects on that one item. It is not considered necessary to do both to see how each model can affect the decisions made by a user of the financial statements. This chapter contains an analysis of certain selected accounts and the behavior of each under different methodologies utilized.

### Individual Item Analysis

The hypothesis to be investigated is: The financial statements of a petroleum company adjusted for different accounting models can be compared and analyzed for a greater understanding of the effects of operations than is possible under conventional accounting methodology. This hypothesis is investigated by the application of various types of analysis, one of which is the analysis of each individual account and its behavior.

The two major revenue categories of a petroleum company in its exploration and production phase of operation are the sales of crude oil and natural gas liquids, and the sales of natural gas. For the company analyzed here, the sale of crude oil and natural gas liquids is the major source of revenue. (Although the sales figures include both crude oil and natural gas liquids, from now on this category will be referred to as crude oil sales.) As shown in Exhibit II, 75% of the company's gross revenue from 1969 through 1974 was derived from the sale of crude oil. Of the remaining 25% of gross revenue, all but 1% was derived from the sale of natural gas. The sales of crude oil are considered first.

#### Crude Oil Revenue

Reported according to generally accepted accounting principles. The following Table I presents the production and sales of crude oil from 1969 through 1974.

TABLE I  
CRUDE OIL PRODUCTION AND REVENUE  
1969 THROUGH 1974

YEAR	PRODUCTION* **	CRUDE OIL REVENUE***	AVERAGE PRICE PER BARREL
1969	123,713	\$330,453	\$2.67
1970	119,212	329,497	2.76
1971	118,260	348,978	2.95
1972	120,920	358,760	2.97
1973	117,472	419,684	3.57
1974	115,028	\$711,269	\$6.18

\*Source: Exhibit IV

\*\*Figures in thousands of barrels

\*\*\*Figures in thousands of dollars

Although production declined by 8,685,000 barrels from 1969 through 1974, revenue from the sales of crude oil increased by \$380,816,000 to \$711,269,000. The average yearly price of a barrel of oil increased from \$2.67 to \$6.18, or an increase of just over 130%.

This data has not been adjusted to reflect any methodology other than what is currently employed by the company in their reporting to financial statement users. This data forms the basis for adjustments made to reflect

other accounting methodologies that may be utilized in reporting the financial operations of a petroleum company.

Adjusted for general price level changes. The Financial Accounting Standards Board favors the use of the Gross National Product Implicit Price Deflator over any other index of changes in the value of the dollar (See Chapter III). For this reason the data was adjusted by use of the GNP-IPD; the results are shown in Table II.

TABLE II  
CRUDE OIL REVENUE ADJUSTED FOR  
GENERAL PRICE LEVEL CHANGES  
1969 THROUGH 1974

YEAR	REPORTED SALES**	RESTATEMENT FACTOR*	SALES IN 4th QUARTER 1974 DOLLARS**
1969	\$330,453	1.386	\$458,008
1970	329,497	1.314	432,959
1971	348,978	1.257	438,665
1972	358,760	1.216	436,252
1973	419,684	1.152	483,476
1974	\$711,269	1.045	\$743,276

\*See Exhibit V for calculation of the restatement factor.

\*\*Figures in thousands of dollars

The sales of \$330,453,000 in 1969 dollars when restated in terms of 1974 dollars increases by \$127,555,000



to \$458,008,000 and is caused only by changes in the value of the dollar as portrayed by the Gross National Product Implicit Price Deflator. The difference between reported sales in 1974 of \$711,269,000 and restated for general price level changes to \$743,276,000 is due to changes in the dollar during 1974. The GNP Implicit Price Deflator index in the first quarter of 1974 is 163.6 (1958 = 100) and the fourth quarter is 177.7; the average index for 1974 is 170.1. Because the restatement is made to fourth quarter 1974 dollars and earnings are considered to be earned equally throughout the year, there is a resultant differential between reported and adjusted sales of \$32,007,000. There would be no difference between unadjusted and adjusted dollars in a current year only when there is no movement in the GNP Implicit Price Deflator.

The above adjustments to reflect general price level changes are analyzed in a later section in conjunction with adjustment to reflect specific price level changes and adjustments to include valuation of the underground crude oil reserves.

Adjusted for specific price level changes. When looking at revenues under conventional reporting the question becomes: was the company really that much better off in 1974 than in 1969 as it appears at first glance? Consider the fact that production has remained relatively constant and in fact has decreased. The phenomenal increase

in revenues is due not to additional production, but to specific price changes in particular. This situation may be readily apparent to an individual who is familiar with the petroleum industry, but there is some doubt if it is as apparent to the average user of financial statements.

Specific price level indexes are published for a number of commodities. Such a specific index is published for crude oil sales by the U.S. Bureau of Labor Statistics; it is reproduced in the Petroleum Independent, published by the Independent Petroleum Association of America. Table III shows the results of adjusting crude oil revenue from that reported using generally accepted accounting principles to that reflecting specific price level changes.

All years are restated to the fourth quarter of 1974 index to be comparable to the restatement made for general price level changes. The differences between conventionally reported sales and sales adjusted for changes in specific price levels are even more dramatic than the differences encountered when adjustments are made for general price level changes.

General and specific price indexes have been increasing each year, but they have in no way moved together. During the period from 1969 through 1974, the Implicit Price Deflator increased by 33% while the specific price index for crude oil sales increased by 102%. A more thorough analysis of the specific price level adjusted revenues is made later.

TABLE III  
CRUDE OIL REVENUE ADJUSTED FOR  
SPECIFIC CRUDE OIL PRICE INDEX  
1969 THROUGH 1974

YEAR	REPORTED SALES**	RESTATEMENT FACTOR*	SALES REFLECTING 4th QUARTER 1974 INDEX**
1969	\$330,453	2.181	\$720,718
1970	329,497	2.162	712,373
1971	348,978	2.027	707,378
1972	358,760	2.016	723,260
1973	419,684	1.821	764,245
1974	\$711,269	1.080	\$768,171

\*See Exhibit VI for calculation of the restatement factor.

\*\*Figures in thousands of dollars

Adjusted for current value reporting. The adjustment of conventional income statements to reflect changes in the value of balance sheet items becomes significantly more difficult than adjusting for only general or specific price level changes. Table IV presents the results of the valuation of the underground crude oil reserves.

