NCY COST OF CORPORATE CONTROL:

The Petroleum Industry

by

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A "q" type of measure is proposed to analyze questions of corporate control and the "agency cost of control." Tobin's q can be decomposed into the product of this control q and an investment q. A capitalized agency cost of control of approximately $ 200 billion is identified among 98 petroleum firms. Agency costs of this size do not result from perks, but from overretention and misspending discretionary cash flow. Higher firm value relative to market value of assets is found to coincide with larger bonded payout commitments of cash flow, with smaller asset size under one management's control, with larger management shareholdings, and with larger shareholdings by the largest block of outside shareholders. This also offers one explanation of large share premia in leveraged buyouts -- capital structure is changed in the direction of increasing bonded payouts and ownership becomes more concentrated, both leading to a reduction in agency cost.

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1. Introduction

How economic activity is organized to create value, to achieve appropriation of gains, or to protect against appropriation, has been a steadily growing question among economists ever since Coase (1937) suggested that the firm and its marketplace are not immutable parameters, but part of an underlying process worthy of study. The widespread transfers of control currently occurring in the petroleum industry (of which only a fraction are the widely publicized hostile takeovers) provide a laboratory for examining theories of control, agency, and the endogenous response of economic institutions. This study develops a formal "q" ratio to measure the value of corporate control and examines its variation across firms to test several theories of agency and of corporate organization.

The proposed measure, q_C, is the ratio of the financial market value of claims on the corporation to the open market value of the corporation's assets (as defined in section 2). Most assets have no intrinsic value and so require an organization to create economic value. Organizations are the intermediary between investors and the actual activity of turning knowledge and assets into economic value. Viewing the modern corporation as an intermediary leads to a definition of the market for corporate control: buyers are investors seeking wealth maximization; sellers are competing management teams or competing organizational methods of control; quantity is the continuous range of assets, divisions, or activities under the scope of an organization's control;[1] the price is the ratio qc -- the market price to investors of the existing organization's control. The degree of competition in the product market does not tell

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[1] This is a slightly more general economic definition of competition for economic control than that of Jensen and Ruback (1983, p. 6) which emphasizes the takeover market. Hostile action by shareholders comprise only one small part of the market for control.

one about the degree of competition in the market for control and vice versa. When the market for corporate control deviates from perfect competition *control agency costs* (further defined in section 2) arise and are borne by investors.

The ratio utilized here is related to other q ratios derived for studying investment behavior, tax effects on investment, and monopoly rents in microeconomics. The traditional q ratio (q_T after Tobin (1969)) can be expressed as the product of two q ratios -- a q-component for physical investment (q_I after Abel (1982)) and a q-component for the value of the existing organization's control (qc from section 2). q_I is investment and industry specific. q_C is firm specific. This distinction between the value of control and the value of investment clarifies some of the confusion found in the economics literature and in popular debate on merger and investment analysis.

The market valuation of managerial control developed here can be used to examine acquisition and divestiture of assets, control transfer in mergers, and synergy in combination of business lines. Because financial markets respond more quickly than organizational changes, this measure might also be used to attribute financial market values to alternative corporate strategies, thus making the technique useful as a management tool. This study uses the measure to examine theories of agency developed over the last ten years. Any excess of the market value of assets (adjusted for imbedded tax liabilities and other asset specific sunk costs) over market value of financial claims is a firm-specific agency cost of control borne by investors. This agency cost is permitted by the deviation of the market for corporate control from one with perfect competition and no transaction costs.

Rational expectations by investors about the free riding prospects in takeovers or about the prospects of internal change cloud the use of the control price (the q_C ratio) as a comparative measure of management and it's practices. To some extent contesters for corporate control must outdo both incumbent managements and market expectations of which firm is a good takeover target. However, it is shown that if takeovers or reorganizations have any cost at all, the observed *ranking* of q_C ratios will remain unaffected by rational expectations of takeovers and reorganizations.

Data was collected on 98 publicly traded petroleum companies. Approximately two hundred billion dollars (present value) of control agency costs are identified. The order of magnitude of the effect upon investors is the same as that from oil price shocks of the last decade or from price and allocation controls imposed by the federal government. Several explanations for the data are considered. Empirical tests show that this "undervaluation" is not undervaluation by financial markets but a systematic appraisal by the market of particular organizational characteristics. The evidence refutes some and confirms other agency theories of corporate control. The evidence overwhelmingly shows that the value of oil and gas reserves is dependent upon the organization which controls the assets and upon their management practices.

This paper is organized as follows. Section 2 develops the principles and meaning of measuring the value of corporate control and gives hypothetical examples. Section 3 applies this to the petroleum industry. The data are described and a variety of cross section tests are reported. Section 4 compares the results with existing theories of the firm and agency. Section 5 concludes and speculates on where future research might lead.

2. A Model of Agency Cost and The Value of Corporate Control

2.1 Notation and definitions

If M is the market value of financial claims on the firm and V is the opportunity cost (to the firm) of the assets under the control of the firm, then the important q ratio for the analysis of corporate control questions is

$$q_C = M/V \tag{1}$$

Equation (1) is a tautology which only illuminates the definitions of these variables. Rearranging terms refocuses attention on the following behavioral relationship:

$$M = q_C V \tag{2}$$

In equation (2), q_C represents the price of corporate (organizational) control. q_C is a function of the following: investors' perceptions, V, current management's ability, the existing charter or other legal control arrangements and incentive structures of the organization, expectations of changes in management behavior, the likelihood of control transfer (such as expectations of takeovers), and degree of competition in the market for control.

q_C is specific to the firm. It is not directly a function of characteristics of the underlying product market. Rents such as those from monopoly, scarcity, sunk cost investments, or disequilibrium (ex post surprises) are contained in V and therefore in M but should not directly affect q_C.

The determination of V is not specific to the firm. The value of assets under the firm's control is set by the product market and the market for control. It reflects the value that assets have as a result of *supply* -- the availability of assets for sale from new sources and by other organizations -- and by *demand* -- the willingness of other organizations to acquire or purchase assets. V also includes the capitalized value of profit opportunities which would *normally* be expected to flow from managing such assets (e.g. including the option value of expected future opportunities generated). V is just the market value of the firm's assets.

The more that an increase (or decrease) in control involves acquisition (or divestiture) of personnel, contractual obligations, future investment opportunities, legal liabilities, reputation, and organizational knowledge, the more accurate is the expression *business operation* or *division* than *asset*. It is almost impossible to imagine a transfer of control solely over some physical asset without associated transfer of some of these other features which contribute value or cost. For brevity, the term *assets* is

used here to refer to net tradable value -- both tangible and intangible -- of physical capital, ongoing operations, divisions, or entire business lines.

Depending upon the optimal use of the assets, V may include part of the organizational knowledge embodied in the human capital of employees.[2] However, only the human capital under corporate control has value reflected in V. For example, a production geologist who devotes his or her life to one oilfield has asset-specific knowledge with economic value which accrues to whoever owns the field. This serf-like component of human capital is reflected in V and through q_C in M. However, the same geologist may have built up general geologic knowledge over many years of working for the company which also has substantial economic value. This part of human capital is transferable to another owner of oil assets and so (to the extent labor markets are competitive) the employee must be paid his or her rental value for this part of human capital. Thus, components of human capital which are portable across organizations appear neither in V nor M.

A hypothetical snapshot of a city taxicab market presents the following information about the state of a highly competitive market. Used taxicabs accompanied by a required medallion sell for $50,000. Two of the many firms are observed. Each of these two firms has ten identical taxis and consequently an asset value, V, of $500,000. The financial market value of the first firm is $600,000 implying a q_C ratio of 1.2. The financial market value of claims on the second firm is $400,000 yielding a q_C ratio of .8. If the ratio q_C is a good approximation for the effect of V on M, then investor wealth would be increased if firm one expanded its scope of control and firm two reduced its scope of control over taxicab assets.

2.2 Equilibrium and pareto optimum in the market for control

The market for assets which sets V is not the same as the market for financial claims which sets M. A difference can arise from the intermediation of organizational

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[2] E.g. the "key employee" theory of firm value.

control. However, market forces do tend to push q_C toward one. With zero transaction costs in the market for control, q_C equals one in equilibrium and this equilibrium is a pareto optimal allocation of control.

