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Valuation of Assets In International Takings

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by *Thomas R. Stauffer**

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Section 1: Introduction¹

The standard of compensation due for expropriated assets has been extensively discussed in legal literature, but here we shall focus on the less thoroughly explored question of how such assets should be valued. Addressed herein is the economics of the relationship between net book value—the accounting concept—and the net present value of an enterprise—the discounted cash flow value—which is a financial or economic concept. The case studies and empirical tests are largely derived from the oil industry, but the arguments and conclusions are more generally applicable.²

Most of the literature dealing with international takings is of little help in reaching the amount due a plaintiff whose property has been expropriated or otherwise taken. The guidelines have little or no operational content, and awards, opinions, and commentaries all fail to lead one constructively to any calculation of the quantum of compensation. Illustrative is a position articulated by the U.S. Department of State:

Compensation shall be payable on the basis of the full value of the property taken, at the time of the taking. Compensation based on the value of the initial investment would not meet the standard . . . if it was less than the value at the time of the taking.

Such language provides little assistance to, or support for, the financial analyst charged with calculating the value of the property. Value in a compensation case is ultimately liquidated in money which is counted. It is therefore critically important that any discussion of the quantum of compensation be ultimately quantifiable.

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- 1 Dr. Stauffer wishes to acknowledge Dr. Frank Lennox, now of Bechtel Corporation, who assisted with the studies underlying Section 4 of this paper.
 - 2 The oil industry cases are of importance and interest in their own right, because the largest nationalizations to date involved oil properties. More generally, the resource-based industries have been the principal targets of hostile takeovers by host governments. The cases are thus of intrinsic as well as exemplary relevance. Burton & Hisashi Inoue, *Expropriations of Foreign-Owned Firms In Developing Countries: A Cross-National Analysis*, 18 JOURNAL OF WORLD TRADE LAW 396 (1984).

This article sets forth two theories. The first is that quantification is possible, and that the two competing methods for valuing properties in international arbitrations are broadly equivalent in the economic sense. Both sets of calculations, bereft of error or exaggeration, will lead to similar results, so that each is a check on the other. Net book value and Discounted Cash Flow (DCF) value are roughly the same, so the “rivulets of ink” and the “soot and gall”³ expended in the debate are of little avail because both methods should accurately produce similar final compensation figures given the inherent uncertainties in such valuations. In other words, we shall show that the dispute over the proper method of valuation is moot.

The second theory is methodological—the present analysis is itself a case study in forensic economics. Qualitative discussion of a quantitative issue is unlikely to provide useful insight, since the resolution of the matter is ultimately the resulting number and one’s ability to test it. Much ink might have been saved, and trees spared, in the debate over the quantum of compensation in international tribunals if the alternatives had been computed and tested. The results here illustrate the importance of addressing a *quantitative* issue with *quantitative* techniques, both theoretical and empirical.

Section 2 of this article sketches the background to the debate over the choice of standard for compensation, while Section 3 proves the “congruence principle” by showing theoretically that the book value and the DCF value are in fact identical except in two special cases: 1) where a project enjoys super-normal profitability or, 2) where the profitability is abnormally low. Section 4 marshalls the empirical evidence supporting the “congruence principle,” i.e., the market data which confirms the approximate identity of the two calculations. Section 5 addresses the “Cinderella effect”—the tendency for the DCF value method to be misapplied to exaggerate values, and the “glass slippers”—the possible ways to test the plausibility of DCF value or other valuations. Section 6 summarizes the theoretical, empirical, and arbitral data and offers guidelines for reconciling conflicting valuations in practice.

Section 2: Background

The literature on compensation in international law is extensive, but the economic dimensions—the “quantification of the quantum”—is given short shrift. The principal issues treated in the legal writings deal with the steps up to, but not including, the point at which one might determine an amount of money as quid pro quo for the taken value. The literature to date concentrates on one or more of the following questions:

- Is compensation due at all when governments take the private property of foreigners?
- Does the amount of compensation to be paid hinge upon whether the taking is deemed to be lawful or unlawful?

3 SIR HENRY CRAIKE SWIFT, THE BATTLE OF THE BOOKS: EXTRACTED FROM SELECTIONS FROM SWIFT 202 (1912).

- If compensation is due, should the amount be adjusted (downward) for any prior “exorbitant” profits or colonialist legacies?

Only the second question is tinged with hints of quantification, because, if a taking is determined to be unlawful, it is argued by some jurists that the government could then be liable for reimbursing lost profits (*lucrum cessans*).⁴

Indeed, the literature is less than helpful because it often reflects an arithmetical innocence which impedes constructive quantification. For example, in legal arguments there arises confusion as to the difference between the mechanics of calculating a present value—the discounting of “lost profits”—and the question as to whether “lost profits” should be awarded in addition to some other measure of loss:

When the private claimant receives, by way of an award, compensation representing the value of his assets, plus any loss of profits in the interim period between the act of nationalization, breach of contract or expropriation and the date of the award, at that date he receives back the value of his business. His “capital” is returned to him. He is presumed to invest that capital elsewhere, so that it will earn him profits in some other business, in some other country. Why, therefore, should the private claimant expect the tribunal to award him loss of profits under the terminated contract for the same period during which the same capital is earning a second set of profits elsewhere? On the assumption that he has put his returned capital to good use, the claimant, in effect, is claiming a double recovery for loss of profits. Such a claim seems both illogical and unethical.⁵

This assessment illustrates the limitations of qualitative analysis of intrinsically quantitative matters.

Two principal methods for determining “value” are discussed in the literature dealing with international takings—“net book value” and “DCF value.” “Net book value” is an accounting concept, being the sum of historical outlays, less the sum of the total depreciation booked against those outlays:

‘Book value’ means the difference between the enterprise’s assets and liabilities as recorded on its financial statements or the amount at which the taken tangible assets appear on the balance sheet of the enterprise, representing their cost after deducting accumulated depreciation in accordance with generally accepted accounting principles.⁶

4 Two recent articles by Lieblich provide a comprehensive, but non-economic, overview of the debate: William C. Lieblich, *Determinations by International Tribunals of the Economic Value of Expropriated Enterprises*, 7 J. INT’L ARB. 37 (1990), and William C. Lieblich, *Determining the Economic Value of Expropriated Income-Producing Property in International Arbitrations*, 8 J. INT’L ARB. 59-80 (1991). See also C.F. Amerasinghe, *Issues of Compensation for the Taking of Alien Property in Light of Recent Cases and Practice*, 41 INT’L & COMP. L.Q. 22 (1992).

5 See Lieblich, *Determining the Economic Value of Expropriated Income-Producing Property in International Arbitration*, *supra* note 4 (quoting Derek Bowett).

6 WORLD BANK GROUP, LEGAL FRAMEWORK FOR THE TREATMENT OF FOREIGN INVESTMENT, VOL. II: GUIDELINES 43 (1992).

The figure is inherently retrospective, and jurists seem to be comfortable with looking backwards to rely upon attestable documents in order to calculate current “value.”

The countervailing notion, “DCF value,” is logically the antipode—it is strictly prospective, intrinsically forward-looking, and involves a projection of the cash flow which the owner might have gleaned from the venture if the owner’s rights to the venture had not been taken:

‘discounted cash flow value’ means the cash receipts realistically expected from the enterprise in each future year of its economic life as reasonably projected minus that year’s expected cash expenditure, after discounting this net cash flow for each year by a factor which reflects the time value of money, expected inflation, and the risk associated with such cash flow under realistic circumstances. Such discount rate may be measured by examining the rate of return available in the same market on alternative investments of comparable risk on the basis of their present value.⁷

The net present value computation is often viewed as speculative. Yet some authors do recognize that such speculative projections of probable or possible income are indeed the basis upon which market transactions are usually negotiated. The emphasis upon net book value, the retrospective measure, is found principally in the “South,”—the developing countries. Typically, in such arguments, net book value, otherwise not precisely defined, is posted as the upper bound for compensable value, while the prospective measure, DCF value, is championed overwhelmingly by jurists from the “North,” the industrialized countries:

The conflict between views has now been cast in the mold of capital-exporting versus capital-importing States, or the haves versus the have-nots, and the arguments in favor of certain positions as opposed to others have more often than not been advanced in terms of capitalism and socialism, with the consequent polarization of stances along party lines, as it were.⁸

The “South” looks to book value as what has been spent but not recovered, while, conversely, the “North” argues that the DCF value represents the economic measure of the market value and thus equals the opportunity cost of the taken asset.

7 *Id.* at 42.

8 C.F. Amerasinghe, *Chapter IV: The Quantum of Compensation for Nationalized Property*, THE VALUATION OF NATIONALIZED PROPERTY IN INTERNATIONAL LAW 91 (Richard B. Lillich, ed., 1974).