The company did not permit access to the data necessary to separate the discovery of underground reserves from upward or downward revisions in the amounts of recoverable reserves. This valuation of underground crude oil

TABLE IV  
VALUATION OF UNDERGROUND CRUDE OIL RESERVES  
USING A 10% DISCOUNT RATE  
1968 THROUGH 1974

YEAR	END OF YEAR RESERVES*	CURRENT PRODUCTION*	LIFE OF RESERVES IN YEARS	AVERAGE PRICE PER BARREL	FUTURE VALUE**	PRESENT VALUE OF RESERVES**
1968	1,424,983	121,446	11.73	\$2.47	\$3,519,708	\$1,094,435
1969	1,219,996	123,713	9.86	2.67	3,257,389	1,220,014
1970	1,131,333	119,212	9.49	2.76	3,122,479	1,213,550
1971	1,072,461	118,260	9.07	2.95	3,163,760	1,282,296
1972	973,868	120,920	8.05	2.97	2,892,388	1,296,979
1973	901,520	117,472	7.67	3.57	3,218,426	1,498,761
1974	856,657	115,028	7.45	\$6.18	\$5,294,140	\$2,521,834

\*Figures in thousands of barrels

\*\*Figures in thousands of dollars

reserves is based on the premise that the company will not be making any future discoveries of crude oil reserves, although additional discoveries are included for each year in which they occurred. Had there been no discoveries of crude oil reserves from the end of 1968 until the end of 1974 the reserves of crude oil would have been 629,104,000 barrels at the end of 1974. The actual reserves of 856,657,000 barrels shows that there was an increase of 227,553,000 barrels in the amount of the reserves, either because of discovery or upward revisions in the estimates of economically recoverable reserves.

Table IV also shows that the reserves have been declining each year; this would tend to reduce the present value of the future cash flows that would be generated from these reserves. However, the present values have in fact risen. This increase in present value is the result of the price increases offsetting the reduction in reserves. Table IV shows the change in the present values of the reserves, and does not directly show the effect that these changes will have on the income of the firm when included in the income statement.

When the increases and decreases in the present value of the underground crude oil reserves are considered in conjunction with the sales of crude oil in each year, a very interesting effect is noted, as shown in Table V: in

1974, revenue more than doubled when changes in the present value of the revenues are included.

Some problems must be considered when examining the data in Table V. The first column lists the difference from the previous end of year present value of crude oil reserves. An increase in the value of the reserves occurred each year except for 1970 when the value of the reserves declined by \$6,464,000. The specific data was not available, so this decline cannot be attributed to a holding loss alone; nor can any of the gains be specifically identified as holding gains and thus separated from values of discovered crude oil. Thus the change in present value of the reserves must be considered as one value figure that is in fact made up of more than one component. (In actual practice these should and could be identified as discovery values and holding gains; and it would not be necessary to assign all of these to the income statement as a direct increase or decrease in net income.)

The change in present value of reserves has been added to the reported sales in each of the years to arrive at a figure representative of a combination of the current year's sales and change in value. Neither the changes in value nor the sales in each year were restated by use of the Gross National Product Implicit Price Deflator to reflect the changing value of the dollar, nor were they adjusted by use of the specific index for crude oil sales.

TABLE V

REVENUES FROM CRUDE OIL SALES AND CHANGES  
IN THE PRESENT VALUE OF UNDERGROUND  
CRUDE OIL RESERVES  
1969 THROUGH 1974

YEAR	CHANGE IN PRESENT VALUE OF RESERVES*	REPORTED SALES*	REVENUE FROM SALES AND PRESENT VALUE CHANGES*
1969	\$ 125,579	\$330,453	\$ 456,032
1970	(6,464)	329,497	323,033
1971	68,746	348,978	417,724
1972	14,683	358,760	373,443
1973	201,782	419,684	621,466
1974	\$1,023,073	\$711,269	\$1,734,342

\*Figures in thousands of dollars

Either could have been done to reflect constant dollars, but it was decided to leave them as they are. Adjusting to reflect price level changes would have required the selection of either a general or specific index; and it may never be possible to state which method of adjusting for changes in the dollar is more appropriate.

Analysis of crude oil revenue. The preceding sections have presented the crude oil revenue of the company on the basis used for reporting in published financial statements, adjusted for general and specific price indexes, and finally adjusted to reflect changes in the value of the

underground crude oil reserves. This section will continue the analysis and compare these four accounting models. Table VI presents these four models on a comparative yearly basis. The crude oil revenues presented for each of the accounting models differ considerably.

Figure 1 shows the same information as Table VI in a graphic format; here the differences become even more apparent. The examination of Figure I brings to light a number of interesting situations and conditions. [It should be noted again that production of crude oil declined in each year except for 1972. (See Exhibit IV.)] Crude oil revenue reported using generally accepted accounting principles portrays a company with what appears to be a very stable growth pattern up to the end of 1972. Then a fairly large increase in revenue during 1973 changes to a fantastic increase in 1974. When crude oil revenues have been adjusted for increases in the general price level, some differences are immediately apparent. The most striking difference occurs where unadjusted revenues are showing stability with some growth up through 1972; the same revenues when adjusted for changes in the general price level show a company that is in fact losing ground, as indicated by the crude oil revenue. The two lines for unadjusted and adjusted revenue do not meet at the end of 1974 because of the loss in general purchasing power. The revenue was considered as being earned equally throughout