If q_C exceeds 1.0 for a firm than one group of investors is doing better than the market norm in generating value from its investments. This "disequilibrium" sets three forces in motion. (1) Other investor groups will imitate to the extent that the financial or legal control devices responsible for this success are replicable. This raises their M and eventually V for that industry until q_C=1 for all firms in the industry. (2) Other investor groups attempt to hire away the controlling managers or nonreplicable feature of this firm by paying a premium. The attempt to bid away a key C.E.O. reduces M for the firm whether the individual is lost or the compensation is increased to prevent the loss. Thus, q_C is driven back toward one. (3) If q_C exceeding one means that $\partial M/\partial V > 1$ and $\partial^2 M/\partial V^2 < 0$ (decreasing economies of scope), then the expansion of scope of control by the organization (increasing V) will increase market value, M, but will drive q_C down toward one. This process will continue until $\partial M/\partial V = 1$.[3] If q_C is less than one for a firm, then forces which would push q_C back toward one arise. Reputational value,[4] monitoring by directors,[5] and direct financial incentives[6] drive managers to continually improve management practices so as to increase firm value. The management team (with $q_C<1$) is also faced with the possibility of being removed or altered by proxy voting,[7] merger, or takeover through a tender offer.[8]

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3 Section 2.4 expands this point.

4 See particularly Fama (1980) for how the labor market for managers -- through reputational information flowing up the management scale, down the management scale, and across firms -- will reduce agency cost.

5 For a discussion of the role of directors in policing agency cost see Fama and Jensen (1983a, 1985).

6 The interplay of direct financial incentives and agency cost is generally referred to as the principle-agent problem. Lewellen and Huntsman (1970) and Lewellen (1975) find that salary and bonuses of top management are generally tied to performance.

7 For a discussion of the role of proxy voting in reducing agency cost see Easterbrook and Fishchel (1983) and Manne (1964, 1967).

8 The first appearance of an article in the economics literature outlining how takeovers reduce agency appears to be Manne (1965). Manne also comments on mergers as a disciplining device: incumbent managers may be threatened (by takeover) or "bribed" into a merger.

Taxes, rigidities, and every other familiar form of market imperfection infects the market for control also. Brokerage costs and tax consequences may create a gap between the net purchase or acquisition price of assets and their net sales/liquidation price. Also, investors cannot costlessly organize to change the organization or controlling management group. The mechanisms of transferring control against management's will -- proxy fights, bankruptcy, takeover battles, and inducements to merge -- all involve considerable expense and gaming situations where efficient allocation of control may not prevail. Thus, observed q_C may differ from one in an equilibrium.

2.3 Agency cost of control

V-M is the control-related component of agency costs. In the absence of the existing agent of the organizational control, investors could obtain value V for the assets by transferring control to a new organization or by selling the assets. Market value, M, is what they are getting. V-M just reflects the capitalized cost of the existing organizational arrangement compared to investors' next best alternative for a specific set of assets. This is not the sum of agency costs described by Jensen and Meckling (1976). Instead, it reflects that component of agency costs which would be eliminated if the market for corporate control functioned frictionlessly.

The agency cost of control arise from interfirm variation in the following:

1) *Competence:* operating the firm with less ability than the market norm for hired agents in this line of business.

2) *Opportunism:* appropriation of potential investor value due to conscious or unconscious a) excessive compensation through salary, bonuses, stock options, retirement plans, etc., b) perks and other on-the-job consumption spending, and/or c) financial, capital budget, personnel, or other strategic decisions which do not maximize investor value; however, only that part beyond what investors consider "normal" or an efficient part of the compensation package -- i.e. only that part necessary to secure management services.[9]

3) *Communication:* lower investor value due to a lack of communication between management and financial markets as to exactly what determines the value of investments.

Hereafter, this paper will refer to V-M simply as agency costs, A. This definition differs slightly from that of economic theorists.[10] Here the relevant costs are defined not as the deviation from a hypothetical norm without agency relationships but as a deviation from an equilibrium where there is no pareto improvement possible given the existing body of knowledge about management and organizational design. To compare actual outcomes to one without any agency issue (investors making every decision) is to make a comparison to a world without specialized information, knowhow, or bounded rationality. This would compound analysis of agency with analysis of the value of expertise, knowhow, and other information.

Monitoring costs are not specifically mentioned for two reasons. First, monitoring is only one direction of communication between investors and management. Management must also regularly incorporate information from financial markets into internal decisions (e.g. computation of Beta). Second, investor monitoring costs are not firm-specific. An investor can passively invest or actively seek out information to improve the expected rate of return. The latter is done to obtain rents from any improvement in ability to select investments rather than for a direct increase in the worth of firms investigated (apart from takeovers).

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9 The use of "opportunism" in the context of agency cost originates with Williamson (1971) who uses this to refer to the pursuit of self interested behavior in conflict with legal duties, moral obligations, promises, or stated intentions.

10 See Jensen and Meckling (1976, p. 6) or Pratt and Zeckhauser (1985, pp. 2-3).

Incompetence (relative to the best alternatively available knowledge of how to manage assets) is an agency cost because investors would prefer managements to use the best available information and practices in running the firm or to hand over control to those who would.

Control agency costs focus upon the cost to investors not the net cost to society. Thus, paying an excessive compensation is a firm-specific agency cost borne by investors, but it may not be a net cost to society if it simply functions as an appropriation of gains (transfer) to managers. Similarly, q_C is a measure of how well the existing organization performs for investors. It is not an objective rating of management capability. Two firms with identical q_C ratios may have management teams with very different capabilities if the superior management team appropriates more of their effort's value.

There is considerable misconception about what limits agency costs. Competition in the product market does not eliminate control agency costs, unavoidable agency costs, excessive agency costs, or any other costs of poor management. Even a steady state perfectly competitive equilibrium with no uncertainty imposes only an upper limit to the firm-specific or abnormal agency cost that management can impose on investors. This amount consists of the value of the quasi rents[11] on the initial investment of stockholders and (if management risks insolvency) the value of the quasi rents from the initial investment of debtholders. Hence, this steady state perfect competition only limits (capitalized) agency cost to the market value of the firm's assets -- or at least the market value of stockholder's equity in this. Actual firms can have potential value derived from not only the quasi rents from the original investment, but also disequilibrium rents, monopoly rents, and any other economic rents beyond expected return on original investment. Because of the selection bias of survivorship, the typical firm should have value in excess of the

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11 "Quasi rents" was coined by Klein, Crawford, and Alchian (1978) to refer to the income flowing from investment which is now sunk cost. They are "quasi" because the investment would not have been made without them. They are "rents" because once the costs are sunk, this income is no different from other economic rents. Demsetz (1982) has gone so far as to argue that all economic rents (in particular monopoly rents from natural monopoly) really have this "quasi" feature. Financial economists' concept of "financial slack" is a closely related idea. The existence of quasi rents (or some other source of economic rents) is a necessary condition for there to be financial slack.

quasi rents deriving from the original contributions to the firm. This amount is the maximum amount that firm-specific agency costs can appropriate. Thus, the product market only constrains q_C to be nonnegative. Observation of any positive market value of the company (or stockholder equity in excess of commitments) at all means that the product market is not *the* binding constraint to control agency costs.

Generally, payments to debtholders are not indefinitely deferred and refusal to meet such payments results in bankruptcy which can dislodge current management control. Thus, the capitalized value of these payments may be off limits to appropriation by managers if one considers only steady state examples. Similarly, payments to equity holders may not be delayed forever. Dividends may be viewed as an obligation to equity holders. If so, then the capitalized value of dividends may also be a limit to the control agency cost. This possibility is examined in section III.

Both the product market and capital structure set an upper limit to opportunism and poor management. Other mechanisms of investor control such as proxy contests, takeovers, bankruptcy negotiations, and financial incentives for top management also influence how close the investor value of the company comes to its potential value. One possible expression of the upper limit to control agency costs is

$$V - M \leq \text{MIN}\left(C_{HT}, C_{PF}, V_{DEBT} + V_{COM}\right) \tag{3}$$

where C_{HT} refers to the cost of a hostile takeover (including free rider gains to other investors), C_{PF} refers to the costs of waging a proxy fight to gain control (including free rider effects) , $V_{DEBT} + V_{COM}$ refers to the present value of commitments, the abrogation of which would result in a shift of control from the current management team. The consequent limitation to q_C is

$$q_C \geq 1 - \frac{\text{MIN}\left(C_{HT}, C_{PF}, V_{DEBT} + V_{COM}\right)}{V} \tag{4}$$

Section 3.2 describes tests for the relationships described by equations (3) and (4).

2.4 Untangling value of investment and value of control

Considerable confusion exists between the financial market value of investment and the financial market value of control in both the economics literature and common parlance. The "prospecting for oil on wall street" utilizing a comparison of financial market value of reserves with the replacement cost of new reserves is frequently made in the trade press as well as by courts.[12] However, this obscures the crucial distinction between control and investment just as does the q ratio literature in economics.