The dichotomies are multifaceted and the splits between the two schools are displayed in Table 2.1:

Table 2.1
Net Book Value vs DCF Valuation: The Dichotomies

	Net Book Value	DCF Valuation
Champions	“South”	“North”
Concept	Lost investment	Lost profits
Perspective	Backward-looking	Forward looking
Basis	Documentable	Speculative

Typically the DCF value, based upon putative lost future profits,⁹ is larger than the net book value, oftentimes very much larger. Thus, for example, differences of 1000% are not unusual. In some recent cases before the US-Iran Claims Tribunal, the claimed net present value of the lost “profits” was an order of magnitude larger than the book values.

Section 3: The Congruence Principle: The Theoretical Demonstration

We turn now to the basic principle – the relationship in theory between net book value and DCF value; this is the nub of the debate over the standards of valuation or compensation, and we shall show that the two different theories lead to the same quantum of value. The economic rule may be stated quite succinctly:

Strong form: The net book value of an average venture and the net present value of expected future cash flows, taken at each point in time over the project’s history, will be identical.

Weak form: The conformed net book value and the net present value of expected future cash flows will be approximately equal.

In its strong form, the “congruence principle” implies that the net book value and the DCF value are identical. The “weak form” of the principle implies only that the two values will be approximately equal when the book value is “conformed” or adjusted to reflect deviations between accounting practice and financial principles. The first version is true in theory and the second obtains in practice.

To demonstrate this critical principle, the following assumptions are made:

- No inflation, i.e., all expenditures and receipts are in real terms.
- There is a one-year lead time for the project, i.e., the cash flow begins one year after the expenditure of the investment monies.

⁹ Illustrative of the ambiguity of much of the literature, commentators fail to distinguish between profits and cash flow.

- Working capital is ignored or admits of a simpler, more familiar adjudication. Therefore, compensation for net working capital can be determined separately and then folded into the final quantum of value.
- All outlays attributable to future cash flows, including exploration or research, are capitalized.
- The firm or project presents its balance sheet in conformance with US Generally Accepted Accounting Principles (GAAP).

None of the above simplifying assumptions are critical; the calculations can be generalized to include those effects, and the “congruence principle” is still valid. The proof, however, is more elaborate, and the demonstration of the basic case suffices here to present the argument. However, a further assumption must be emphasized:

- The project earns an “average” rate of return, i.e., it is neither abnormally profitable nor notably unprofitable.

This assumption is critical. The two valuations are not the same where there are either super-profits or low returns, and we shall return to its implications in the course of the subsequent discussions.

3.1 Base Case

Let us consider a numerical illustration (see Figure 3.1). The project consists of an initial investment, which generates cash flow over a period of six years. At the beginning of the first year (time $t=0$), \$1000 is invested. Thereafter, the cash flow from the project declines linearly each year until it ceases after the end of the year $t=6$. Cash flow equals the depreciation charge plus the projected profits in each of the years 1 through 6. The annual depreciation charge is \$166.67, so that the net book value is decreased each year by that amount; thus, for example, the Net Book Value (NBV) at the end of year 2 (or beginning of year 3) is \$666.67, i.e., the original costs of \$1000 less 2 times the annual depreciation of \$166.67.

Figure 3.1 – Idealized Investment/Cash Flow Profile

The profit in the first year is \$150, and the cash flow is \$316.67 which reflects \$150 of profit plus \$166.67 in depreciation charges. The cash flow falls off in each year as the asset ages, dropping to \$191.67 in the final, 6th year. The discount rate equals 15%, and the net present value of the cash flow at $t=0$ (when the invest-

ment is made) is \$1000. Thus, by construction, the NBV, which is the undepreciated initial investment, equals the DCF value at that point in time.

The identity in act holds for all years. At the beginning of year 2, the net book value is \$833.33, and one calculates the net present value of the cash flow for the 5 remaining years, i.e., as of the beginning of year 2 to be also equal to \$833.33. The identity can be verified directly for each of the years.¹⁰

Table 3.1
Net Book Value vs DCF Value (zero inflation)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	NBV (BOY)	Deprec-a tio	NBV (EDY)	Profit	Cash flow	NPV (BOY)	NPV/ NBV
1	1000	166.7	833.3	150.0	316.7	1000.0	1.00
2	833.3	166.7	666.7	125.0	219.7	833.3	1.00
3	666.7	166.7	500.0	100.0	266.7	666.7	1.00
4	500.0	166.7	333.3	75.0	241.7	500.0	1.00
5	333.3	166.7	166.7	50.0	216.7	333.3	1.00
6	166.7	166.7	0.0	25.0	191.7	166.7	1.00

The preceding result is an artifact of the example, but it in fact is much more generally true, and the following theorem can be stated with reference to an existing corpus of literature dealing with the measurement of economic rates of return:¹¹

Strong version: The present value of the cash flows in future years from an investment project equals the net book value of that project if: 1) the project earns the “average” rate of return and, 2) if the depreciation schedule used to calculate NBV equals the rate of economic depreciation.

Weak version: The result is approximately true if the depreciation schedule approaches the rate of economic depreciation.

10 Compare column 2 with column 7 in Table 3.1.

11 F.M. Fisher & J.J. McGowan, *On the Misuse of Accounting Rates of Return to Infer Monopoly Profits*, 73 AER 82-97 (1983). T.R. Stauffer, *The Measurement of Corporate Rates of Return: A Generalized Formulation*, 2 BELL J. OF ECON. & MGMT. SCIENCE 434 (1971). T.R. Stauffer, *Economic Profitability of Oil Companies*, OPEC REVIEW VOL. XVII, NO. 2, 163 (1993). FINANCIAL ACCOUNTING STANDARDS BOARD (FASB), STATEMENT OF FINANCIAL ACCOUNTING STANDARDS NO. 89: FINANCIAL REPORTING AND CHANGING PRICES (1986). FINANCIAL ACCOUNTING STANDARDS BOARD (FASB), STATEMENT OF FINANCIAL ACCOUNTING STANDARDS NO. 82: FINANCIAL REPORTING AND CHANGING PRICES: ELIMINATION OF CERTAIN DISCLOSURES (1984). FINANCIAL ACCOUNTING STANDARDS BOARD (FASB), STATEMENT OF FINANCIAL ACCOUNTING STANDARDS NO. 82: FINANCIAL REPORTING AND CHANGING PRICES (1979).

Although some limitations exist (see Section 3.4), the approximation is remarkably good for most cases of practical relevance, especially in the upstream oil industry where unit-of-production amortization is the standard.

There is also a heuristic demonstration of the strong version of the congruence principle, which follows immediately from the practice of using DCF value methods to evaluate investment decisions:

1. Firms use a discount rate to determine whether a project is acceptable or not.
2. That discount rate is their target rate of return (as corrected for project-specific risk).
3. No investment is undertaken if the net present value of the projected cash flow is less than the investment itself.
4. Thus, when expectations are realized on average, the net present value of the future cash flow will equal the initial investment, i.e., the NBV at $t=0$.

Hence, the congruence principle will hold on average for the first year of any project, and it will hold approximately subject to the qualifications to be discussed later. In other words, the close relationship between NBV and the DCF value is equivalent to noting that expectations are realized on the average, so that the relationship will be close in such measure as the venture is typical or average.

Figure 3.2—Rational Expectations: The Link between Book and DCF Values

This relationship, albeit counterintuitive at first blush, should in fact be expected. There is a substantive link between the two quite different concepts of value, e.g., the rational expectations of investors that their projects will on average yield the average rate of return. The typical investment yields the average rate of return, and it is that empirical fact, as well as the definition, which creates the critical link between the historical measure of investment, book value, and the prospective measure of its current worth—the DCF value. Only where outcomes differ markedly from expectations should the two be markedly different.