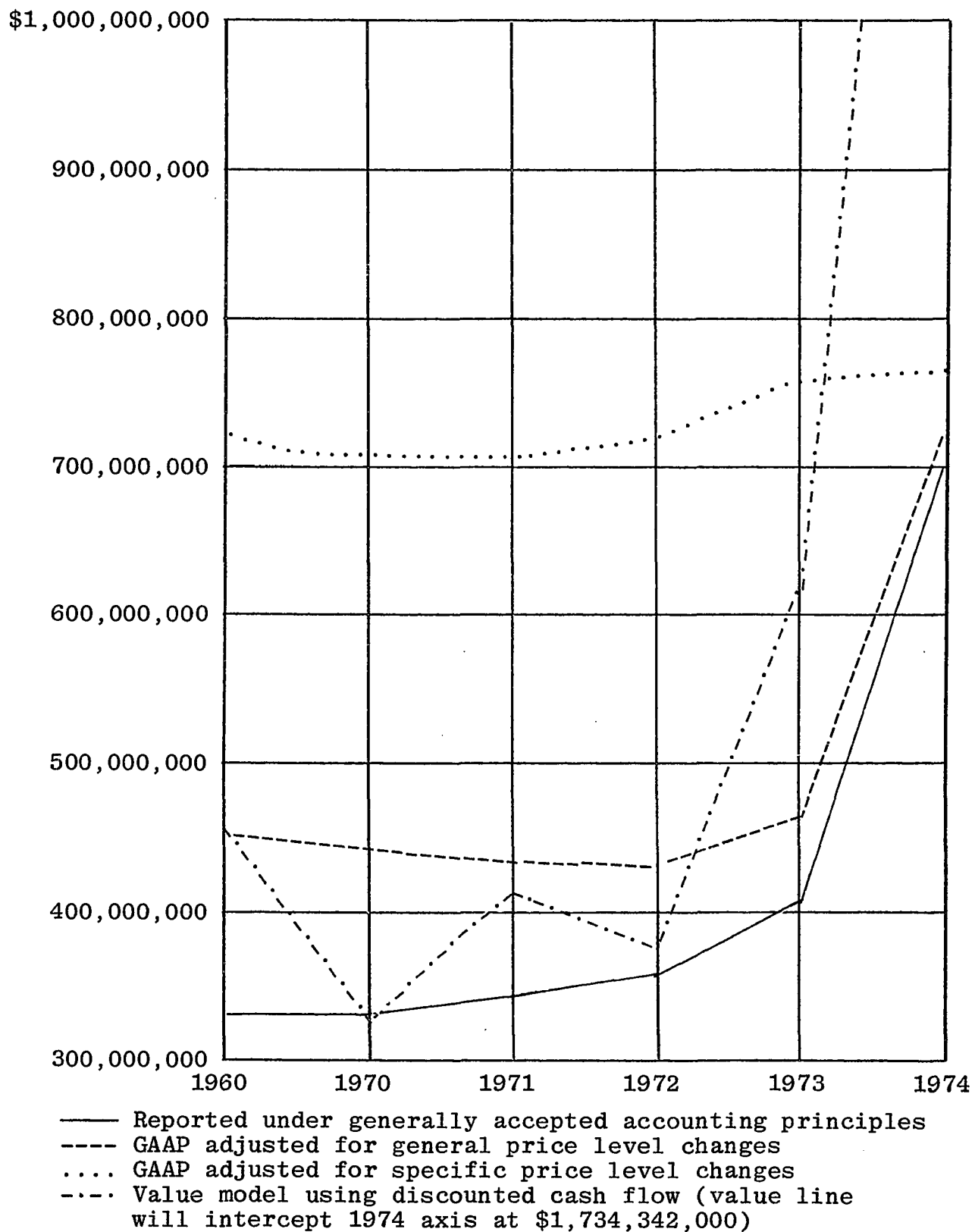
TABLE VI  
CRUDE OIL REVENUE USING FOUR DIFFERENT ACCOUNTING MODELS  
1969 THROUGH 1974

YEAR	AS REPORTED USING GENERALLY ACCEPTED ACCT. PRINCIPLES*	CONVENTIONAL REPORTING ADJUSTED FOR		
		GENERAL PRICE LEVEL CHANGES*	SPECIFIC PRICE LEVEL CHANGES*	PRESENT VALUE OF CRUDE RESERVES*
1969	\$330,453	\$458,008	\$720,718	\$ 456,032
1970	329,497	443,959	712,373	323,033
1971	348,978	438,665	707,378	417,724
1972	358,760	436,252	723,260	373,443
1973	419,684	483,476	764,245	621,466
1974	\$711,269	\$743,276	\$768,171	\$1,734,342

\*Figures in thousands of dollars

FIGURE 1

CRUDE OIL REVENUE USING FOUR DIFFERENT ACCOUNTING MODELS  
1969 THROUGH 1974



the year and all adjustments to reflect general price level changes were based on fourth quarter dollars; the difference between the two lines in 1974 is thus due to the changes in the value of the dollar during the year.

At this point crude oil revenue is the only account that has been examined and then only in regard to two methodologies; still a conclusion may be reached: the revenue adjusted for general price level seems to portray the operations of the company in a more realistic sense, but not if a reader of the statements equates the prospects of a company with the amount of reserves of underground hydrocarbons on hand. However, this is only one company so one cannot presume it would be the same for all industry. The other methodologies must be considered as to their impact on the reporting of revenue.

Sales of crude oil adjusted for specific price level changes also reflect the dollar at the end of 1974. This adjustment of crude oil revenue, as shown in Figure 1, requires some extensive thinking. The change from unadjusted figures is dramatic to say the least, yet the yearly changes are not as severe as the other methods already considered. Is the portrayal of revenue by the specific price level adjustment more representative than the general price level adjustment? Here again consider that only one company is involved, and not all of the proposed methodologies have been examined.

A final methodology of reporting revenue is determined by the discounting of the future cash flows of the underground hydrocarbon reserves. The value model used here fluctuates much more than any of the other models in Figure 1. This fluctuation is due to a number of factors which are not considered in the same combinations in the other models. Only the value model explicitly takes into account the changes that have occurred in the quantity of the underground hydrocarbon reserves. (As mentioned earlier, this is considered one of the major factors in the determination of the possible future of a petroleum company.) This value method utilizes the price of crude oil in each period and thus without any adjustment, the value method uses in fact historical prices as currently required by generally accepted accounting principles. Changes in the price level for either specific or general price level increases were not included in the calculations because the choice then became which one has been proven the most appropriate to use. In addition to taking into account the changes in reserves that are affected by discoveries, and revisions in reserve estimates and production, the value method does take into consideration that the production will remain constant until the reserves are depleted (that is constant, relative to the production in the year of calculation). It also assumes that the company will not be

making any future discoveries of underground hydrocarbon reserves, and this may be unrealistic.

The company will most likely discover future reserves each year; and some of them may be significant as evidenced by those companies which made the discoveries on the North Slope of Alaska. However, to include possible future discoveries would be in fact forecasting future revenues, and this would tend to cloud the issues being examined here.

From this previous tentative analysis, the methodology of discounting of future cash flows appears to be the better indicator of the crude oil revenue of this company.