Tobin (1969) first postulated a measure of investment value in the ratio of market value to the replacement cost, RC, of capital stock:

$$q_T = M/RC = M/P_kK \quad (5)$$

12 For example, the large damages in the Texaco-Pennzoil case resulted from a confusion over financial value, market value of assets, and replacement cost through investment.

where K refers to units of capital and P_k refers to the price or marginal replacement cost per unit. This has been modified and used in a variety of forms.[13] Abel (1982) linked several investment theories through a variable which is the ratio of the price of existing capital which is currently in place, S (a shadow price if there is no market), to the marginal cost, P_k, of replacing it. This yields an investment q:

$$q_I = S/P_k$$

S and P_k can differ due to adjustment lags and ex post realizations differing from ex ante planning.

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[13] Ciccolo (1975), von Furstenberg (1977), and Tobin and Brainard (1977) made empirical attempts to link investment decisions to q and discussed whether average q was a good proxy for marginal q (the "true" determinant of the investment decision). Summers (1981) and Abel (1982) used q based investment models to investigate changes in tax policy on investment decisions.

Peltzman (1968) uses the ratio of market to book value of equity (M/B) to examine the economic rents across states caused by the existence, elimination, or initiation of state banking regulation. Peltzman finds that states with restrictive regulations had higher values of this ratio and that states which eased entry regulations during 1962-65 experienced a lower ratio -- thus supporting the capture theory of regulation. Stigler (1964) used this same ratio to find a correlation with concentration for 17 industries in the 1953-57 period. Ornstein (1972) uses the same ratio but also examines the relationship with concentration as well as a measure of scale economies (percentage of industry value of shipments accounted for by the average size plant of the largest 50% of plants). Schwert (1981), however, criticizes the use of this ratio because the relationship of accounting book values to economic value varies tremendously across industries due to differing accounting practices such as treatment of advertising, research, development, and even basic investment reporting (e.g. oil). Thomadakis (1977) uses a related financial ratio: the difference between market and book values of equity divided by annual sales. Using 1965-68 cross section data, he finds this measure related to both concentration and market share. This ratio has the same problems as that used by Peltzman, Stigler, and Ornstein. Schwert (1981) also casts doubt on the statistical significance of Thomadakis' results because of the instability of regression coefficients.

Tobin's version of the q ratio has also been used to investigate microeconomic questions. Lindenberg and Ross (1981), Smirlock et al (1984), and Salinger (1984) use q ratios to address traditional questions in industrial organization. Lindenberg and Ross examine whether there are any monopoly rents in the economy and develop a function of q which is an upper bound for the Lerner index of market power. Smirlock et al (1984) examine concentration and firm size and find that dominant firms make more money because of superior efficiencies rather than shared market power (Ornstein's conclusion). Salinger examines the effect of concentration and unionization on inter-industry q's to show that the larger profits of entry barriers and concentration are largely appropriated by unionization in these sectors. All three studies contain good discussions of the advantages of using financial data in the form of q ratio rather than accounting data to address important microeconomic issues. For a general literature review and discussion of the use of financial market valuation data in microeconomic studies see Schwert (1981). Further perils of comparing accounting rates of return to some other financial rate of return are chronicled in Fisher and McGowan (1983). Lindenberg and Ross also contain a detailed discussion of a variety of ad hoc simplifications needed to construct traditional q ratios from Compustat data -- a procedure exactly followed by Smirlock et al.

Another derivation of an investment q is to note that the marginal value of capital is just it's marginal revenue product:

$$V = V(K)$$
$$V' = \partial V/\partial K = S = P_f MP_k$$

where

P_f is the price of the final product,
MP_k is the marginal product of capital, and
$P_f MP_k$ is the marginal revenue product.

A long run equilibrium characterized by ex post realizations agreeing with ex ante investment planning would bring $S=P_k$. Under this formulation, the current market value of the firm's assets is just $V=SK$. Investment spending which replaces these assets has a replacement cost of $RC=P_kK$. An investment q is

$$q_I = V/RC = V/P_kK = S/P_k \qquad (6)$$

which is the same formulation used by Abel (1982). Thus, q_I can be viewed as a ratio which abstracts from the intermediation of a particular organization's control. It simply compares present value of investment and present value of its cost at the margin.

The traditional q_T measure for a firm compounds the measure of control and the measure of investment. Equations (1), (5), and (6) yield

$$q_T = q_C q_I \qquad (7a)$$

This relationship also exists for a marginal formulation of q:

$$q_T' = \partial M/\partial(PK)$$
$$q_C' = \partial M/\partial V$$
$$q_T' = q_C' q_I \qquad (7b)$$

If there are diseconomies (economies) of scope, then $q_C' < q_C$ ($q_C' > q_C$). q_C may be a useful proxy for q_C' although the actual relationship is an empirical matter. Cross section data examined in section 3 does indicate some diseconomies of scope ($q_C' < q_C$).

q_C' is the price of managerial scope in the sense of Coase (1937). q_C' tells whether the firm should expand or reduce its scope of control. q_i tells whether more or less physical investment should be made in that industry. q_I is the same for any firm (or possible entrant) in the industry. It can be less than one or can exceed one due to disequilibrium, adjustment lags, or some other constraint on replication of assets. Only in equilibrium with free entry and exit of production factors would q_I be one.[14]

There are two entirely separate questions for any one firm to address in its investment policies: 1) should the firm expand or contract its scope of control? (is $q_C'>1$?) and 2) Is it economic to make additional physical investments? (is $q_I>1$?). The sharp distinction between these questions can be seen when they yield different answers. Conceivably, the answer to the first question could be no and the second yes. If $q_C' < 1$ and $q_I > 1$ the firm could increase investor value by making investments and simultaneously selling or spinning them off to others. Conversely, if $q_C' > 1$ and $q_I < 1$, a firm could increase investor value by expanding its scope of control through acquiring the assets of other firms rather than by new investment. The difference between these two questions also explains why firms enter depressed industries with limited investment potential. In the entrant's view, his q_C' for that industry will exceed one and he will outperform incumbent firms. If $q_I < 1$, then he would choose to enter by acquiring existing assets.

The earlier taxicab example illustrates this distinction. If the source of new taxis is revealed to be the city selling medallions at \$35,000 and cars selling for \$20,000 (identical with those currently used) then replacement cost is \$55,000 compared to a current value of \$50,000 and so $q_I = .91$. Efficient investment in this

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[14] This is actually a result of treating P as net of the tax effects of the purchases. Abel (1982) and Auerbach (1979a) actually use a denominator which is the sales price of new assets. If P were the sales price, then an equilibrium could result in $q_I<1$.

market dictates that no "new" taxis be purchased at this time. q_T for firm one ($600,000/$550,000) is 1.09 and so gives a misleading indication of whether new investment is warranted. Firm one should expand (q_C is 1.2) but do so by acquiring assets from other firms which are willing to sell at $50,000 each.

2.5 Rational expectations of takeovers and organizational change

Although q_C is a measure of the value of corporate control, it is not an exact measure of differences in value from differences in corporate strategies or some other aspect of control. In general, q_C underestimates intraindustry variation arising from organizational differences, because of the probability that management practices or the organization itself will be changed. In the earlier taxicab example firm two may be following a strategy which has a present value of only $300,000 -- if that were the only strategy ever pursued. Its market value of $400,000 would reflect the expectation by investors that there is a possibility that either the management or their strategy will change. Only if it was expected to change momentarily would the value of the company reflect the underlying $500,00 of assets rather than the $300,000 value of the strategy and practices currently pursued by the existing organization.

If M* reflects the present value of the existing organization absent any prospect of change, then the current financial market value of the organization is as follows:

$$M = DV + (1-D)M^* \tag{8}$$

$$q_C = D + (1-D)q_C^* \tag{9}$$

where

$$D = \int_{t=0}^{\infty} P_t e^{-rt} dt \qquad q_C^* = M^*/V$$

D reflects the discounted probability of takeover or organizational change. Thus, the observed market value, M, and the observed q_C are weighted averages. The higher is the probability of change, the closer is q_C to one. D is itself endogenous to the takeover process. In a takeover market with zero transactions costs, one undiscounted time period, and 100% probability of takeover whenever profitable, P_0 and D would be either zero or one. These extreme assumptions thus elicit the Grossman and Hart (1980) model.