It is often argued that there is no connection between book value and DCF value:

In view of the fact that book value and related approaches to valuation are based on mistaken notions of value, it is hardly surprising that they are incapable of producing useful results in valuing expropriated property. It is also worth noting that the phrase 'book value' is itself a misnomer, because it has nothing to do with 'value' properly defined, but refers instead to the manner in which certain accounting conventions treat assets recorded on a firm's balance sheet using variety of assumptions and decisions have little or nothing to do with 'value.'¹²

The above citation illustrates a common line of argument, but the discussion is purely normative. This argument fails to recognize the key link between investment, expectations, book value, and DCF value and is not buttressed by empirical study nor quantitative analysis. It thus misses the central economic and empirical fact: *DCF value and book value will differ materially if and only if certain testable conditions are not satisfied; otherwise, the two values will concur closely enough that they can be accepted as rough proxies for each other.*

While it is true and the two values can diverge, the thrust is, in fact, the opposite of the argument quoted above—NBV is close to DCF value *except* in special cases which can be defined and tested.¹³

3.2 Impact of inflation

The principle can be immediately extended to the case where inflation cannot be ignored. The demonstration involves two steps: first, one expresses the future cash flows in dollars of the year in which they are received. They must be escalated by the inflation index. Let us assume a high rate of inflation, 23% p.a., in order to highlight the effects. Hence, in year 3, \$266.7 in the dollars of time $t=0$ becomes \$403.4 dollars in dollars of year 3. The present value at any time is then calculated by discounting the escalated dollars of cash flow by the inflation-adjusted discount rate; those results are shown in Column 5 of Table 3.2. We note that the cash flow in nominal, current-year dollars actually increases for the first years, even though the real cash flow falls linearly.

The NBV must also be expressed in dollars of each year. This can be done using two potentially different inflation indices: monetary or equipment specific. If one uses the inflation index for monetary inflation, i.e., that which reflects the general decline in the purchasing power of money, one obtains an updated or inflation-adjusted value for the depreciated initial investment. This can be interpreted as the unrecovered initial outlay expressed in the dollars of each year after $t=0$. An

12 Lieblich, *Determining the Economic Value of Expropriated Income-Producing Property in International Arbitrations*, *supra* note 4.

13 An important qualification must be noted. The principle does not apply if the project enjoys "super-profits," i.e., monopoly profits or some form of windfall profits, such as might result from spectacularly favorable geological conditions. In that case, i.e., if the project is better than average, then its DCF value will be greater than the NBV. The ratio will be roughly equal to the ratio of the project rate of return to the expected or average rate of return. Thus, monopoly profits or windfall returns will lead to a ratio greater than one. Therefore, if the argument that the DCF value is five times the NBV, it is equivalent to arguing that the project yields a rate of return five times better than average. This becomes a reality check on such calculations.

equipment specific index is not discussed since the method is confounded by variables including technical progress and relative valuation in a technically dynamic environment.

The congruence principle remains valid; the updated figures for the NBV and DCF value are equal in each year (compare columns 5 and 7 in Table 3.2, where a high figure for inflation, 23% p.a., has been chosen in order to highlight the effect). Thus, for example, at the beginning of year 4, the inflation-adjusted NBV value is \$930 in current dollars, and the present value of the remaining three years' cash flow is the same. In general, this identity between book and DCF values holds for any inflation rate as long as the rate of inflation applicable to receipts is not materially different from that applicable to hardware. This will remain true without exception if all computations are designed to reflect changes in monetary value, rather than replacement costs.¹⁴

Year	(1) Historical NBV (BOY)	(2) Historical Cash flow	(3) Inflation Index	(4) Escalated Cash Flow	(5) NPV (BOY)	(6) Pro Form NPV/ NBV	(7) Up- dated NBV (BOY)	(8) Up- dated NPV/ NBV
1	1000.0	316.7	1.230	389.5	1000.0	1.00	1000.0	1.00
2	833.3	291.7	1.513	441.3	1025.0	1.23	1025.0	1.00
3	666.7	266.7	1.161	496.2	1008.6	1.51	1008.6	1.00
4	500.0	241.7	2.289	533.1	930.4	1.86	930.4	1.00
5	333.3	216.7	2.815	610.0	763.0	2.29	763.0	1.00
6	166.7	191.7	3.463	663.7	469.2	2.82	469.2	1.00

3.3 Quasi-Capital Outlays: Exploration and R&D

NBV must be adjusted for expensing quasi-capital outlays¹⁵ such as mineral exploration or, more generally, the expensing of research and development outlays (R&D). The argument for expensing those outlays is straightforward and reaches to one of the historical notions underlying the concept of "book value"—it represents assets which could be attached or recovered. Dry holes have no value, and any "value" attributable to R&D is diffuse and difficult to identify.

Statistically, a certain incidence of unsuccessful exploration is inextricably part of the dynamic of finding oil or minerals. It is an artifact that some or all of those

14 Note that neglecting to correct for inflation would result in a material distortion—the ratio of *historical* NBV to the DCF value at the point when $t = 0.45$, reflecting the impact of inflation on the understatement of the residual book value. The vintage NBV is less than half the adjusted value, and this specific example illustrates why such corrections are obligatory.

15 Baruch Lev & Theodore Sougiannis, *Industrial Capitalization Amortization and Value-relevance of R&D*, 21 J. OF ACCT. & ECON. 107 (1996). See generally Stauffer, *supra* note 11. H.G. Grabowski & D.C. Mueller, *Industrial Research and Development, Intangible Capital Stocks, and Firm Profit Rates*, 9 BELL J. ECON. & MGMT. 328 (1978).

outlays might be expensed currently. Since the successful venture could not have been brought about absent such exploration, and since the exploration was consequentially linked to future production, those outlays must be capitalized in the determination of what had been spent on the enterprise.

The mechanics for adjusting for direct exploration or R&D outlays are therefore straightforward, albeit approximate. These costs should be capitalized and amortized as part of the pool of investment costs being depreciated or amortized in the standard accounts.¹⁶

Allowance for unsuccessful exploration or fruitless R&D, must also be allocated to the successful venture. No uniquely definable basis for such additional allocations has been agreed. Note that there is a need to recognize second-tier exploration and R&D costs when determining either valuation for takings or profitability.

The two effects together frequently will add 50% or even more to the NBV of the larger integrated companies. Impacts could be still larger in the case of smaller firms or stand-alone exploration and production (E&P) ventures.

3.4 Depreciation schedules

The NBV and DCF value relationship depends upon the choice of depreciation schedule. If the depreciation schedule is more rapid than the economic depreciation, the NBV will understate the DCF value. The converse is also true.

There are only a handful of common depreciation formulae:

Straight-line—a fixed percentage of the initial value is charged each year. That formula will be correct if and only if the time pattern of the cash flow is exactly the shape shown in Figure 3.1.

Sum-of-the-years' digits—the depreciation is more rapid in the early years according to the expression base (cost minus salvage value) multiplied by the diminishing fraction of year over the sum of years.¹⁷

Double-declining balance—another, more rapid depreciation schedule defined as the unrecovered cost or other basis depreciated at a uniform rate per annum, the rate not to exceed twice the appropriate straight-line rate computed without adjustment for salvage.¹⁸

Unit-of-production—a schedule widely used in the oil and gas and mining industries according to which the investment is prorated over production or mine output so that each unit produced carries the same depreciation charge.

16 We note that smaller firms in the oil industry frequently use this accounting option which has hitherto been recognized as admissible under Generally Accepted Accounting Principles (GAAP), provided that it is declared and the conventions observed.

17 See MARK LEE LEVINE, REAL ESTATE TRANSACTIONS, TAX PLANNING AND CONSEQUENCES 335-6 (1973).

18 PAUL E. ANDERSON, TAX PLANNING OF REAL ESTATE 40 (1977).

Tax schedules (US)—the U.S. Internal Revenue Service has specified various formulae over the years, each of which is no less arbitrary than those used for financial accounting.

We confine our attention to the case of “unit-of-production” (UOP) depreciation, since that schedule is used for most investments in the upstream, or producing sector, of the oil industry. The rationale for that choice by the oil industry is straightforward: the outlay for a well, for example, is directly related to the intended production of oil, so that the depletion or depreciation charge should be proportionate to how much oil is produced, rather than some arbitrary period of time over which the oil might be presumed to be recovered.

In this special, but important case, the relationship is no longer exact between the NBV and DCF value, but the agreement is remarkably close. It can be shown that the congruence principle holds quite accurately over wide variations in the production pattern of an oilfield as long as UOP depreciation is used. This result cannot be encapsulated in an equation; however, extensive simulations studies have been executed, covering the typical range of discount rates, reservoir decline curves, and production profiles. The resulting ratios of NBV to DCF value exhibit only modest deviations from the theoretical relationship—the span of the errors is from plus 10-15% to minus 25%; the NBV is more likely to overstate the DCF value than to understate it.¹⁹

3.5 The Congruence Principle

The congruence principle applies in general: NBV and DCF value are identical. That general relationship occurs where prices are rising providing that the NBV figure, as reported by the accountants using vintaged prices, is updated for inflation. The rule can be automatically extended where quasi-capital outlays, like exploration and R&D are expensed, rather than capitalized. In that case, too, a uniquely determinable adjustment can be calculated for the NBV. The adjustments for inflation and expensing require no speculative projections; each can be made using data routinely available in a firm’s accounts.