#### Natural Gas Revenues

The second major revenue classification that must be considered is the sales of natural gas. The analysis is presented in a manner similar to that for sales of crude oil for ease of comparison and a later combined analysis.

Table VII presents the production and sales of natural gas for the years 1969 through 1974. It forms the basis for future calculations of revenue from the sales of natural gas when different accounting methodologies are presented.

Natural gas production and sales closely parallel that of crude oil in that production has shown a consistent downward trend except for an increase in production in 1970.

TABLE VII  
NATURAL GAS PRODUCTION AND REVENUE  
1969 THROUGH 1974

YEAR	PRODUCTION* **	NATURAL GAS REVENUE***	AVERAGE PRICE PER MMCF
1969	633,118	\$107,969	\$0.171
1970	654,175	114,171	0.175
1971	651,449	117,893	0.181
1972	637,258	124,482	0.195
1973	626,022	138,232	0.221
1974	604,440	\$190,760	\$0.316

\*Source: Exhibit IV

\*\*Figures in millions of cubic feet (MMCF)

\*\*\*Figures in thousands of dollars

This increase was not evident in sales of crude oil, but is clear with regard to the natural gas. Similar to crude oil, the revenue generated by the increased production of natural gas has steadily increased due to the increase in the price of the gas sold. However, from 1969 through 1974, while the price of crude oil increased by over 130% the price of natural gas increased by only about 85%. The smaller increase is due in part to the fact that a significant amount of gas is sold in interstate commerce and is regulated by the Federal Power Commission.

Adjusted for general price level changes. The adjustment for general price level changes to sales of natural gas are similar to those for sales of crude oil; and because of this similarity, no further comment is necessary at this point. The effects of those adjustments are shown in Table VIII.

TABLE VIII  
NATURAL GAS REVENUE ADJUSTED FOR  
GENERAL PRICE LEVEL CHANGES  
1969 THROUGH 1974

YEAR	REPORTED SALES**	RESTATEMENT FACTOR*	SALES IN 4th QUARTER 1974 DOLLARS**
1969	\$107,969	1.386	\$149,645
1970	114,171	1.314	150,021
1971	117,893	1.257	148,192
1972	124,482	1.216	151,370
1973	138,232	1.152	159,243
1974	\$190,760	1.045	\$199,344

\*See Exhibit VI for calculation of restatement factor

\*\*Figures in thousands of dollars

Adjusted for specific price level changes. The oil and gas industry publishes no specific price level index for natural gas prices primarily because there is no way to segregate the different pricing policies. Some of the gas

is sold in markets subject to regulation while other sales occur in unregulated markets. So, no adjustments have been made to reflect any specific price level changes in the sales figures for natural gas.

Adjusted for current value reporting. Table IX presents the adjustment of production and prices along with reserve considerations to reflect changes in the value of the underground natural gas reserves in the income of the company. The assumptions made for the adjustment or calculation methods are similar to those for crude oil: the amount of production is based on the amount that the company produced during the year under consideration; the discount rate of 10% was used for reasons noted in Chapter II; and there is no forecast of future possible discoveries of natural gas. Because of restrictions placed on this research by the company there is no way to determine the amount of reserve revisions or the amount of natural gas discovered during the years under study. It is thereby impossible to separate the gains into holding gains and gains resulting from current discoveries, which should be done in actual practice.

Table IX shows that, similar to crude oil, as the natural gas reserves have been declining each year with the exception of 1970, the present value of these reserves has been increasing. The price increases, although not as severe as with crude oil, have in fact stayed ahead of the



TABLE IX  
VALUATION OF UNDERGROUND NATURAL GAS RESERVES  
USING A 10% DISCOUNT RATE  
1968 THROUGH 1974

YEAR	END OF YEAR RESERVES*	CURRENT PRODUCTION*	LIFE OF RESERVES IN YEARS	AVERAGE PRICE PER MMCF	FUTURE VALUE OF RESERVES**	PRESENT VALUE OF RESERVES**
1968	8,126,346	602,305	13.49	\$0.177	\$1,438,363	\$375,347
1969	6,868,146	633,118	10.85	0.171	1,174,453	398,717
1970	6,521,262	654,175	9.69	0.175	1,141,221	422,892
1971	6,679,751	651,449	10.25	0.181	1,209,035	435,484
1972	6,313,430	637,258	9.91	0.195	1,231,119	459,007
1973	6,000,189	626,022	9.59	0.221	1,326,042	510,537
1974	5,467,418	604,440	9.05	\$0.361	\$1,973,738	\$801,825

\*Figures in millions of cubic feet (MMCF)

\*\*Figures in thousands of dollars

reduction of the reserves. The adjustments shown in this Table IX provide a present value figure assuming the company were to sell the reserves at year end, but they do not directly show the effect of these changes upon the income statement of the firm.

In Table X the sales for each year are added to the increase in present value of the reserves calculated in Table IX. The change in present value of the natural gas reserves is made up of more than one component, as explained in relation to a similar table for crude oil sales (Table V), and is not repeated here.

TABLE X  
REVENUES FROM NATURAL GAS SALES AND CHANGES  
IN THE PRESENT VALUE OF UNDERGROUND  
NATURAL GAS RESERVES  
1969 THROUGH 1974

YEAR	CHANGE IN PRESENT VALUE OF RESERVES*	REPORTED SALES*	REVENUE FROM SALES AND PRESENT VALUE CHANGES*
1969	\$ 23,445	\$107,969	\$131,414
1970	24,175	114,171	138,346
1971	12,592	117,893	130,485
1972	23,523	124,482	148,005
1973	51,530	138,232	189,762
1974	\$291,288	\$190,760	\$482,048

\*Figures in thousands of dollars

The revenue of the company does increase each year when the changes in value of the underground reserves of natural gas are considered. This is especially true for 1974. Using the discounted cash flow method for the valuation of the underground reserves, reported revenue increased by \$291,288,000--or an increase in excess of 150%.

Analysis of natural gas revenue. Revenues from the sale of natural gas have been presented in the preceding sections on the basis used for reporting in financial statements, adjusted for changes in general price levels, and adjusted to reflect changes in the value of underground reserves. Table XI presents a comparison of these three models. The revenues from natural gas sales (as shown in Table XI) do not vary as much from one model to the next when compared to the crude oil revenue (Table VI). The major difference occurs in 1974 when natural gas revenue as reported differed in excess of \$290,000,000 from revenue using discounted cash flow analysis of the underground reserves.