Rational expectations of takeovers yield a limit on agency cost and hence a limit upon q_C. The gain to a contester for control over the assets of a firm is

$$G = a(V-M) - C = a(1-D)(V-M^*) - C \qquad (10)$$

where C represents the cost of the takeover effort. C consists of fees, legal expenses, and lost profits from diverted management attention. a represents the fraction of ultimate gain obtained before the takeover is fully anticipated by the market. The free ride on takeover profits by passive investors means that a is less than one. The Williams Act amendments require announcement of holdings and intentions within ten days of accumulating a five percent stake. During the ten day interval before announcement, more may be purchased before the market realizes a takeover is imminent. Thus a exceeds five percent.[15] If a firm adjusts its policies so as not to be a profitable target, then

$$G \leq 0$$

$$V - M^* \leq \frac{C}{a(1-D)}$$

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[15] Casual empiricism indicates that this is about 10% for publicly traded companies, although this will depend upon the ability and the reputation of the raider, the pattern of stockholdings, the pattern of normal trading, and other factors beyond the scope of simple economic analysis.

$$q_C \geq \frac{a}{a+c} \tag{11}$$

where

$$c = C/M$$

For example, if a is 10% and a takeover would expend real costs equal to 5% of the market value of the target firm, then the takeover market imposes discipline on the firm which requires that q_C be at least .67. A management in this situation could appropriate one third of the potential value of the firm (e.g. through incompetence, bonuses, pet projects, etc.) without suffering takeover discipline.

2.6 Measuring Competition in the Market for Corporate Control

The extent of competition in the product market is not the extent of competition over control for producing that product. Competition in the market for control is competition for control over the *unique* assets and personnel of a particular firm. Apart from warring factions on a corporate board, any one management is a monopolist intermediary for its shareholder's investment. Thus, the extent of competition is the extent of contestability for corporate control.[16] Since the concentration ratio is 100%, another measure of competition must be found. q_C provides this measure.

With absolutely no competition in the market for corporate control, the existing organization is an unthreatened monopolist in control of the shareholder's investments. The organization need not allow any benefits to flow to investors, so that q_C is zero. Although examples might be found,[17] it is more likely in a modern corporation that repudiation of debt, dividends, lease commitments and all other investor claims would quickly bring threatening entrants into the control of the firm. Thus, as described in equation (4), the legal and financial organizational arrangements all influence the

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16 This is the same use of "contestability" as that by Baumol (1982).

17 An example might be a single party government controlling an economic enterprise. Expenditures rise to fill whatever financial slack is ever available.

degree of competition in the market for control of a firm's assets. With perfect competition in the market for corporate control, financial market value of investor claims, M, cannot remain below asset value, V, so that q_C is 1.0.

The perspective of traditional industrial organization also shows that q_C is an indicator of the extent of competition in the market for control. In product markets, market power is manifested in price exceeding marginal cost. A well known measure of this is the Lerner index:

$$L = \frac{P - MC}{P}$$

In perfect competition this measure is zero. In a perfect monopoly, $L = 1/E$ where E is the elasticity of market demand. Thus, the actual value of L will range between zero and $1/E$ depending upon the extent of competition in the market.

In the market for corporate control, the product is management control per dollar of assets. Thus, the marginal cost is one dollar, the price that one dollar of assets can be bought and sold for. If investors pay a price for management control in excess of the competitive price, then M<V and V-M is an indication of what they are paying. (V-M)/V is this amount per dollar of assets. Thus, the Lerner index in the market for corporate control is

$$L = \frac{(V-M)/V - 1}{(M-V)/V} = 1 - q_C \qquad (12)$$

In perfect competition for management services, this is zero. With the industry being a small part of the capital market, the rate of return of other investments will be unaffected (to a first approximation) by the return on investment in this industry. This implies that the elasticity of market demand for investment in this industry is infinite. Thus, in a monopoly with absolutely no competition in the market for control, the value of L is 1.0. In this latter case, the management effectively appropriates the full value, V. Thus, the actual value of L will range between zero and one depending upon the extent of competition.

Section 2.3 argued that V-M is a measure of control agency cost. Per dollar of assets, this measure is $1-q_C$. Equation (12) shows that the measure of this agency cost per asset dollar is the same as the Lerner index of competition in the market for control of that particular organization. Thus, an alternative definition of control agency cost is the cost (incidence) to investors of deviation from the perfectly competitive outcome in the market for corporate control.

3. Agency Cost in the Petroleum Industry

3.1 Measuring q_C and agency cost

Cross section data was obtained on 98 companies with significant petroleum reserves in order to measure q_C and hence assess the extent of agency cost in the petroleum industry. The petroleum industry makes a good test for several reasons. Restructuring and hostile takeovers are currently changing the organization of the industry. A variety of capital structures and organizational forms are coexistent in the data. Also, management resistance to restructuring is one indication that agency cost may be present and may not be quickly eliminated -- thus permitting their measurement and analysis. A second reason for examining petroleum companies is that their assets consist primarily of reserves in the ground. Even supposedly "diversified" energy companies such as Exxon and Mobil each have 87% of the market value of their assets in the form of oil and gas in the ground. The S.E.C. requires extensive disclosure of financial and physical information about these reserves which permits computation of their value.

The market value of the firm's financial claims, M, consists of common and preferred equity, executive stock options, warrants, royalty trusts, master limited partnership shares, and debt (including lease obligations). Non-petroleum assets were evaluated at markups or (more commonly) markdowns from original cost depending upon the condition of that particular asset market. The value of petroleum assets was derived by valuing current reserves with a contingent claims valuation model where there is a future option to start up or shut down. This model uses the term structure of crude oil futures prices and their volatility. One advantage of this method is that

it is driven by market values of traded claims, rather than the forecast of an appraiser.

Company data is that audited for December 31, 1984. Values of financial claims are closing prices from December 31, 1984. With some bond data, the average of the last trade in 1984 and the first trade in 1985 was used. Appendix A describes the source of the data and the computation of M and V in more detail.

Table 1 describes the overall data on capital structure for the industry as a whole. All valuation data is specific to a particular day (12/31/84). Over time, all of these magnitudes will vary, perhaps significantly. An investigation of the dynamics of increase or decrease in agency cost must be left to a later study. The debt to total capitalization (at market value) is 32.5% for the industry as a whole. These 98 firms control $485 billion of assets, but have a market value of all financial claims of only $294 billion. Thus, the agency costs of control total $191 billion. Excluding the estimate of firms for which M>V, agency costs of control would total $203 billion. Thus, the market is valuing these firms at a 39% discount (q_C=.61) from the market value of assets. This discrepancy is due to imperfections in the market for control of assets and is large enough to account for the large share price premiums offered in hostile tender offers.

These results can be compared to others based upon alternative estimates of the value of reserves held by companies. Table 2A shows the comparison. Bernard Picchi of Salomon Brothers examined 12 large petroleum companies.[18] All 12 are in this study's sample of 98 companies. John S. Herold Inc. analyzes petroleum companies on a rolling basis. Asset value appraisals using year end data for 1984 include 31 companies in this study's sample of 98 companies. All twelve of the firms examined by Picchi are in the Herold sample. The SEC standardized measure and the Hotelling Valuation Principle estimate are available for any publicly traded company.

The SEC standardized measure requires firms to forecast all costs of extraction, taxes, and revenues (assuming constant prices), and field decline and to discount the

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[18] See Picchi (1985).

estimate at a 10% discount rate. Most traders of reserves believe that this number is generally too low. Annual reports of companies usually accompany these estimates with warnings that this number is an underestimate of asset value.[19] The estimate of Salomon Brothers is based upon a modification of the SEC data, the most important being a substantial reduction in the future tax liability for some firms below the statutory rate reflecting the prospective use of tax shields. The John S. Herold estimates appear to be higher primarily because of the higher long run price of oil forecast and because of the value placed on unexplored leases. The Hotelling Valuation Principle is the net price received on current production times the quantity of reserves.[20] This will overestimate the value of reserves because this rental component of the price includes quasi rents from the investment/exploration phase (oil reserves cannot be instantaneously produced), disequilibrium rents from surprises in higher oil prices, as well as the scarcity rents. Thus, this figure overestimates scarcity rents and overestimates the extent of expected increase in oil prices. Consequently, this measure provides the largest estimate of the agency cost of control for all three groups of firms. All estimates show that the agency costs of corporate control are a substantial dollar magnitude and that as a group petroleum firms sell at a substantial discount from the market value of their assets.

A further comparison of alternative valuation methods is contained in Table 2B. The simple correlation coefficients between asset values from alternative techniques and that used in this paper are all over .90 and only one is less than .95.

Two sources of bias which may occur in the data are semi-private information about unreported liabilities and semiprivate information about unreported but valuable assets. The former (latter) tends to yield an estimate of q_C which is too low (high) and an estimate of agency costs which is too high (low). Conversations with analysts and corporate raiders suggests that there is no unreported -- but known to the

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19 Typical is Pennzoil's 1984 annual report (p. 54): "The Company cautions that this standardized measure is not a measure of fair market value, and that the standardized measure presented for the Company's proved oil and gas reserves is not representative of their value. The standardized measure is intended to assist financial statement users in making comparisons between companies. The company believes that the fair market value of its proved oil and gas reserves is substantially in excess of such standardized measure.