The congruence principle, however, only holds approximately when the firm’s depreciation schedule does not exactly equal the economic depreciation rates. In that case, however, at least for the oil industry, the deviations are modest, as is verified by simulation calculations using UOP depreciation schedules, the convention applicable to most oil industry outlays.

Several caveats must be noted. First, working capital must be analyzed separately. Where the entity being valued is part of an international corporation, each

19 We note that expensing exploration, for example, is an extreme case of accelerated depreciation. We also have noted that expensing does lead to distortions in the measurement of conformed NBV. The fact that unit-of-production depreciation does not is due to the fact that it is not based upon an arbitrary timing of deductions, but rather that the deductions are smoothed out over the lifetime of the fields. That timing importantly mitigates any error due to the fact that the unit-of-production schedule itself is not theoretically ideal—while the convention is not perfect, it yields acceptably accurate results in most instances.

interaffiliate account must be tested to see if it meets an arm's-length standard. Second, if projects have long lead times, the NBV can understate DCF value by an amount which can be estimated where the lead times can be approximated. Third, it is frequently necessary to allocate back to a producing affiliate some share of company-wide unsuccessful exploration or R&D, which also means that adjusted net book value is understated by an amount which can, too, be estimated. Fourth, where tax and book accounting differ, it may be necessary to recalculate the deferred tax reserves in the redetermination of book value. Fifth, the allocation of costs and overheads between the venture and its parent or affiliates must be reviewed, along with any possible transfer prices, where this question of validation of non-arm's-length transactions is a general and familiar concern which is not specific to valuation as such.

Subject to the above qualifications, one can restate the congruence principle in several equivalent forms:

- The best proxy for the speculative calculation of DCF value for an entity is the adjusted NBV.
- If the DCF value is significantly higher than the adjusted NBV, two interpretations are possible:
 - (1) The value of the property has been systematically inflated—the “Cinderella effect” to be explored below.
 - (2) The property enjoys real windfalls which cause the DCF value to exceed the NBV (the bonanza case).
- The evidentiary burden must be shifted where a DCF valuation is claimed which is materially different from the conformed figure for the NBV — the divergence must be justified, since under representative conditions the two values should be reasonably close.

The two different measures of value, conceptually so very different, should nonetheless yield similar compensation values. The NBV, as adjusted, is more readily calculated, since it involves no speculative forecasts. The DCF value is conceptually the preferable method, even though its calculation requires projections of future costs and revenues which are not directly testable. The two methods, however, even though ostensibly founded on different principles, should be comparable except under atypical, definable conditions.

SECTION 4: EMPIRICAL TESTS

Empirical tests of the congruence principle in valuation are elusive, given the very nature of the question, but this section shall sketch an array of evidence which strongly supports the hypothesis, even though a definitive demonstration has not been realized. The exercise is intrinsically difficult because one requires three sets of information for each firm or each industry to be tested: 1) the market value; 2) the DCF valuation at the same point in time; and, 3) the conformed figure for

the net book value. All three are needed to verify the hypothesis, as illustrated in Figure 4.1:

Figure 4.1
Triad of Elements

We note that established practice in the industry supports the conclusion *a priori* that the market value, where there is a transaction, was most probably determined as the result of discounted cash flow valuations undertaken both by buyer and seller. This is true for acquisitions and mergers, it is true for project investments, and is also generally true in the case of the stock market valuation of listed companies. There, theorists argue, the value of a stock is determined by an investor's discounting a projected future stream of dividends.²⁰ Thus it can be argued that the market value is the DCF value—if one knew the consensus values for future income or dividends and if one also knew the related discount rate used by buyers.

There is virtually no direct evidence as to the determination of a DCF value in cases of real market transactions although one can infer that the market value is the DCF value. In particular, one must immediately dismiss the figures emanating from litigation as providing any tests of the principle. The DCF values claimed, or reported, in opinions or arbitration awards, do not meet a market standard, nor are they useful for analysis. First, they fail the market test because those reported values reflect only the claims of the parties as to what someone purportedly would have paid. Those figures are not based on a sum actually paid in the marketplace; a willing buyer did not pay such sum to a willing and informed seller.²¹ Since there was no transaction, there was no market value proven. Second, the data is unreliable for purposes of analysis in almost all instances because the financial or economic evidence, especially in international cases, is reported only fragmentarily, if at all, and is filtered through the lenses of jurists and the authors of such opinions, whose financial expertise is limited. Thus, key terms such as “cost,” “profit,” or “asset” are frequently used cavalierly, so that analysis is precarious.

20 J. FRED WESTON & E.F. BRIGHAM, *ESSENTIALS OF MANAGERIAL FINANCE* 405 (7th ed. 1985). RICHARD BREALEY & STEWART MYERS, *PRINCIPLES OF CORPORATE FINANCE* 45 (1984).

21 Lieblich, notably, differs and argues that courts are an effective surrogate for the marketplace. See Lieblich, *supra* note 5.

Market value and NBV, however, can be compared with some precision. There exists a large corpus of evidence concerning the relationship between book value and market value and there also is a limited block of data which relates book and DCF values for the special case of upstream oil and gas properties (the exploration and production segments of oil and gas firms). Thus those two elements of the triangle in Figure 4.1 can be established with considerable confidence, while the remaining link — the identity between DCF value and actual market value can only be inferred from the quite different anecdotal evidence or results of surveys which indicate that properties are acquired based on prices determined from discounting estimated future cash flows.

4.1 Tobin's 'q'—Market vs Book Values in Economic Theory

The ratio of market value to NBV of a firm has been graced with its own moniker—it is designated most commonly as Tobin's 'q',²² after the economist who is identified with the early efforts to use that indicator as a measure of the relative success of firms and their competitive positions. Most economic studies of Tobin's 'q' focus on efforts to explain that value in relation to competitive or non-competitive factors in the industry or market being studied; they address *why* the ratio might differ from unity. Collaterally, however, such reports typically do report the values of the ratio for the firms or industries being investigated. The thrust of such studies is quite different, but the data on the ratios, however, otherwise explained or interpreted, are relevant here.

The literature on Tobin's 'q' does indicate that the market value can occasionally be significantly greater than book value, sometimes by a factor of three or more. However, that literature must be interpreted with care because the book values are rarely, if ever, corrected for any of the accounting conventions which bias the values, such as inflation and expensing of quasi-capital items. Without such adjustment, and without scrutiny for other possible aberrations, the studies on Tobin's 'q' do not in fact provide a reliable test of the hypothesis. What can be concluded is a much more restrictive result—such studies show that market value is rarely a large multiple of *unadjusted* or *unconformed* NBV.

In general, this research leads to the conclusion that the value of Tobin's 'q' should be close to unity except where there are special market or monopolistic forces that can be identified and which lead to a higher value—i.e., some circumstances in which windfall profits or economic rents can be captured by the firm. The studies support the conclusion that book and market values are approximately equal for the "average" firm which does not enjoy some special market advantages. This research, however, must be interpreted carefully, since, as noted earlier, many of the published studies do not systematically correct for the biases resulting from accounting conventions. In particular, inflation is not always recognized, and the impact of expensing R&D or exploration is only occasionally introduced as a correction. The studies of Tobin's 'q' confirm only the weak version of the hypothesis:

22 E. Linberg & Stephen A. Ross, *Tobin's 'q' and Industrial Organization*, 54 J. OF BUS. 1 (1981).

- Market value is usually not dramatically higher than NBV (unadjusted).
- Reported deviations are often of the same magnitude as the inflation adjustment where it was not explicitly introduced into the data.
- If market value is claimed to be significantly higher than NBV, the reasons must be presented explicitly, since any such departure is abnormal.

The utility of this body of economic literature in the present context is not that it provides a rigorous test of the hypothesis, but rather the fact that it approximately confirms the hypothesis over a broad and diversified set of firms and industries. What it lacks in depth, it provides in breadth. In particular, it supports the narrow version of the theorem that any large premium over conformed NBV is unlikely.

4.2 Book Versus DCF Valuations: The Evidence from “Reserve Recognition Accounting” Reports

There is extensive empirical data on the relationship between book value and estimated DCF values for one industry segment for the period after 1979. The SEC mandated that oil companies report on the value of their oil and gas reserves, and the methodology was ultimately prescribed by the Financial Accounting Standards Board (FASB) in 1982, after considerable discussion within the industry, active objections by industry representatives that such DCF value projections were unreliable, and the review of extensive comments on the exposure drafts.²³ Such data on the DCF value of business enterprises is available only for the oil and gas industry, the only industry subject to such a ruling from the SEC, but that information is nonetheless of considerable interest because many of the largest cases of expropriation, and thus of valuation for compensation, involved oil ventures.