Figure 2 shows graphically the trends of revenue as reported under each of the methodologies used. The behavior of natural gas revenues under the three methodologies is surprisingly similar to those same methodologies for crude oil sales. The revenue reported under generally accepted accounting principles shows the same fairly stable growth pattern until 1974 when sales increased by a large amount.

TABLE XI  
NATURAL GAS REVENUE USING THREE  
DIFFERENT ACCOUNTING MODELS  
1969 THROUGH 1974

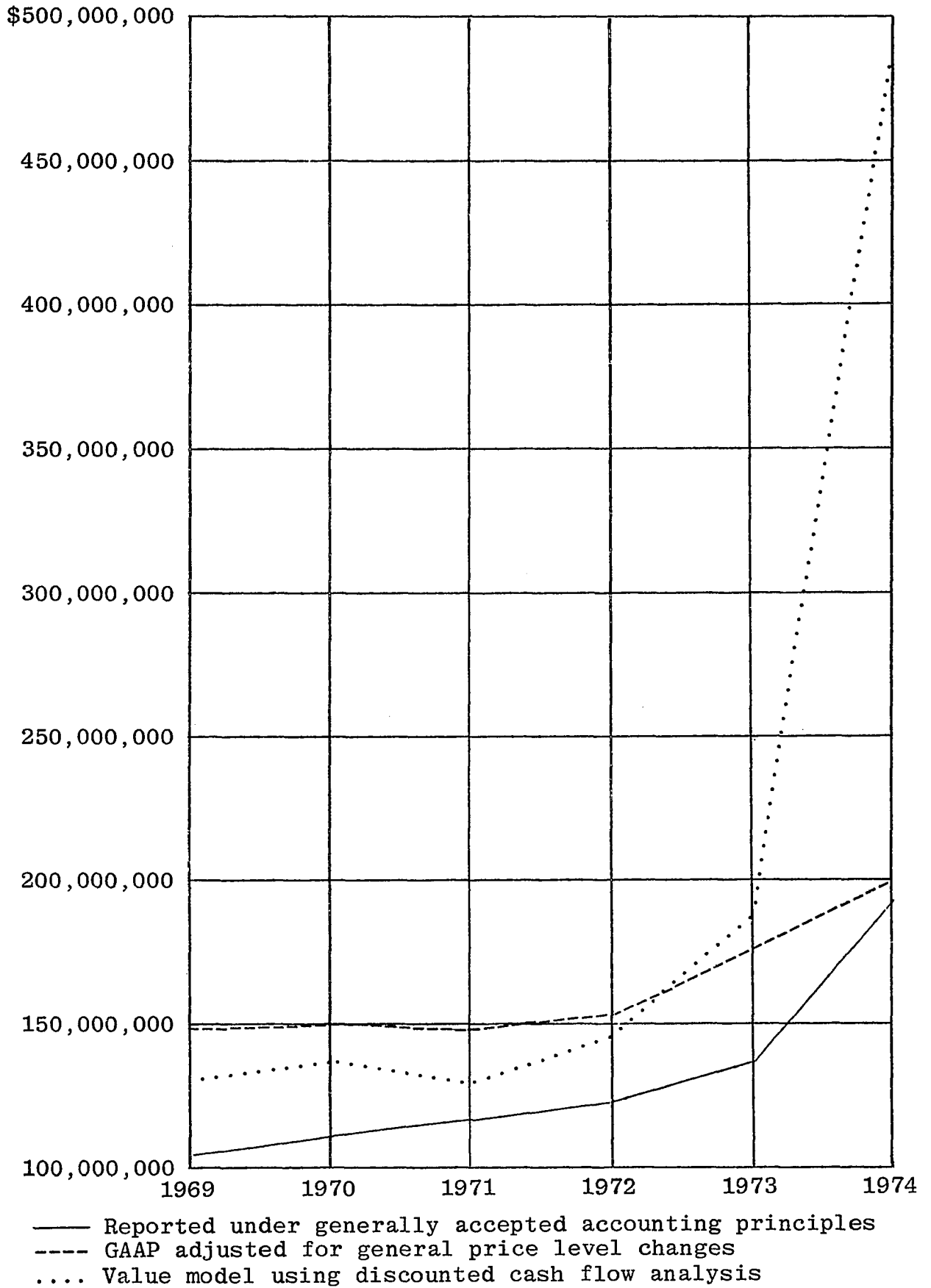
YEAR	AS REPORTED USING GENERALLY ACCEPTED ACCT. PRINCIPLES*	ADJUSTED FOR GENERAL PRICE LEVEL CHANGES*	REPORTED USING PRESENT VALUE OF NATURAL GAS RESERVES*
1969	\$107,969	\$149,645	\$131,414
1970	114,171	150,021	138,346
1971	117,893	148,192	130,485
1972	124,482	151,370	148,005
1973	138,232	159,243	189,762
1974	\$190,760	\$199,344	\$482,048

\*Figures in thousands of dollars

The same revenue adjusted for changes in the general price level shows little change in sales from 1969 until 1973 when adjusted for the changes in purchasing power; sales then increased somewhat and went up dramatically in 1974. The facts that the revenue is considered as being earned equally during 1974 and the price level adjustment is as of the fourth quarter of 1974 account for the difference between cost and cost adjusted for general price level in 1974.

The major difference in revenue is in comparison of the value model with the other two models. The behavior here is again similar to crude oil revenue with the dramatic

FIGURE 2

NATURAL GAS REVENUE USING THREE DIFFERENT ACCOUNTING MODELS  
1969 THROUGH 1974

increase in the revenue in 1974, attributed to the increase in price of natural gas in 1974. The decline of reserves in 1974 indicates again that the company is producing more than it is discovering, but it is impossible to separate the increase due to a holding gain from that attributed to discoveries during 1974.

### Time Series Correlation Analysis

This research is one company's actual financial data, so there is not a sufficient data base for statistical testing of the research question. Generalizations may not be made from this to any population, but the use of time series correlation analysis is acceptable. It will merely provide an insight which is not apparent from preceding sections of the chapter.