20 This value can be exactly computed from SEC-required disclosures, although the required number often overestimates tax liability by using statutory rates and neglecting possibilities for using more tax shields.

market -- liability which explains the estimated large discount on the market value of firms. The takeover battles of Gulf, Phillips, and Unocal did not unearth significant liabilities. However, some of these takeover battles and negotiations did unearth several billion dollars of assets unknown to outsiders.[21] Thus, it seems more likely that estimated q_C might be too high rather than too low if there are biases in the data.

Table 3 describes the sample data in this study in more detail. Because of the high concentration of assets, the largest firms account for most of the agency costs of control in this industry. However, they also account for a disproportionate share of the agency cost of control. The average q_C for the top ten firms is only .58, the lowest of any cohort of ten firms. The smallest firms in the sample have a financial market value of their claims which is very close to the market value of the assets owned by the firms. The smallest half of the firms only accounts for one half of one percent of all of the agency costs identified here, while the largest ten firms alone account for approximately 82% of the agency costs of control identified here.

3.2 An empirical test of interfirm variation in q_C and agency cost

Explanatory models for both agency cost and for q_C were estimated. The basic functional form is as follow:

$$q_{Ci} = q_C(\mathrm{DEBTV}_i, \mathrm{RTPTV}_i, \mathrm{PFDV}_i, \mathrm{DIVV}_i, \mathrm{REPURV}_i, \mathrm{OWNSHMAN}_i, \mathrm{OWNSHOUT}_i) + e_i \quad (13)$$

$$A_i = A(\mathrm{DEBT}_i, \mathrm{RTPT}_i, \mathrm{PFD}_i, \mathrm{DIV}_i, \mathrm{REPUR}_i, \mathrm{OWNMAN}_i, \mathrm{OWNOUT}_i, V_i) + e_i \quad (14)$$

where the variables are as described in table 4.

If overretention of cash flow is the nature of the agency problem in this industry, then (following the discussion on section 2.3) higher levels of debt, royalty trusts, partnership claims, dividends, and stock repurchases should be associated with

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[21] Conversations with the staff of Mesa Petroleum.

lower agency cost and higher firm value for any given level of assets. If the problem is genuinely a result of a conflict of interest between management and shareholders then bonded payouts -- interest, trust or partnership dividends, and preferred dividends -- will be the most significant factors in reducing agency cost. The failure to make any one of these payments out of available incoming cash flow opens additional legal doors for alternative parties to enter into competition for control of the firm's assets.

If the phenomena described in section 3.1 is not due to a conflict of interest than the coefficients of each of the payout devices should be zero. Maximization of value by management should make the coefficient of any variable under management control equal to zero in a cross section observation. Any deviation should be of a magnitude explainable by adjustment cost.

Ownership patterns may also influence agency cost. Jensen and Meckling (1976) asserted that the market value of the firm is higher, the higher is the ownership share of existing management. In general, the agency literature has repeatedly emphasized that agency costs are lower the closer are the "agent's" (here management's) interests to those of the "principle" (here the shareholder/investors). Also, Stulz (1985) has hypothesized a nonlinear relationship between management ownership share and firm value resulting from the relationship between management share and the difficulty of a takeover.

Alternatively, the null hypothesis of no managerial shareholder divergence would imply that management contracts can be written such that there is little additional additional reduction in agency cost if management owns more of the firm.

A large block of outside ownership may also affect agency cost in several ways. A large single share of independent ownership internalizes the policing or monitoring costs of existing management. A large block of stock in the hands of an outsider also reduces the transaction costs of any decision over changing control. This latter factor may also mean that agency cost will never rise very high before there is a change in control. If so, then this prospect of a switch in management or potential pressure on

management would be reflected in lower capitalized agency cost at any one point in time.

Here again, the null hypothesis of an efficient market for control implies that ownership patterns and any other features linked to the market for control should not have a significant effect on the market value of a firm.

Table 5 presents the results of the estimation. Among these firms, increases in debt obligations, royalty trusts or partnership claims, preferred stock, or common dividends are each associated with lower agency cost and increased market value per dollar of asset owned and the relationship is statistically significant in each specification. This is clear support for the hypothesis of overretention of cash flow in this industry.

The economic magnitude of the coefficients is also significant. Regression 1 says that higher debt level per dollar of asset base means on average firm value as a fraction of the asset base increases by 71%. In other words, across these firms a one dollar debt increase increases firm value by 71 cents holding assets and other elements of ownership and capital structure constant. Alternatively (regression 2), an increase in debt (holding assets constant) reduces equity by only 29.1% rather than a full 100% offset (the null hypothesis).[22] Regression 3 says that increases in interest obligations increase the total value of the firm by 4.5 times the increase in interest payments. Regression 4 says that agency cost (market value of the firm) is reduced by (increased by) 54% of the increase in debt.[23]

Higher common dividends also appear to be significantly related to higher market value of the firm across this industry. Holding assets and other factors constant, an increase in the announced dividend rate of one dollar per year is associated with a five (from regression 1) to ten (from regression 5) dollar increase in

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[22] The alert reader will note that the similarity of regression 1 and 2 is not an accident. Subtracting one of the right hand side variables from the left hand side variable is a nonsingular transformation of the data and so will not affect the results.

[23] Again, regressions 6 and 7 are nonsingular transformations of the data matrix in regression 6 and so will have the same numeric estimates.

the market value of the firm. Again, increased payout to investors per unit of corporate assets is associated with lower agency cost (higher firm value).

Higher value due to shifts into royalty trusts or preferred stock are even more extreme in the sample. For example, from regression 4, a one dollar increase in royalty trusts or partnership claims in the capital structure would appear to raise overall market value of the firm by $1.92! This coefficient in particular points out the difference between *embedded* advantages of capital structure which fall out of a cross section test and the *potential* advantages of a capital structure change for any one company. A change in the capital structure which carved out significant royalty trust interests or partnership interests would have dramatically increased firm value for almost any petroleum firm doing this prior to mid 1984.[24] Tax law changes at that time dramatically increased the tax burden associated with this reorganization. Royalty trusts and master limited partnerships set up before this time would still be associated with higher firm value within any sample of firms due to embedded tax advantage. However, the significance of the coefficient would be an incorrect indicator of the value to any one firm of making a change. In general whenever a reorganization is costly (relative to the magnitude of potential agency cost) the estimated coefficient will not accurately reflect the marginal value of restructuring for a particular firm.

Unlike other forms of cash flow payout, the coefficient of equity repurchase is statistically insignificant. One explanation is that only bonded forms of payout of the cash flow are valued by investors.[25] There is no natural constraint which will constrain managers from reducing this form of payout to fund some favored project. Reducing future repurchases does not open the door for any threat to the control of existing management. Therefore current (or just completed) levels of share repurchases do not reflect any factor which would be capitalized into the current market value of the firm.

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[24] See Jacobs and Limberg (1985) for a detailed discussion of this effect and the impact on the tax cost of reorganizing petroleum companies.

[25] Although this begs the traditional question of why common dividends are viewed by investors as a bonded commitment.

There are also more mundane explanations for the result of this coefficient. REPUR is the dollar magnitude of shares repurchased during 1984 -- the only explanatory variable constructed from historical data. It is the only variable not directly linked to the future condition of the firm. It is not a promised or even an announced level of future repurchases. In part this is a problem with any variable which describes share repurchases -- there is no bonded financial claim of stock repurchase. Use of recent share repurchases is only a proxy for expected future share repurchases. Share repurchases may indeed be valuable and future share repurchases may be reflected in share prices but this is only partially correlated with recent share repurchase rates. In other words, there may be an "errors in variables" problem which would likely bias this coefficient toward zero.

Another explanation for the insignificant coefficient of share repurchase arises from the dual nature of stock repurchases. Share repurchases are a way of channeling cash flow back to investors. Targeted share repurchase can also be a way of forestalling a hostile transfer of control (greenmail). The latter may be associated with firms with high agency cost (low q_C ratios) while the former may be associated with effective management and low agency cost (a higher q_C ratio). Equity repurchase may be an important feature of a management's behavior, but may show up in a cross section test with a net wash between these two effects. Some support for this is seen in regression 5 which breaks out the largest share repurchase: Texaco's $1.28 billion targeted repurchase from the Bass brothers. When the effect of this one datapoint is removed through a dummy variable, statistics on the other coefficients remain approximately the same, while the coefficient of equity repurchase switches sign in the direction of showing that share repurchases increase firm value and reduce agency cost, although it is still statistically insignificant. From the data collected it is impossible to ascertain which of the other 29 companies repurchasing shares did so to remove key shareholders and which did so as part of a systematic repurchase program. The announcement of new systematic share repurchase programs by several major petroleum companies during 1985 should provide additional data for researchers to answer this question.