The reporting requirement stipulates a standardized format for projecting cash flows from existing proved reserves: “Standardized Measure of Discounted Future Net Cash Flows Relating to Proved Oil and Gas Reserve Quantities.”²⁴ The revenues from such reserves are projected and then are discounted, net of taxes, in order to determine—on a comparable basis—the present value of those reserves. Specifically, FASB 69²⁵ codifies the requirement of the SEC by detailing the elements of such a forecast:

- Project production and gross revenues from *proven* reserves.

23 FINANCIAL ACCOUNTING STANDARDS BOARD (FASB), STATEMENT OF FINANCIAL ACCOUNTING STANDARDS NO. 69: DISCLOSURES ABOUT OIL AND GAS PRODUCING ACTIVITIES (1982). See also PRICE WATERHOUSE & CO., RESERVE RECOGNITION ACCOUNTING: AN EVALUATION OF ITS VIABILITY AND APPLICATION (1979). Arthur Andersen & Co., Disclosures About Oil and Gas Producing Activities: An Analysis of Statement of Financial Accounting Standards No. 69 (1983). See generally, Arthur Andersen & Co., Annual Oil & Gas Reserve Disclosures.

24 FINANCIAL ACCOUNTING STANDARDS BOARD (FASB), STATEMENT OF FINANCIAL ACCOUNTING STANDARDS NO. 69: DISCLOSURES ABOUT OIL & GAS PRODUCING ACTIVITIES (1982).

25 *Id.*

- Project revenues assuming a constant real price unless documentable contractual terms specify some other determinable price.
- Deduct projected cash operating costs and any foreseeable supplementary investments needed to sustain the production forecast.
- Calculate royalties and income taxes due based upon existing statutory clauses or concession agreements.
- Discount the resulting cash flows at an illustrative rate of 10% (which, given the prescriptions, is equivalent to a real, inflation-adjusted discount rate of 10%).

Thus, the mechanics of these DCF analyses, which had to be reported annually and certified by the reporting firm's accountants, are indeed identical to the steps which would be executed in a DCF valuation of the firm's upstream operations.

The "standard measure" therefore provides a test of the relationship between book value and DCF value, for the given discount rate of 10%, because the net book value of the upstream or producing assets is also reported as the "disclosure of capitalized costs." That information for some 200-plus oil and gas firms was surveyed and summarized annually by Arthur Andersen & Co. (Andersen) for a number of years.²⁶ Both the DCF values and the net fixed assets were computed on comparable bases and in conformance with audit standards, so that the ratio of DCF value to book value is determinable (subject to qualifications to be noted below):

FIGURE 4.2 DCF VALUATIONS VS "CAPITALIZED COSTS: THE ARTHUR ANDERSEN SURVEY

The raw results of the Andersen survey are displayed in Figure 4.2, and it appears that the ratio of DCF value (10%) to net capitalized costs is larger than one—the ratio for both classes of reporting firm is close to two (double the theoretical value) in the early 1980's, but that ratio declines to 1.05-1.28 by 1987. This ratio, however, overstates the conformed figures for two reasons. First, the DCF value is calculated in "real" dollars of each year, whereas the "net book value" is reported in vintaged dollars, i.e., without any adjustment for inflation. Second, the "net book value" as compiled by Andersen excludes working capital—it includes only the net depreciated or amortized costs of physical assets. A comprehensive cor-

26 See generally Arthur Andersen & Co., Annual Oil & Gas Reserve Disclosures.

rection to the Andersen database is not available. However, other studies suggest the magnitude of both corrections: 1) net assets in that period should be multiplied by approximately 1.4 to express the end-of-year net figures in dollars of each year; and, 2) the adjustment for working capital is between 1.1 and 1.4.

The “capitalized costs” reported by Andersen are too low. If they are adjusted for inflation the difference between DCF and “book” values are much reduced. The ratio for 1981, for example, drops to about 1.3 from a ratio of circa two-to-one. In the later years the corrected ratio (approximate) drops below unity. Therefore, the Andersen survey, as conformed, supports the following conclusions:

- DCF value (at 10%) is at most slightly higher than conformed book value.
- The ratio of DCF value to conformed book value dropped steadily during the 1980’s, after the oil price crises, and was less than unity in the later period.

A final source of bias must be noted—a discount rate of 10% is lower than that which oil companies usually cite as being the minimum acceptable rate of return, or the minimum hurdle discount rate. If the discount rate were higher, the DCF value would be still lower, and the DCF value as determined by the FASB rules would be seen to be *less* than conformed book value.

4.3 Conformed Book Value Versus Market Valuations: Survey of Large Oil Companies

A final test of the principle is obtained by comparing the stock market valuations of a set of oil companies with the *conformed* NBV. For some 30 of the largest companies, a full-scale analysis of the asset accounts was undertaken, and all of the major adjustments were calculated for a twenty-year period from the mid-1960’s through the mid-1980’s. The following adjustments proved to be material:

- Inflation. The asset accounts could not be restated, but net fixed assets were converted into end-of-year dollars using formulae for vintaging which reflected the historical rates of new investment for each firm and also its depreciation practices.
- Expensing. Expenses exploration and R&D outlays were capitalized and added to the net fixed asset accounts under the assumption that they would have been amortized at the same average rate as the total fixed asset pool. Since such expensed quasi-capital outlays were typically 30% or more of total annual investment expenditures, the adjustment was large in most years for most companies.
- Inventory accounting. Most firms use LIFO accounting, i.e., the most recently acquired barrels of oil were assumed to have been the first barrels sold, so that the book values of inventories usually reflected not the current values, but rather, the values of barrels acquired many years earlier at much lower prices. Since markets would reflect such knowledge, this adjustment is necessary and was particularly important in the years after 1980.

The market valuation was much easier to determine; the end-of-year stock price was multiplied by the number of shares outstanding at the end of each year in or-

der to calculate the market capitalization. That figure is unequivocal and equals by definition the market value of the entire firm.

Market values were less than book value after 1970. Indeed, as oil prices rose, the market values of the larger oil companies dropped steadily in relation to book values. The history from 1965 through 1988 is plotted in Figure 4.3:

FIGURE 4.3 — BOOK VALUES VS MARKET CAPITALIZATIONS

The average ratio was about 1.5 in the mid-1960's, but it dropped below one by 1969 and has hovered between 0.5 and 0.6 ever since. Oil companies have not sold above conformed book value for almost 20 years. There was considerable variability, however, and a few firms were valued higher than book value in the later 1980's. It was rare, but those are the exceptions which "prove" the rule.

4.4 Summary

Empirical evidence supports the theoretical conclusion: book value, adjusted for accounting conventions, is close to, or *greater* than DCF value. The general literature on Tobin's 'q' supports the weaker conclusion that market value is at most a small multiple of book value. That literature overstates the relationship, because the book value figures are unadjusted, even for inflation, and therefore are too low, so that the actual agreement with theory is significantly better than the raw data suggests.

Second, the Reserve Recognition Accounting²⁷ data indicates that DCF values, at a real discount rate of 10%, are at most slightly higher than conformed book value but in later years have been less. Third, the study of the 30 largest US companies showed that market values were consistently less than conformed book value. From the available industry and company surveys, therefore, one can conclude:

1. Companies generally sell at a modest premium, if any, over the adjusted or conformed book values.
2. The DCF value of upstream operations of US-domiciled companies, including their international operations, has been equal to or less than the conformed book value of those operations.

27 See generally HAROLD S. BLOOMENTHAL, 3 SECURITIES AND FEDERAL CORPORATE LAW § 2A.06[a-e] (1996).

3. Oil companies have rarely sold at prices which were greater than the adjusted book value. To the contrary, the market discount below book value has been large and persistent.

Each empirical analysis is flawed; none is comprehensive. However, the weight of the data supports the theoretical conclusion from Section 3 that book and DCF values are close, after adjustment for accounting conventions and that, if anything, that book value is frequently greater than DCF or market value.