The formula used for the calculation is for the determination of a correlation coefficient from raw data that has not been adjusted for any trends. Because the data for value and the other unadjusted and adjusted models have little relationship to each other, the elimination of trend factors was not considered necessary. The formula used is taken from Applied General Statistics<sup>1</sup> by Croxton and Cowden:

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<sup>1</sup>Frederick E. Croxton and Dudley J. Cowden, Applied General Statistics, 2nd ed. (Englewood Cliffs, N.J.: Prentice Hall, Inc., 1955), p. 563.

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}}$$

The results of the correlation analysis are shown in Table XII.

TABLE XII  
TIME SERIES CORRELATION OF CRUDE OIL  
AND NATURAL GAS REVENUE  
1969 THROUGH 1974

CORRELATION OF:	CRUDE OIL REVENUES CORRELATION COEFFICIENT	NATURAL GAS REVENUES CORRELATION COEFFICIENT
GAAP Model to GNP Adjusted Model	0.988	0.980
GAAP Model to Specific Adjusted Model	0.792	N/A*
GAAP Model to Value Model	0.993	0.980
GNP Adjusted Model to Specific Adjusted Model	0.750	N/A*
GNP Adjusted Model to Value Model	0.997	0.999
Specific Adjusted Model to Value Model	0.768	N/A*

\*There is no specific price adjustment for natural gas revenue therefore these correlations are not applicable.

The correlations for both crude oil and natural gas revenues are extremely high between the generally accepted accounting principle model, the model adjusted for general price level changes by use of the Gross National Product

Implicit Price Deflator, and the value model where changes in the value of the underground reserves are included. However, when the specific price level adjusted model is correlated with the other three models (for crude oil revenues only), there is a much lower coefficient of correlation.

The conclusion drawn is that a selection made on the basis of the above data would be a choice of using specific price index adjusted figures or one of the other three models. The specific price index model could be rejected; it is quite diverse and shows little correlation with the other models. In view of the very high correlation the choice appears to be between the generally accepted accounting principles model, the general price level adjusted model, or the model which reflects the discounted cash flow of the underground hydrocarbon reserves. The selection of a model is not that easy; it is still impossible to ascertain which is the better merely on the basis of time series correlation analysis.

### Conclusion

Current reporting practice in the petroleum industry is analogous to that of a manufacturing concern that would not consider its inventory of raw materials, work-in-process, or finished goods inventory in the determination of its income or gross profit. If inventory considerations are



necessary (and they are) for income determination for a manufacturing concern, they should also be considered for a petroleum company. This inventory is the supply of underground hydrocarbons that the company has access to for future production and sale.

Revenues of underground hydrocarbon production are a direct result of the availability of the reserves; and it is important that any changes in these reserves are accounted for. As noted in Chapter III, petroleum companies do buy and sell underground hydrocarbon reserves based on the discounted cash flows that may be expected from those reserves. But most important, the discounted cash flow model shows a change in value of the company's assets (in this case only the underground hydrocarbon reserves). Sales from and increases in hydrocarbon reserves would be the actual revenue of the company since the reserves could be sold at their discounted value plus or minus some small factor depending upon the bargaining power of the companies involved. The most significant point for revenue recognition for this company appears to be at the time of discovery of underground hydrocarbons. When everything is taken into account, the most appropriate method for a petroleum company to use in reporting is that methodology of discounting of future cash flows from underground hydrocarbon reserves.

## CHAPTER V

### SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This research was undertaken because of the current controversy involving financial statement presentation of data relevant to the needs of the users of financial statements in their decision-making process. If the investors do in fact use the financial statements in their decision-making process and if the main objective of financial statement presentation is to provide relevant useful information (both of which have been proved in prior studies), then these users should be provided with the best possible information that is available.

There is a significant amount of controversy regarding which accounting methodology will provide the better information to financial statement users. Because no one methodology may be best for all situations, there may ultimately be a compromise where more than one methodology will be utilized in the financial statements.

#### Scope of Study

The objective of this research was to adjust the revenues of one major petroleum company to determine the

effects that various accounting methodologies would have on the revenue of the firm. One company was selected and a case study approach was adopted. It was considered fortunate that even one company would provide inside information to allow this research to proceed.

This study was limited to the exploration and production phases of operation that were conducted in the United States from 1969 through 1974. This time frame provided a set of data which reflected the extreme increase in prices experienced by petroleum companies in their sales of crude oil and natural gas.

Because the study involved just one company it was not possible to apply statistical tests of significance. A time series correlation analysis was performed, but it did not definitively prove which methodology was the better.

### Summary

The major methodologies considered in this study were: (1) current reporting practices using generally accepted accounting principles; (2) generally accepted accounting principles adjusted for general price level changes; (3) revenues adjusted for specific changes in price level; and (4) revenues adjusted to reflect the changes in the value of an asset classification.

The first methodology studied in this research was that currently used in financial reporting. It utilizes generally accepted accounting principles, which are

primarily cost based. In many cases the argument in favor of the cost method is the result of the accountant's reluctance to use figures that may not be as precise as he desires. This reluctance can be understood but is no basis for the rejection of other methodologies that may in fact be more relevant to the users of the financial statements.<sup>1</sup> The major argument advanced for the continued use of the cost method is that it is best understood by the users of the financial statements. This is in direct opposition to the argument that the statements are not relevant to the users.

A final argument in favor of the cost method is that it is the most objective of the figures that may be utilized. However, the contention is that cost is relevant only at the time of the initial transaction and may not be relevant at any other time. It is easy to determine the cost (in most cases), but this is not a justification for the use of that methodology. Relevance is a much stronger criterion by which to judge.

The second methodology considered in this research is that of conventional financial statements adjusted for general price level changes. The Financial Accounting Standards Board has proposed that financial statements be adjusted to reflect changes in the value of the dollar.

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<sup>1</sup>"Replacing-Cost Accounting Plan Adopted by SEC," The Wall Street Journal, 25 March 1976, p. 6.

Upon their recommendation, the only acceptable method of adjustment is to use the Gross National Product Implicit Price Deflator. There would be no leeway to use any other index for adjustment and all elements of the statements would have to be adjusted for general price level changes. Major criticism is levied against this methodology in that it is not a major improvement over traditional historical cost financial statements. They are still cost based financial statements.<sup>2</sup> In addition the statements would be adjusted entirely for changes in the purchasing power of the dollar when the effects for some asset classes, and in fact entire companies, could possibly go in an opposite direction from the trend of the Gross National Product Implicit Price Deflator. Such statements would be less useful than those showing just the original cost.