The size of the company also appears to be positively related to the level of agency cost discount. Regression 3 shows a negative relationship between firm size

and q_C. Regression 4 shows that across these firms, each dollar of increase in asset size of the company is associated with a 71 cent increase in control agency cost (or alternatively, a 71 cent decrease in market value of the firm). This indicates that the marginal agency cost of aquiring more assets exceeds the average discount of 39% (from Table 1).

The corporation's ownership pattern is also associated with control agency cost. Increased ownership by management and increased ownership by the largest outside block of stock are both statistically significantly associated with higher firm value for any level of assets. Regression 4 points up that the dollar magnitude of this effect is economically significant. For a dollar extra of common stock ownership in the hands of either management or the largest outsider, the total market value of the company is slightly over 50 cents higher.

The positive effect of concentrated ownership points to an additional source of size diseconomy because managements of larger firms hold a smaller share of equity. Management owns \$7.66 billion or 4.1% of common equity. This contrasts with the simple numeric average of 7.1% managerial shareholdings across the sample. Interestingly, the pattern of largest-block outsider shareholdings shows no such difference. The largest outside blocks control 14.4% (\$22.8 billion) of all equity. A simple average of largest block percentage holdings across all 98 companies is also 14.4%.

3.3 The link with investment behavior

Other evidence indicating that one source of agency cost in the petroleum industry is overretention of discretionary cash flow by management comes from data on investment behavior of the industry. McConnell and Muscarella (1985) investigated the response of equity prices to announced changes in the investment behavior of firms though the event study methodology. Announcements of increases in capital budgets for exploration and development in petroleum were associated with decreases in share prices while announcements of capital budget decreases where associated with increases in share price. The petroleum industry was the only significant exception to

a pattern of announced capital budget changes positively correlated with abnormal changes in share prices.

Reserve discovery data also provides another source of supporting evidence. Table 6 shows computations of q_I taken directly from SEC reserve disclosure data as compiled by Arthur Andersen & Co. in the 1980-1984 survey of 400 Publicly owned petroleum companies. For each entry in the table, the denominator is the total finding costs for new reserves -- exploration and development spending for that year. The numerator is the present value of discovered reserves, as required in SEC calculations.[26] According to this data, value added in the 1980's in this industry has averaged about 62% of capital spending.

IV. Empirical Results and Theories of Agency, Control, and the Corporation

The evidence here supports a general view of the agency problem in the petroleum industry. The median firm is overretaining cash flow and is maintaining an asset size far in excess of what is valued by investors. The overretention of cash flow may be used for too many perks and too much salary. However, this will not begin to account for the level of funds involved (capitalized value of $200 billion). Acquisition of firms outside the oil industry has been relatively modest as a percent of cash flow.[27] The principal use of these funds has been reinvestment in traditional lines of business. Either the overall level is excessive, or the nature of the investments is inappropriate. As a result, investors are discounting the value of these companies by at least one third. This interpretation is also developed by Jensen (1986). He suggests that the the origins of large agency costs arise over the disposition of large quasi-rents or free cash flow and emphasizes the role that debt can play in compelling organizational changes.

Reinvestment in traditional lines of business does three things for existing managers. It maintains or enlarges the size of the company. This is directly related to the level of salary and perks which appear acceptable. The size of the company is also

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[26] See appendix A for more discussion of this valuation.

[27] See Jacobs and Limberg (1985) for a review of these mergers.

associated with the social prestige of top management. Second, by reinvesting in traditional lines of business, top management preserves the value of their professional human capital which has been built up over many years. Investing in newer areas would require inclusion of unknown experts in the top decision-making. These individuals are outside the "good old boy network," and might threaten the role of existing management by increasing competition in the market for control. Third, middle level managers also benefit from reinvestment in traditional lines of business. The internal incentive systems derived over years of trial and error are set up to sift promotion as junior executives "cut their teeth on new projects." The changed economics of the industry threaten these internal organizational structures.

The importance of the shareholding pattern for firm value is also demonstrated here. The prediction of Jensen and Meckling (1976) that increased managerial shareholding raises firm value is borne out. Their theory posits that this relation holds because alignment of managerial interests and shareholder value induces management to improve the value of the firm. However, the data does not distinguish between this proposition and the possibility that large shareholdings by management simply reduce the prospect of resistance to takeover and thus leave an anticipated takeover premium in the share price. The effect of larger manager shareholdings reducing takeover resistance is documented by Walkling and Long (1984).

One wrinkle not anticipated by Jensen and Meckling (1976) or Stulz (1985) is that the largest block of outside shareholding is just as important (has a similar marginal effect) in reducing agency costs. This supports the hypothesis that large shareholders can serve a policing function over management -- or that control transfer costs will be lower.

Some support was found for Baumol's (1967) theory that firms seek to maximize their size at the expense of shareholders. However, the role that the financial slack of quasi and economic rents play was not anticipated by Baumol. Giving the shareholders the minimum acceptable rate of return would only imply that firms are at $q_C = 1$. Firms actually go further and give their shareholders the minimum acceptable return or value which is just enough to prevent takeover or other job threat.

Easterbrook (1984) closely anticipates some of these empirical results. Dividends are seen as keeping firms going into the capital markets to raise money:

> "Managers who need to raise money consistently are more likely to act in investors' interests than managers who are immune from this kind of scrutiny...The principal value of keeping firms constantly in the market for capital is that the contributors of capital are very good monitors of firms." (p. 654)

Although accurate in seeing the role of dividends in reducing agency cost, he did not combine this with a view of the similar role played by debt. Grossman and Hart (1982) do recognize that this role is played by debt but they do not model dividends as a substitute for debt in this bonding capacity. Their model also gives an ambiguous prediction about whether higher bonded payouts would be observed cross sectionally as positively related to higher firm value. Additionally, neither of these arguments adequately explains why dividends or debt obligations can't be offset with additional raising of funds in the capital market. What prevents management from securing outside funds for a program of over-reinvestment? The answer appears to lie in the argument of Jensen and Meckling (1976): The new funds would come at a value discounted for the agency cost -- a much higher cost source than internally generated funds which come at the cost of the opportunity cost of capital for investor/owners. New funds (particularly equity isues) can only be obtained at a discount which reflects anticipated agency costs. These firms do not have access to new issues at a hypothetical rate which reflects the opportunity cost of funds to the investor. However, retained cash flow only has the opportunity cost of funds which is the investors next best source of investment. Thus, because of agency cost, there is a substantial difference between the opportunity cost of retained cash flow as a source of capital and the (higher) opportunity cost of external sources of funds. The data shows that this wedge is not driven by tax considerations or any other considerations which would be consistent with shareholder wealth maximization without agency cost.

The evidence also sheds new light on the relation of bankruptcy costs and capital structure. Previous literature has portrayed bankruptcy costs as pushing optimal capital structure toward less debt. Bankruptcy costs are sometimes viewed as one of the tradeoffs explaining why firms don't utilize the tax advantages of debt

further. However, bankruptcy costs should be considered in the context of agency cost and the costs of displacing (or threatening management) with a proxy fight or takeover. Increasing debt may actually reduce the cost to investors in the aggregate of optimally reorganizing the firm. Thus, as a mechanism of control, debt (and its consequent increase in expected bankruptcy cost) is a substitute for proxy and takeover activity (and the consequent reduction in expected cost of these mechanisms of shifting control). Also, bankruptcy costs (in eliminating bonuses, perks, peace of mind, a job, or a reputation) may fall more heavily upon management than agency cost does. This discrepancy in incentives may lead to economizing too much on bankruptcy cost relative to agency cost. However, increasing leverage is a blunt instrument for maintaining investor control. It only works after unfortunate occurrences have depressed the value of the company not if an up market increases financial slack. It also tends to exclude common equity owners (residual claimants) from the reorganizing process. This would impose costs if debtholders have interests not coincident with interests of equity owners.

The results in section 3 should also prompt caution in the use of the financial concept of a "pure play" investment in the financial claims of a company. The market's valuation of a particular business activity may compound at least three entirely separate management functions: 1) caretaking and optimum management of current assets, 2) management of the incoming cash flow (quasi and other rents), and 3) management of the flow of information (particularly about investment opportunities) which derives from managing in the industry. Using the financial claims of a company to represent claims on its underlying assets may lead to a large error.

An signaling explanation for some of the results is provided by Ross (1977, 1978). Firms have differing qualities which are exogenously determined. These qualities are known to management but not to the market. Debt and other forms of bonded payouts will be a signal of high quality, because it will not pay a firm of low quality to try to signal that it is of high quality by increasing debt since the costs to management of higher bankruptcy are too high. Management shareholding might also be viewed as a positive signal of firm value. In this study's sample, bonded payout levels and management shareholding would be viewed by the market as proxies for

higher underlying firm value which is not contained in the publicly available data on firm assets which is used to compute V.