SECTION 5: FINANCIAL HYPERBOLE: THE “CINDERELLA EFFECT”

There is an oft-mentioned drawback to DCF valuations, i.e. the method is readily characterized as “speculative” or “hypothetical” or “unreliable” because it is perforce predicated upon a forecast of expected revenues and costs from the venture which is by its very nature untestable. Even though modern analysts agree that DCF valuations are the cornerstone of valuations in the determination of real market transactions, the methodology is viewed with jaundice when applied in the courtroom:

Great care must be taken, or such valuations can reach wonderland proportions. It is necessary to take into consideration manifold and varied factors like future supply and demand, economic conditions, estimates of mineral recoverability, the value of currency, changes in the marketplace, and technological advances. Many of the factors are impossible to predict with reasonable accuracy.²⁸

The factors which must be weighed are many, and the pitfalls are no fewer. The courts and advisory panels have repeated the caveats attendant upon efforts to value properties by capitalizing, or discounting, prospective income:

Also, the myriad factors and great variables involved in the capitalization process (capitalization rates, Inwood factors, gross income, effective gross income, net income before recapture, net income after all depreciation, residual techniques, etc.) preclude it [the capitalization of income] from being a readily understandable approach in any event. Each of the factors must be carefully analyzed and objectively supported to prevent the result from being utterly fanciful.²⁹

The uncertainty in a DCF valuation is intrinsic—one must estimate the future outcome of the venture; it is understandable that courts are reluctant to base a present judgment not upon past conduct or performance, which—for better or worse—is adjudicable, but upon opinions as to the untestable future. An imperfect mirror looking back into the past, towards net book value, is preferred to the clouded crystal ball of a seer:

In sum, there is a big difference between an investment decision in the market and a judicial decision in a court . . . a businessman can and should accept calculated risks . . . based on forecasts of an uncertain future. The judicial organs,

28 *U.S. v. 47.14 Acres of Land*, 674 F.2d 722, 726 (8th Cir. 1982).

29 INTERAGENCY LAND ACQUISITION CONFERENCE, UNIFORM APPRAISAL STANDARDS FOR FEDERAL LAND ACQUISITIONS 20 (1992).

however, have a mandate to reduce to the minimum possible the element of uncertainty or risk while deciding on juridical issues. This is why, as pointed out in para 230 of *Amoco*, the judicial bodies—even United States domestic for a—have been disinclined to use the DCF method for valuation.³⁰

The World Bank, in its guidelines for settling disputes over takings of investment assets, has added its not inconsiderable weight to the voices of caution with respect to the use of DCF valuations:

For a going concern . . . discounted cash flow may represent an acceptable method of valuation . . . However, particular caution should be observed in applying this method as experience shows that investors tend to greatly exaggerate their claims of compensation for lost future profits.³¹

The DCF method has indeed been tainted by misapplication, and it has been used to justify valuations which reach beyond the “fanciful” to “wonderland proportions” (see case studies below). ARCO, one of the litigants before the US-Iran Claims Tribunal which advanced a DCF-based compensation claim, itself summarized the impediments to a DCF value in a contemporaneous report:

Because of unpredictable variances in expenses and capital forecasts, crude oil and natural gas price changes, largely influenced and controlled by U.S. and foreign governmental actions, and the fact that the bases for such estimates vary significantly, management believe the usefulness of these projections is limited.³²

ARCO referred here to the cash flow projections mandated under standardized guidelines for calculating the present value of oil firms’ oil reserves, but the caveat extends more generally to any such projections which are not ultimately validated by real arm’s-length transactions.³³

5.1 *The “Cinderella effect”: Selected Case Studies*

The “Cinderella effect”—overvaluation of taken properties—is not surprising, but it is surprisingly difficult to document clear-cut examples from the public record. Most court decisions or tribunal awards are parsimonious in the economic detail which is presented. Whatever financial data is offered by the court has been filtered through a jurist’s prism and typically is not amenable to economic analysis. The terminology is either too casual—confusing income with cash flow, for example—or the pieces of the financial puzzle are too few.

30 Seyed Khalil Khalilian, *The Place of Discounted Cash Flow in International Commercial Arbitrations: Awards by Iran-United States Claims Tribunal*, 8 J. INT. ARB. 31 (1991).

31 World Bank Group, *supra* note 6, at 26.

32 ARCO, ANNUAL REPORT TO STOCKHOLDERS 56 (1986).

33 See Lieblich, *supra* note 4.

5.1.a The Aminoil Case³⁴

The award in *Aminoil* does contain enough financial information to test the congruence hypothesis and also to illustrate the Cinderella effect. Aminoil, in its submission before the arbitrators, claimed that the present value of its lost profits (cash flow) was some \$2,500 million; the sum consisted of \$400 million in “profits” which were lost between the date of the taking and the date on which it submitted its memorial to the arbitration panel. The claim added another \$2,100 million for the profits which it expected to garner between the latter date and the end of the concession in 2008.³⁵

That value was astonishing on its face. Aminoil’s concession, producing some 100,000 b/d, was a dim star in the Middle East constellation. Like that of Getty for the southern, Saudi-controlled part of the same fields in the then Neutral Zone, the operation was doubly disadvantaged and seen to be the least attractive of the producing areas in the Middle East. Costs were high—production came almost entirely from pumped, low-productivity wells—and, the oil was of low gravity and high in sulphur, selling at a large discount in the market. Moreover, the concession had been sold, some time earlier, at a much lower price, and the prior sale figure, even adjusted for subsequent developments, was irreconcilable with the claimed value.

We can test the post-taking, Cinderella valuation against another DCF valuation, based upon Aminoil’s declared expectations as articulated *prior* to the taking. The reference point is Aminoil’s income in the years after the 1973 price increase, but prior to the taking (1974-77). Aminoil had indicated, in representations to the Government of Kuwait (GOK) in the 1970’s, the annual return which Aminoil perceived as providing a “fair” annual return for its investments—it stated that it needed \$20 million per year (after taxes) in order to realize a reasonable rate of return, a figure which the GOK countered with an offer of \$7.5 million p.a. Given the parties’ interests in those negotiations, these figures can be accepted as upper and lower bounds, respectively.

The declared pre-taking figure for what constituted a reasonable income can be translated into a capitalized value. If Aminoil’s target income could have been earned unabated until the end of the concession, i.e., \$20 million per year for the next 31 years, using Aminoil’s own discount rate of 7.5%, the corresponding DCF valuation would be \$267 million.³⁶ This is the *maximum* DCF valuation which is

34 In 1977, the Government of Kuwait nationalized the oil concession located in the northern half of the Saudi-Kuwait Neutral Zone which was held by a US-domiciled firm, Aminoil. There is extensive comment on the resulting arbitration and the arbitral award. Fernando R. Teson, *State Contracts and oil Expropriations: The Aminoil-Kuwait Arbitration*, 24 VA. J. INT’L. L. 323 (1984).

35 *In the Matter of an Arbitration Between Kuwait and the American Independent Oil Company (AMINOIL)*, 1979. See generally *Arbitration Tribunal: Award in the Matter of an Arbitration Between Kuwait and the American Independent Oil Company (AMINOIL)*, 21 I.L.M. 976 (1982).

36 This figure, an upper bound, assumes that the income would be received at a constant level in perpetuity. Oil fields decline; a technically more plausible calculation, using a reservoir

consistent with Aminoil's own parameters, as presented prior to the taking, and it still comes to less than \$300 million.

An upper bound pre-taking value of between \$170 and a maximum of \$267 million, derived from Aminoil's own financial presentations, is one-eighth of the DCF valuation which Aminoil presented to the Tribunal arising from two discrepancies. How did the eightfold discrepancy value arise—what is the basis for the \$2,200 million difference in the valuations? A post mortem of the award proves to be instructive. First, the discount rate was low; a figure of 9-12%, based upon data which became available later, would have been more reasonable.³⁷ A higher discount rate would have trimmed the claimed value by perhaps one-third. The second, and much greater factor, was the major distortion in Aminoil's valuation. Aminoil projected its lost income based not upon the generally applicable tax regime, nor upon the basis used for its own tax return, but instead, upon the implausible overstatement of prospective income from the financial terms of Aminoil's 1961 agreement with the Government which specified a 57% tax rate. The fiscal terms prevailing after 1973 were much more severe: an 85% tax rate and a 20% royalty, thus overstating after-tax income by a factor of four.

The claimed DCF valuation was also dramatically higher than the updated net book value of the operation. Aminoil presented the Tribunal with a figure for the depreciated replacement value of its equipment—an amount of \$189 million. This calculation was introduced as part of an argument for claiming *damnum emergens* in addition to lost profits. The difference was large—the DCF valuation (ignoring working capital) of \$2,500 million was 13 times higher than the adjusted NBV.³⁸ The unadjusted NBV was still less—not more than circa \$50 million.³⁹

Two conclusions emerge. First, the Aminoil case illustrates the “fanciful” dimension of a DCF valuation as presented to an arbitration tribunal. Data is available in the public record indicating a maximum DCF value of some \$267 million, whereas Aminoil claimed \$2.5 billion. One can identify and quantify the elements of the Cinderella effect: most of the overvaluation in Aminoil's DCF calculation resulted from an unsupportable assumption that a favorable tax regime, long dor-

decline rate of 5% (illustrative) leads to an upper bound of \$155 million. This is the figure which is equivalent to arguing that the value taken is that attributable to investment through the date of the taking, but not including any effect for future income from future investments.