A final criticism of the general price level adjusted statements is that many of the statement users may consider these statements as being indicative of the value of the items portrayed. Value cannot be reflected by merely adjusting for general price level changes. If the statement users perceive that these are value statements, they will again be in a more precarious position than with the traditional cost statements.

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<sup>2</sup>Eldon S. Hendricksen, Accounting Theory, rev. ed. (Homewood, Illinois: Richard D. Irwin, Inc., 1970), p. 213.

The third methodology studied was that of adjustment for specific price levels. This method should more closely reflect the value of the items being adjusted than the general price level adjustment. Specific price level adjustments are in many instances considered a surrogate for replacement cost. The Securities and Exchange Commission has made replacement cost reporting a requirement for many of the companies that are registered with it. These companies may have to use specific price indexes to report or adjust for replacement cost because of a lack of any better measure of the replacement cost.

The most important criticism of replacement costing or the use of specific price indexes for the petroleum industry is that there is no known relationship between the cost of discovery of underground hydrocarbons and their value. It is thus impossible to utilize replacement cost in this regard. It would also be unsuitable to use specific price indexes to adjust revenues to approximate these replacement costs when they are not at all relevant. (The Securities and Exchange Commission may have recognized this when they granted a one year moratorium on the requirement that companies in the extractive industries report hydrocarbon reserves on a replacement cost basis.)

The final methodology considered is that of reporting value in the financial statements. The first step to recognizing value will be to value separate assets of the

company and not the value of the entire firm. The value methodology utilized in this research is that of discounting the future cash flows of underground hydrocarbon reserves. Prior research by both John P. Klingstedt and Alan F. Smith have shown that when value is used in the financial statements of a petroleum company, the most appropriate valuation procedure is that of discounting the future cash flows. In addition, this methodology was shown by both to be superior in the information it provided to users of the financial statements.

Criticisms raised against the use of value in the financial statements have often been much greater in intensity than those against the other methodologies, primarily because value reporting is the most significant departure from the conventional reporting practices. These arguments appear to have grown less severe as accountants have been more inclined to recognize that the needs of the statement user should come first and that a methodology should not be abandoned without adequate consideration just because it will produce certain problems for the accountant. Many feel it would be difficult to audit statements prepared on a value basis. This is not a valid argument; accountants have overcome these types of obstacles before such as with the auditing of automated data processing systems, which was considered impossible not too many years ago.

Another argument against the use of value is that it is not objective enough. This has been overcome to a certain extent by the Securities and Exchange Commission's requirement for the use of replacement costs in the financial statements. In the case of a petroleum company it is much easier to assign a value to underground hydrocarbon reserves by using discounted cash flow procedures than to use replacement cost which has no relationship to the value of the reserves.

### Conclusions

Because it is a study of only one major petroleum company, the conclusions drawn from this research cannot be directly generalized to include the petroleum industry as a whole nor any other company or industry. However, if the results are viewed in perspective, they could have an impact on other companies. These conclusions reached in this study are based on the following facts developed in prior chapters:

- (1) There is a high correlation coefficient between the generally accepted accounting principles methodology, the general price level adjustment methodology, and the value methodology. The correlation between these three and the specific price level adjustment methodology was comparably very low and therefore the latter could be eliminated.



- (2) Although there was a high correlation between the generally accepted accounting principles methodology and general price level methodology, the general price level method was rejected because it does nothing more than portray the same information in different dollars.
- (3) The current methodology of using generally accepted accounting principles was rejected because of its lack of relevance to decision makers.

The value methodology was thereby accepted because it best reflects the status and operation of the company.

The conclusions reached in this study are:

- (1) The petroleum industry should use changes in the present value of the discounted cash flow from underground hydrocarbon reserves in reporting revenue on the financial statements.
- (2) The companies should disseminate this information to the investing public; it should be as useful to them as it is to those in the company.
- (3) The use of discounted cash flow procedures is most appropriate for the valuation of the underground hydrocarbon reserves, but it may not be applicable to any other asset category in the industry.

Recommendations

A significant amount of additional research is needed prior to the adoption of any particular methodology by any of the accounting bodies. The following research possibilities should be examined:

- (1) Another study of this type should be conducted.

This study should utilize more than one company if the information is made available to the researcher.

- (2) A similar study should be undertaken in other extractive industries to determine their relationship to the conclusions regarding this company. Due to the energy situation, the most likely candidates would be companies in the coal industry.

- (3) Because of the extreme differences resulting from the use of discounted cash flow procedures on this company's data, these procedures should also be tested for effects on companies outside the extractive industry. The effects are great here where there is a significant unrecorded asset in the form of the underground hydrocarbon reserves. But would discounted cash flow procedures be as useful for these other companies?

- (4) An investigation should be made concerning the problems that would be encountered in an audit

of a company which utilizes discounted cash flow procedures for valuation purposes. This should be done well before it becomes a required methodology by the Securities and Exchange Commission or another regulatory body.

- (5) A study should be made concerning the decisions that users would make when utilizing the data generated here. Unless the views of the statement users are taken into account, no methodology can definitively be proved more desirable; but because of their diverse views it may not be proved then.

This research does not prove conclusively that the value methodology of discounting future cash flows is superior to any other. However, it does indicate that for this particular petroleum company it appears to be the best. Hopefully further research will be undertaken that will finally establish the use of discounting cash flow procedures as a generally accepted accounting methodology to be used for applicable classes of assets: in particular, the valuation of underground hydrocarbon reserves.

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LIST OF EXHIBITS  
(Appendix)

- I. Underground Hydrocarbon Reserves
- II. Actual Data Received from the Company
- III. Description of Data Received
- IV. Production of Crude Oil and Natural Gas
- V. GNP Implicit Price Deflator and Restatement Factors,  
1968-1974 by Quarters
- VI. Specific Price Index for Crude Oil and Restatement  
Factors, Annually 1968-1974 & 4th Quarter 1974

EXHIBIT I  
UNDERGROUND HYDROCARBON RESERVES

<u>Year Ended</u>	<u>Crude &amp; Natural Gas Liquids (MBBLS)</u>	<u>Natural Gas (MMCF)</u>
1969	1,219,996	6,868,146
1970	1,131,333	6,521,262
1971	1,072,461	6,679,751
1972	973,868	6,313,430
1973	901,520	6,000,189
1974	856,657	5,467,418

Only underground hydrocarbon reserves located in the United States are included in the above figures.