Several results are not explained by the signaling equilibrium story, however. This view only explains why the market value of the firm, M, exceeds the market value of assets, V; it offers no explanation for the observed agency cost of control. Second, it doesn't explain why this discount should be larger for the larger firms. Third, it doesn't offer any explanation for the role of outside stockholders.

The cross section data of this study cannot finally prove whether results come from a signaling equilibrium or from organizational features which reduce agency costs. The latter implies that management actions are endogenous while the former ascribes only signaling actions to management -- they don't affect underlying value. Thus, a further test to distinguish between these two theories would demonstrate (or fail to demonstrate) the effect of organizational structure on actual management actions and performance.

V. Conclusions

The evidence on q_C ratios (both marginal and average) strongly supports the hypothesis that there are significant agency costs in the oil and gas industry. In particular, two related theories of this agency problem are supported by the evidence: excessive retained cash flow and diseconomies of scope.

Rechanneling the incoming cash flow directly to shareholders before spending it is unambiguously associated with higher firm value. The relationship between cash flow from the scarcity rents on existing reserves and the existence of profitable opportunities has changed over the years. If available profitable investment opportunities are less than income from existing reserves, then maximizing value implies paying out these rents. If investors refuse to provide additional debt or equity for new projects then the firm is essentially liquidating a portion of its asset base since the source of these economic rents is a depleting asset. Refusing to return these economic rents to shareholders imposes an agency cost which result in the discounted value of the company. Debt claims, royalty trust claims, master limited partnership

claims, equity dividends, and share repurchases are gross substitutes for this purpose. Additionally, the evidence is consistent with the hypothesis that it is the bonded payouts which coincide with lower agency costs.

Second, asset size is unambiguously associated with lower market value and lower q_C ratios. This indicates that on average a smaller asset base per company would be more efficient. This may be due in part to the reduced advantages of vertical integration over the last fifteen years. The repeal of the depletion allowance and the growth of intermediate markets in crude and products have narrowed the gap between the cost of intrafirm trade and interfirm exchanges and trades. The optimal size of oil companies is smaller. If management refuses to reduce the size of their company when confronted with such incentives, then agency cost arises and the market value of the company will be depressed.

It would also appear that diffuse ownership patterns lead to lower value of the firm relative to the market value of its assets. Alternatively, an increase in ownership concentration should increase the market value of the firm. This points out two pillars for huge share price premiums in leveraged buyouts (by either management or an outsider). The leveraged buyout alters capital structure in a value increasing direction *and* increases the concentration of ownership. Both factors can be a source of gains which account for share price premiums in tender offers. A third support for increased value occurs if the leveraged buyout also induces (or requires) a selloff of assets, thus ameliorating diseconomies of scope.

One perspective on this study is that a manufacturing firm can be viewed as a closed end mutual fund, where the portfolio is the set of assets owned by the firm. In the petroleum industry the value of these assets was estimated and it was found that in the aggregate, firms sold at a substantial discount to their underlying portfolio of assets. This discount is a market based assessment of the agency cost of control.

Economic control by particular raiders does not appear to be *unusually* highly valued by the market. Mesa Petroleum's estimated q_C is only 1.07. However, economic control by incumbent managers of target firms does appear to bear an excessively low value by the market and this appears readily identifiable long before the actual

takeover attempt. This contradicts the view that raiders are either unusually good managers or superb security analysts. Instead, they appear to be exploiting innovations in takeover mechanisms which have increased the maximum size of takeover candidates. Since agency cost is inversely related to the likelihood of becoming a target, raiders exploited this innovation by going after firms both undervalued and previously viewed as difficult targets. Other newly perceived potential targets are reducing agency cost by taking value increasing steps to raise their value up to the point where a takeover would not be profitable.

These results also support the conclusion that the takeovers are generating genuine economic value and that economic value could be increased further if takeovers were less difficult and less costly. If investors could directly control the cash flow in this industry, then cash flow might well be reinvested elsewhere in the economy. The present value of this opportunity is approximately $200 billion. Thus, issues of corporate organization in one industry have an economywide impact on productivity as large as the most prominent macroeconomic issues.

The agency perspective is that shareholders are essentially the buyers of management for the assets they own. Management teams sell their services to shareholders for compensation and the prestige of running a large corporation. The product they offer is income and value maximization per dollar of value of the assets. This is a market which is subject to its own characteristics of supply and demand. Competition in the product market does not require competition in the market for control of producing assets for an industry. Persistently low q_C ratios in this industry may be an indication of the lack of competition in the market for control. The industry wide q_C is .61 which indicates a Lerner-type index of competition for control of .39. Antitrust concern over the last fifteen years with competition in the actual goods (oil, gas, and their products) market is bean counting compared to the real issue which is this market for management control of oil and gas resources.

Anticompetitive practices[28] and calls for anticompetitive protectionist legislation[29] certainly exist in this market. Whether they are sufficient to warrant government action is doubtful given that the likely outcome in this area would be a protection of existing competitors (incumbent managements) rather than competition itself.[30]

The separation of ownership and control in the modern corporation was an important evolutionary step in organizing economic activity -- one with large economic benefits. This innovation gave rise to the conflict of interest between managers' fiduciary duty and their natural self interest. The only methods for investors to displace incumbent managers against their will are hostile takeovers, proxy fights, and bankruptcy negotiations. The results suggest that these are quite costly and quite imperfect as disciplinary threats. The modern corporation is a relatively new species of organization in private property economies. Further evolution of the corporation to increase the ease of investor control over management appears to have enormous possibilities for increasing value. Developments of covenants over ownership patterns of claims might be one branch of mutations. The Japanese have pioneered a strip financing method which requires that certain financial claims be held in restricted combinations. Separate voting classes of stock are a decomposition of claims in traditional common stock. Venture capitalists typically call for restrictive covenants about management holdings of stock and debt. This reduces bankruptcy costs by making the process a private reorganization.[31] The evidence here, indicates that such a restriction might have marginal value even in larger corporations.

Finally, the work here has provided new tools and methodology for future empirical and theoretical work on the market for control. Why would rational individuals design corporations in a way which permits such large agency costs to

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28 These include coordinated pressure by oil companies to put pressure on banks backing Mesa Petroleum. Another involves the attempts to influence trust departments not to vote with Mesa proposals. Of unknown success are steps such as holding industry meetings to try to figure out how to stop Mesa from threatening existing managements, or public exhortations about the evils of "prospecting for oil on wall street."

29 e.g. successful coordinated lobbying for tax changes to raise the costs of reorganizing oil companies and spinning off assets, calls for a tightening of the Williams act restrictions on takeover activity.

30 For a good discussion of these issues see Baumol and Ordover (1985) and references cited there.

31 See Jensen (1986).

arise in one industry? Is the petroleum industry unique in the features discovered in section 3? What increases competition for control? Which mechanisms function in which type of industries? Can a cross section analysis of q_C in an industry lead to an improved value maximization strategy the way event studies do? Neoclassical economics, the study of maximizing behavior by agents, has made enormous strides in understanding how the price system coordinates the use of resources through product and service markets, but much less progress in understanding the internal workings of organizations and other economic control mechanisms. However, in recent years, economists have been penetrating and breaking down the market as the basic unit of analysis. Whether the basic unit will remain markets and their participants, become discreet intervals of control, or become a continuum of knowhow distributed across individuals and organizations awaits further research and debate.

APPENDIX: The Data

The market value of the company is the sum of the value of all the outstanding financial claims as of the close of markets on 12/31/84. Where conflicts exist in the number of outstanding shares of an issue, the number used was the one appearing in the 10-K report. Untraded debt is evaluated at a discount to its book value based upon the discounts of similar traded debt. The same method was used to value untraded preferred claims. Several simulations were tried with this approach and with that of Lindenberg and Ross (1981) who built up values directly from what was available on compustat tapes. Using a stylized method of discounting from book value was found to work better, particularly for preferred stock, perhaps because convertibility options are a large part of the value of such shares. Lease obligations were capitalized using the yield rate for bonds having the same S&P rating as that of the firm. Short term obligations other than obligated lease payments due within a year and debt due within a year were netted out of the financial claims in the total for non petroleum assets.