- 37 The author was responsible for that discount rate; the figure equaled the average rate of return earned by US companies from foreign operations. While it was derived directly from market data, some judgmental allowance for upstream risk should have been added, even though no empirical measure was found. The GOK's choice of discount rate was also flawed, being based upon uncorrected data of rates of return from successful exploration ventures in the North Sea, which were riskier than the maturely developed production from Aminoil's concession.
- 38 The GOK contested the book value figure—reckoning it at between \$8 and 14 million, but we focus here on Aminoil's own claims. See *supra* note 36.
- 39 Haliburton Fales, *A Comparison of Compensation for Nationalization of Alien Property With Standards of Compensation Under U.S. Domestic Laws*, 5 NW J. INT'L L. & BUSINESS 871 (1983).

mant, would be resurrected to Aminoil's benefit. Correcting the distortion reduces the purported DCF valuation from \$2,500 million to some \$600 million. The remaining difference between \$600 million, as corrected, and \$300 million (the upper bound) was due to the choice of discount rate, price escalation rate, and other factors.

Second, the congruence principle is approximately confirmed. The plausible DCF valuation is close to Aminoil's own estimate of the updated NBV. The upper bound for the DCF valuation is \$267 million (and more likely \$175-200 million), whereas the updated NBV was reported to be \$189 million. The two are reconcilable as accurately as can be expected, given the other uncertainties and sketchiness of the published data.

5.1.b Miller Brothers Case

Another example arose in a recent Michigan case, where a company sued the State of Michigan for thwarting exploration of a property on which drilling had been prohibited by a state environmental order.⁴⁰ The land in question, some 2,200 acres, had never been drilled, and no nearby area had proven to be commercially attractive. It was thirty miles from where the main trend of exploration was located in Michigan. Plaintiffs projected scheduled exploration and development outlays, and they also hypothesized income streams from the acreage, using an innovative risk analysis to conclude that the lost net cash flow from the property would have had a net present value of \$71 million, equivalent to a value of \$35,000 per acre.

That DCF valuation was breathtakingly high—the mineral rights to oil and gas lands in Michigan, even in the heart of the area being explored, typically sold for less than \$1500 per acre. The market for such rights was active, and there was a score of sales of comparable or better acreage indicating values in that range or less. No higher figure was known.

Here too, the question must be asked—what generated so deviant a valuation? Two sets of errors or untenable extrapolations were identified in the instant case. First, plaintiffs' consultant, in testimony markedly incompatible with his own published writings, erred in calculating the probability distribution of successes and then used the wrong formula to compute the risk-adjusted value. Those errors resulted in a six-fold exaggeration of the DCF value. Second, Plaintiffs posited that the fields to be discovered were of a size and frequency akin to those in the distant, most prolific area of exploration. They ignored the evidence that the tracts adjacent to the property in question were either dry or marginally productive. Using the most relevant geological evidence, the reserves and flow rates were recalculated, and that set of distortions was shown to have inflated the value by a factor of at least four. Thus, correction of error and geological hyperbole resulted in a revised DCF value which is very much less—at most \$2 million, consistent with abundant market data.

40 *Miller Brothers v. Dept. of Natural Resources*, 513 N.W.2d 217 (Mich. Ct. App. 1994); See also P.R. Rose, P.R. & J.C. Jones, *MAKING MONEY WINNING ENVIRONMENTAL LAWSUITS* (1993).

This case, therefore, supports the potential validity of a DCF valuation at the same time that it illustrates the many available inflation devises and the precarious nature of such a valuation. The case does not test the congruence principle because substantive investments were not made, thus rendering net book value meaningless. However, DCF valuation compared with determinable market value underscores the Cinderella effect—the property was worth more in the courtroom than on the open market.

5.1.c *Iran cases*

The US-Iran Claims Tribunal cases illustrate the Cinderella effect as well as test for the relationship between DCF and NBV.⁴¹ These cases are of special interest because awards and decisions from this tribunal are often referenced in valuation methodology discussions.

The disparities between claimed valuations, based upon DCF analyses, and the reported NBV are dramatic—the plaintiffs argued for quanta of compensation almost ten times higher than book value; see Figure 5.1

The claimed compensation ranged between \$310 million and \$1,570 million in the three cases illustrated in the figure. The corresponding book values are seen to be much smaller, ranging from \$34 million to \$181 million. The DCF valuations were between 820% and 950% of the NBV—consistently, the disparity was almost a full order of magnitude.

Reported figures for the NBV are historic and unadjusted—they are neither corrected for inflation (i.e., updated) nor are they adjusted for the expensing of exploration outlays. Those figures are low by a factor which can be estimated to be roughly two-to-one. Even with that rough adjustment, one estimates that the claimed DCF values—the “Cinderella figures”—exceed adjusted book value by a factor of four or more.

Two explanations emerge. First, the claimants used very low discount rates, ranging between 4.75% and 6% at the maximum. These discount rates were little different from those for US Treasury bills at the time and were much lower than the rate of return for the foreign, upstream

41 See *Amoco International Finance Corp.*, 15 Iran-U.S. Cl. Trib. Rep. (1987) (Khemco); *Amoco Iran Oil Company v. Islamic Republic of Iran and the National Iranian Oil Co.*, 1 Iran-U.S. Cl. Trib. Rep. 493 (1982) (Amoco). *Phillips Petroleum Co., Iran v. Iran*, 1 Iran-U.S. Cl. Trib. Rep. 487 (1982) (Phillips). *Arco Iran v. Iran*, 25 Iran-U.S. Cl. Trib. Rep. 339 (1990) (LAPCO).

FIGURE 5.1—CLAIMED DCF VALUATIONS VS. NET HISTORICAL BOOK VALUE

(Iranian oil cases)

segment of the oil industry at that time. Since the claimants' calculations presumed not only the high prices of 1980, but also ever rising prices thereafter, the low discount rate can be shown to have roughly doubled the claimed valuation.

Second, the claimants presumed that the operations after the taking have been much more profitable than before. In the case of the offshore producing ventures, for example, a tax remission specifically conceded for a period of falling prices, was continued through a period of high and rising prices. This device roughly doubled the projected profits.

Two conclusions may again be drawn. First, "Cinderella" owed her transformation to an understated discount rate and an implausibly extended tax concession. The magnitude of the Cinderella effect is roughly the difference between the claimed values and the estimated figures for the adjusted book values. Second, DCF values calculated using likely cash flows and industry-wide discount rates are found to be in rough agreement with the conformed NBV. The demonstration of the Cinderella effect is unequivocal, but the test of the congruence principle, in these cases, is only suggestive, since adjusted NBV are not available.

5.2 Reality Checks: The "Glass Slipper"

There are reality checks: "glass slippers" which courts can use to cull the false princesses and verify the fit to the real contender. First, one must determine a consistent rate of return which the claimant has or would earn on the project based on projected performance after the taking. That figure can then be compared with the expected discount rate or reasonable rate of return which a prospective buyer would expect on that property. The greater the disparity between the two figures, i.e., the higher the projected rate of return on the hypothetical future revenues, the greater the likelihood that one is dealing with a false princess.⁴²

Another simple reality test is a comparison of the income before and after the taking—i.e. actual performance under normal conditions versus the income projected after the date of the taking—the *ex ante/ex post* litmus test. Any difference is suspect and would need to be justified. Aminoil failed this test—the future income

was much higher than that in prior years, without there being any material change in operations.

Extreme overvaluation, thus, can usually be detected with relatively simple “reality checks,” such as those applied in the examples sketched above. The “glass slipper” can indeed be useful. A valuation cannot be invalidated by such a check—it can only be flagged as suspect. However, any valuation which does not pass such litmus tests must be examined more carefully, because bonanzas, while not unknown, are also not common, so that the burden of proof, in the logical if not the legal sense, must become more stringent insofar as reality checks are violated.

SECTION 6: CONCLUSIONS

The debate over the choice of the standard valuation is essentially moot—it is a distinction without a difference. The concepts of updated NBV and DCF valuation are strikingly different, but the two standards are arithmetically identical in theory and close in practice. The “congruence principle”—the substantive identity of DCF and adjusted NBV—holds even though NBV is intrinsically retrospective while the DCF value inherently is both prospective and speculative.

Most precisely, the NBV is a close proxy to the DCF valuation for an “average” property provided that adjustment is made for inflation and accounting conventions. The requisite adjustment formulae are generic, not case-specific, and adjustment rules can be laid down *a priori*: 1) updating the depreciated book value of fixed assets, as recorded at historic costs, for monetary inflation and 2) adjusting the book value of inventories from LIFO to a current valuation. The other adjustment, which is especially important for an exploration-intensive industry such as oil and gas or for a research-intensive industry such as pharmaceuticals, is the capitalization and amortization of exploration and R&D expenses which otherwise would have been expensed against income.