# EXHIBIT II

## ACTUAL DATA RECEIVED FROM THE COMPANY (000's omitted)

Revenues:	1969	1970	1971	1972	1973	1974
Crude and Natural Gas Liquids	\$330,453	\$329,497	\$348,978	\$358,760	\$419,684	\$711,269
Natural Gas	107,969	114,171	117,893	124,482	138,232	190,760
Sulfur	2,453	1,406	147	131	150	299
Gain on Sale of Assets	1,496	77	924	538	843	191
Other Income	5,919	3,688	4,529	3,979	4,505	4,315
Total Revenue	<u>\$448,290</u>	<u>\$448,839</u>	<u>\$472,471</u>	<u>\$487,890</u>	<u>\$563,414</u>	<u>\$906,834</u>
Expenses:						
Operations	\$127,548	\$132,940	\$135,568	\$138,673	\$149,004	\$247,301
Dry Drilling	11,380	9,342	9,168	9,334	9,689	21,643
Lease Rentals	4,208	2,646	1,831	1,831	1,978	3,635
Exploration & Land	20,181	15,593	13,607	13,876	17,830	24,144
Administrative & General	23,083	19,421	20,572	20,932	24,153	25,148
Total Expenses	<u>\$186,400</u>	<u>\$179,942</u>	<u>\$180,746</u>	<u>\$184,646</u>	<u>\$202,654</u>	<u>\$321,871</u>
Capital Retirements:						
Depletion & Depreciation	\$ 73,244	\$ 67,005	\$ 65,973	\$ 68,729	\$ 79,421	\$ 86,250
Amortization & Surrenders	13,940	13,370	8,200	7,481	5,278	25,016
Total Capital Retirements	<u>\$ 87,184</u>	<u>\$ 80,375</u>	<u>\$ 74,173</u>	<u>\$ 76,210</u>	<u>\$ 84,699</u>	<u>\$111,266</u>
Net Income Before Income Taxes	<u>\$174,706</u>	<u>\$188,522</u>	<u>\$217,552</u>	<u>\$227,034</u>	<u>\$276,061</u>	<u>\$473,697</u>

A brief description of each of the above line items is given in Exhibit III.

The above figures have been adjusted by a confidential factor to protect the identity of the company that supplied this data.

## EXHIBIT III

## DESCRIPTION OF DATA RECEIVED

Crude and Natural Gas Liquids--sales and transfers of products

Natural Gas--sales and transfers of products

Sulfur--sales and transfers of products

Gain on Sales of Assets--receipts from sales of assets less cost of assets sold

Other Income--all income other than above (examples are royalty from contractual use of patented oil finding devices, sales of seismic data, etc.)

Operations--total operating expense in connection with the production of crude, gas and products

Dry Drilling--total expense for exploration in the finding of production

Lease Rentals--total expense for exploration in the finding of production

Exploration and Land--total expense for exploration in the finding of production

Administration and General--total indirect or administrative overhead involved in both producing and exploration operations

Depletion and Depreciation--depletion (write-off on unit of production basis) of investment in lease and facility tangible equipment, developed leasehold investment, intangible drilling costs, and capitalized operating costs depreciation (useful life basis) of investment in all non-oil producing tangible assets

Amortization and Surrenders--write-off of investment in all non-oil producing tangible assets

EXHIBIT IV  
 PRODUCTION OF CRUDE OIL AND NATURAL GAS\*

YEAR	CRUDE & NATURAL GAS LIQUIDS**	NATURAL GAS ***
1969	123,713	633,118
1970	119,212	654,175
1971	118,260	651,449
1972	120,920	637,258
1973	117,472	626,022
1974	115,028	604,440

\*Only production from underground hydrocarbon reserves located in the United States are included in the above figures.

\*\*Figures in thousands of barrels

\*\*\*Figures in millions of cubic feet



## EXHIBIT V

GNP IMPLICIT PRICE DEFLATOR  
AND RESTATEMENT FACTORS  
1968-1974 BY QUARTERS\*

YEAR	QUARTER	GNP-IPD, ANNUAL AVERAGE	RESTATEMENT FACTOR, ANNUAL AVERAGE	GNP-IPD, (1958=100)	RESTATEMENT FACTOR (4 Q74=1.000)
1968	1	122.3	1.453	120.4	1.476
	2			121.6	1.461
	3			122.9	1.446
	4			124.3	1.430
1969	1	128.2	1.386	125.6	1.415
	2			127.2	1.397
	3			129.1	1.376
	4			130.9	1.356
1970	1	135.2	1.314	132.9	1.337
	2			134.4	1.322
	3			135.8	1.309
	4			137.9	1.289
1971	1	141.4	1.257	139.5	1.274
	2			141.1	1.259
	3			142.0	1.251
	4			142.7	1.245
1972	1	146.1	1.216	144.6	1.229
	2			145.3	1.223
	3			146.5	1.213
	4			148.0	1.201
1973	1	154.3	1.152	150.0	1.185
	2			152.6	1.165
	3			155.7	1.141
	4			158.9	1.118
1974	1	170.1	1.045	163.6	1.086
	2			167.3	1.062
	3			171.9	1.034
	4			177.7	1.000

\*Source: Federal Reserve System, Federal Reserve Bulletin, (Washington, D.C.: Federal Reserve System, January, 1976), p. A54.

EXHIBIT VI  
 SPECIFIC PRICE INDEX FOR CRUDE OIL  
 AND RESTATEMENT FACTORS,  
 ANNUALLY 1968-1974 &  
 4th QUARTER 1974\*

YEAR	INDEX NUMBER (1967=100)	RESTATEMENT FACTOR (4th Q74=1.000)
1968	100.8	2.276
1969	105.2	2.181
1970	106.1	2.162
1971	113.2	2.027
1972	113.8	2.016
1973	126.0	1.821
1974	212.5	1.080
1974 (4th Quarter)	229.4	1.000

\*Source: "Vital Oil Statistics, Petroleum Independent, Washington, D.C.: Independent Petroleum Association of America.