Available empirical studies confirm the congruence concept. The NBV, when adjusted for the most important distorting factors, is arithmetically equivalent to the DCF value as demonstrated by three empirical tests. First, general studies, unrelated to the oil industry, showed that high ratios of market value to book value imply monopoly power in some form, but also that the deviations, adjusted for inflation or accounting conventions, were not large. Second, the DCF valuations of producing segments of oil companies, even at a discount rate of 10%, were little more, but usually less than adjusted book value. Third, we showed similarly, using stock market data on the values of oil company shares, that the market capitalization of oil companies is at most equal to the adjusted NBV, but more typically is less. The empirical tests are imperfect and incomplete, but support the theoretical conclusion that it is unlikely that DCF values can much exceed adjusted book values, so that each is a cross-check upon the other.

Two caveats must be recorded because NBV (conformed) can—under certain testable conditions—differ substantially from the DCF value. First, “super-normal” profits are, of course, possible. Occasionally, a venture is indeed spectacularly profitable. If the interest being valued reasonably could be expected to have yielded super-profits, i.e., if it enjoyed economic rents or windfall profits, the

DCF value would be higher than the adjusted NBV. That case is unlikely, but not impossible. Second, conversely, if one party claims that the DCF value is notably less than the adjusted NBV, the abnormally poor performance must equally be explained, since, by definition most firms or ventures realize “average” rates of return. In both instances, any valuation which is materially different from the adjusted NBV must be reviewed with particular care, since such disparity is not likely.

Any disparity between the two standards of value must be explained. In either case, where it is claimed that the property’s value is materially different from the NBV, a higher evidentiary standard must be required. Theoretical analysis and empirical data both indicate rough congruence. Thus, any such argument would need to be supported by clear evidence as to why the property was unusually profitable, or unusually unprofitable, since “congruence” requires that the two valuation methods produce comparable results, absent some demonstrable basis for deviation.

This general result can be articulated as a set of guidelines for valuations in the case of international takings. In contrast to North America, where direct market comparables are generally available and preferable as bases for valuation, elsewhere market sales are rare or non-existent, so that only the capitalization of income or the NBV are available as options for determination of value:

1. The starting point for valuation is NBV.
2. NBV, per GAAP, is then adjusted for inflation, expensing of exploration and R&D, LIFO inventory reserves, or other demonstrable distortions or accounting conventions which affect comparability.⁴³
3. The adjusted net book is thus the benchmark for value and is the touchstone against which any other claimed valuation is tested.
4. Any material disparity between the claimed value and adjusted NBV is likely to be error or bias. If the DCF valuation, for example, is significantly higher than the adjusted NBV, that figure is potentially a “Cinderella” valuation. The income projections and other parameters in the valuation must be tested for bias and the super-profits explained and verified. Conversely, if the claimed DCF valuation is materially less than adjusted NBV, the projections and parameters must equally be tested for bias and the poor profitability explained.
5. The greater the divergence between DCF value and NBV, as adjusted or conformed, the greater the burden of proof upon the party arguing for the difference.

The debate over the appropriate concept for determining value is indeed moot, and the issue has been shown here to involve a distinction without a difference. It is all too reminiscent of Jonathan Swift’s *Battle of the Books*⁴⁴ where the “An-

43 Adjustment may be needed for other accounting conventions which distort “value” as defined here; that can be determined only on case-by-case. For example, deferred tax reserves, if material, must be analyzed with care.

44 See *supra* note 3.

cients” and the “Moderns”—adherents of classical versus contemporary literature⁴⁵—jostled for primacy. In those broils, as satirized by Swift, “. . . whole rivulets of ink have been exhausted and the virulence of both parties enormously augmented,” and the trophies for each combat were duly recorded in Valhalla as “disputes, arguments, rejoinders, briefs, considerations, answers, replies, remarks, reflections, objections, [and] confutations.” Only memorials were not noted.⁴⁶

The analogy with Swift is not unreasonable. The “Ancient” method of valuation was indeed book value—*faute de mieux*, quite literally, because no alternative method was widely known. However, the “Moderns” have emerged with discounted cash flow analysis. This newer method, which is conceptually preferable, has gained wide acceptance only since the 1950’s, when it became the standard analytical technique.

Distrust of the DCF methodology is understandable. “Fanciful” valuations, based upon DCF analyses, have jaundiced jurists’ perspectives, and such examples of “Cinderella valuations” have been encountered often enough in the literature. The principle is too flexible, and thus too fragile, in practice—the scullery maid too readily can be fobbed off as the princess. However, litmus tests are available for verifying the credibility of DCF valuations. First and foremost is the adjusted NBV — any difference must be proven: the adjusted book value is the best and quickest “reality check” on a DCF value in those instances of a going concern with an existing verifiable balance sheet. However, the “glass slipper” tests of rate of return compared with discount rate, and income before and after the taking will identify the real princess.

45 “Contemporary” refers to Swift’s own age, i.e. the turn of the eighteenth century. *See supra* note 3.

46 *See supra* note 3.

NOTE
SOUTHERN UTE INDIAN TRIBE v.
AMOCO PRODUCTION COMPANY:
JUDICIAL CONSTRUCTION OF COALBED
METHANE GAS OWNERSHIP

I. INTRODUCTION

In recent years, heightened interest in the commercial recovery of coalbed methane gas (CBM gas)¹ has been spurred by technological advances² and congressional incentives.³ Actual CBM gas production in the United States rose from 26 bcf in 1987 to 348 bcf in 1991⁴, and CBM gas currently accounts for six percent of all proven gas reserves.⁵ The United States has approximately 90 trillion cubic feet of recoverable CBM gas, the equivalent of five years of natural gas production.⁶ CBM gas generally contains over 80 percent methane, the

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- 1 CBM gas is a recognized by-product of the "coalification process." Jeff L. Lewin, Hema J. Siriwane, Samuel J. Ameri, and Syd S. Peng, *Unlocking the Fire: A Proposal for Judicial or Legislative Determination of the Ownership of Coalbed Methane*, 94 W.VA.L.REV. 563, 572 (1992). When plants incorporate carbon dioxide and water, hydrocarbon-based compounds are formed. These compounds decay to form peat which is buried under other sediments. Pressure and temperature eventually convert the peat to coal, methane, and other gaseous byproducts. See *Carbon County v. Baird*, 1992 WL 464786, *2 (Mont. Dist. 1993). See also Lee Davidson, *Oil and Gas Law: Ownership of Coalbed Methane Gas*, *Vines v. McKenzie*, 33 WASHBURN L.J. 911 (1994).
 - 2 Donald F. Santa, Jr. and Patricia J. Beneke, *Federal Natural Gas Policy and the Energy Policy Act of 1992*, 14 ENERGY L.J. 1, 44-45 (1993). The increase in commercial recovery interest is attributed to a "greater understanding of the geology and the technology necessary to produce CBM gas." *Id.* at 44. With a push toward developing alternative energy resources, the production of CBM gas has grown significantly in recent years. Interest in the development of CBM gas in the United States did not become substantial until the energy crisis of the 1970s. European nations, however, have used CBM gas as an energy source since the 1950s. Lewin, et al., *supra* note 1, at 566.
 - 3 Congress enacted a federal tax credit applicable to the production of CBM gas in the Internal Revenue Code. 26 U.S.C. § 29 (1996). Although CBM gas is not specifically addressed in the statute, CBM gas falls under the statutory definition as a gaseous product in the coal strata. Additional incentives for CBM production were included in the Energy Policy Act of 1992. Pub. L. No. 102-486, 106 Stat. 2776 (1992).
 - 4 Santa and Beneke, *supra* note 2, at 44-45.
 - 5 *Proved Oil and Gas Show Improvement*, 217 WORLD OIL 79 (1996). See generally Jeff L. Lewin, *Coalbed Methane: Recent Court Decisions Leave Ownership "Up in the Air," But New Federal and State Legislation Should Facilitate Production*, 96 W.VA. L. REV. 631, 632 (1994).
 - 6 Lewin, et al., *supra* note 1, at 574. See also Herbert T. Black, *Update on U.S. Coalbed Methane Production*, NATURAL GAS MONTHLY, Oct. 1990.

primary component in natural gas.⁷

7 Lewin, et al, *supra* note 1, at 572. Despite the characteristic similarities, natural gas and CBM gas are easily distinguishable because of their chemical make-up. For instance, CBM gas usually contains smaller quantities of ethane than does natural gas. Unlike natural gas, CBM gas contains no propane, butane, pentane, carbon monoxide or sulfur compounds. *Id.*