Non petroleum assets were computed from the balance sheet and the notes to the financial statements. The original cost of each asset was marked up or (much more commonly) marked down by a fraction which reflected the state of that asset market. As an example, for refineries, executives and investment bankers associated

with selling and purchasing refineries were asked to assess the state of the market. The consensus was that the value of a refinery in spring of 1985 was only the value of oil in inventories, scrap value of its steel, and any remaining land value after salvage. Even the option value of a turnaround in market conditions appeared to have little value. The reason for the latter was apparently that OPEC members were integrating downstream into refining as a way of internally disguising discounts on crude oil so as to preserve their market share, and this depressing factor would be setting the marginal value of refineries for years to come. Thus, late spring of 1985 appeared to be the bottom of the refinery market and refineries were worth roughly 10-20% of original cost. Since refineries had a slightly higher expected value on 12/31/84, the figure of 20% of original cost was used to value refineries. The only physical asset evaluated at higher than original cost was land held for real estate development. Unconsolidated equity holdings were valued at the market value of the claims. Obligations related to take or pay contracts were evaluated at 10% of the dollar amount which reflects the typical court and out of court settlement rate of the thousands of these contracts which are being broken.

Petroleum assets are worth considerably more than book value. However, simple valuation is impossible because a barrel in the ground can be worth from zero to twelve dollars per barrel depending upon it's grade, location, extraction rate, cost of lifting, embedded tax characteristics, etc. Fortunately, since 1980, there is a large amount of required disclosure about the actual nature of petroleum assets owned by a publicly traded company. Also, production from known reserves follows a maximum production path, which can only be increased -- if at all -- by additional development spending. This permits the development of an explicit valuation model based upon a contingent claims model of a production stream. The model is illuminated in Black (1976) and McDonald and Siegel (1984, 1985). Futures claims on crude oil sales beyond two years out are simulated by a model of the term structure of the convenience yield which is driven by the term structure of the convenience yield on traded months, the long term convenience yield as suggested by McDonald and Siegel (1984), and the term structure of interest rates. The risk free interest rate for any one maturity period was the treasury bill/bond rate for the corresponding time period. The option to shut down or start up production was evaluated as a once a year decision over each of 30 future years. Thus, the valuation model considered each separate reserve as 30

commodity options from T=1 to T=30. On average, this measure was 5% higher than the the standard discounted cash flow evaluation required for SEC reporting. However, it should be emphasized, that the computation here is an estimate which would vary daily.

Here, the present value of reserves is modeled as the sum of the present values of production over the next 30 years.

$$\text{PV of Reserves} = \sum_{t=0}^{30} V_{o,t} \qquad (15)$$

If there is no option value at all, then the production stream and corresponding cash flow are fixed and the value of any future year's production is

$$V_{o,t} = e^{-rt}[NR_{o,t} - NC_{o,t}]q_t \qquad (16)$$

where

$NR_{o,t} = P_{o,t}(1-T)$

$NC_{o,t} = C_t(1-T) - TD_t$

r = the risk free rate of discount.

$P_{o,t}$ = futures price at time o for delivery at time t.

C_t = average production cost at time t (current year dollars).

D_t = average cost depletion remaining at time t.

T = marginal tax rate (including extra personal tax on corporate income and net of marginal tax shields).

q_t = production in year t.

The value of the reserve is given by equations (15) and (16).

Oil prices are volatile, however, and production is flexible. If net revenue, NR, falls below net cost, NC, in a particular year, production can be shut in. If oil prices follow an Ito process for commodity prices described by Black (1976) and McDonald and Siegel (1984), then the value today of an option to produce at time t is given by equation (15) and (17) and equation.

$$V_{o,t} = e^{-rt}[NR_{o,t}N(d_1) - NC_{o,t}N(d_2)]q_t \qquad (17)$$

where

q_t = the maximum production in year t.

$N(\ )$ = the standard normal cumulative density function.

$d_1 = [\ln(NR_{o,t}/NC_{o,t}) + \sigma^2 t/2]/\sigma t^{1/2}$

$d_1 = [\ln(NR_{o,t}/NC_{o,t}) - \sigma^2 t/2]/\sigma t^{1/2}$

σ = standard deviation of (instantaneous) proportional rate of change in petroleum prices; $(dP_t/dt)/P_t$.

and boundary conditions:

$V_{t,t} = (NR_{t,t} - NC_{o,t})q_t$ if $NR_{t,t} > NC_t$

$V_{t,t} = 0$ if $NR_{t,t} \leq NC_t$

The average cost of producing remaining reserves is given in required disclosures in current dollar terms both discounted and undiscounted. Future nominal costs are assumed to be higher by an inflation rate. The wholesale price index futures market allows trading in certainty-equivalents for inflation out three years. The inflation rate four and more years into the future was assumed to be the inflation rate during the most future six months traded in wholesale price index futures. This may not be an unbiased forecast of inflation, but it does yield the market's certainty equivalent which should be discounted back at the risk free rate.

Ownership patterns were taken from proxy statements of the companies. Management holdings are holdings of insiders and other board members who are in the management of the company. Uncertainty about the degree to which an insider holding constituted "management" was resolved by including that holding as management. The largest outsider block of stockholding was taken from the list of shareholders or trusts owning in excess of 5% of the stock. Thus, there is a gap in the data between zero and 5% for this variable.

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TABLE 1

Capital Structure of 98 Firms in Sample

All Values Are Market Values as of 12/31/84

VARIABLE	DESCRIPTION	AMOUNT (Billions)		%
	Common Equity	$187.9		64.0%
	Preferred Stock	5.1		1.7%
	Royalty Trusts & Partnership Claims	2.7		0.9%
	Options & Warrants	2.5		0.9%
E	Total Equity Claims		198.2	
D	Total Debt		95.6	32.5%
M	Market Value of Firm		293.8	100.0%
	Non Petroleum Assets		137.5	28.3%
	Oil and Gas Reserves		347.7	71.7%
V	Value of Corporate Assets		485.2	100.0%
A = V-M	Agency Cost of Control		191.4	
q_C = M/V	Industrywide Price of Control		0.61	

TABLE 2A

Measures of Agency Cost With Alternative Valuations of Reserves

SAMPLE		Salomon Bros.	J.S. Herold	SEC Std Meas	HVP	Jacobs
12 firms examined by Salomon Bros.	Sum V =	136.0	172.9	112.4	176.5	147.5
	Sum A =	56.7	93.7	33.2	97.3	68.2
	Ag Q-J =	0.58	0.46	0.70	0.45	0.54
	Num Avg Q-J =	0.65	0.52	0.76	0.55	0.63
31 Firms in Sample covered by John S. Herold	Sum V =		505.4	359.0	511.8	451.7
	Sum A =		247.6	257.8	257.8	200.9
	Ag Q-J =		0.51	0.72	0.50	0.56
	Num Avg Q-J =		0.60	0.85	0.62	0.71
98 Firms in entire sample	Sum V =			394.0	559.3	485.2
	Sum A =			100.2	265.5	191.4
	Ag Q-J =			0.75	0.53	0.61
	Num Avg Q-J =			0.97	0.68	0.90

TABLE 2B

Correlation Coefficient of Asset Appraisals with Value Used Here

SAMPLE	Salomon Bros.	J.S. Herold	SEC Std Meas	HVP	Jacobs
12 firms examined by Salomon Bros.	0.982	0.902	0.984	0.985	1.000
31 Firms in Sample covered by John S. Herold		0.937	0.965	0.989	1.000
98 Firms in entire sample			0.974	0.991	1.000

TABLE 3

Distribution of Sample Data by Firm Size (Total Assets, V)

FIRMS (grouped by size)	Numeric Avg Q-J's	% all Non Neg Agency Costs*	% of Assets Owned by	% Total Market Value of Firms
10 Largest: 1 - 10	0.58	81.7%	72.2%	64.7%
Next ten: 11 - 20	0.75	12.5%	17.0%	19.8%
Next Ten: 21 - 30	0.88	2.9%	5.6%	8.3%
Next Ten: 31 - 40	0.67	2.2%	2.5%	2.7%
Next Ten: 41 - 50	1.02	0.2%	1.1%	1.7%
Smallest Half: 50 - 98	1.03	0.5%	1.6%	2.8%
Total Sample: 1 - 98	0.90	100.0%	100.0%	100.0%

*Excludes negative agency costs for firms with M > V

TABLE 4

Variables Used in Analysis

A	Agency cost of corporate control. Equals V - M.
DEBT	Market value of Debt
DIVS	Dividends of comon stock. Dollars per year at declared dividend rate on 12/31/84.
DTEXACO	Dummy variable equals one for Texaco, zero for other firms.
EQDIVS	Dividend payouts of both common and preferred equity.
INT	Interest paymentes required to support the debt.
M	Market value of the company.
OWNSHMAN	Share of common equity owned by management as of 12/31/84.
OWNSHOUT	share of common equity owned by the largest block of outside shareholder(s) as of 12/31/84.
OWNMAN	Dollar value of common equity owned by management as of 12/31/84.
OWNOUT	Dollar value of common equity owned by the largest block of outside shareholder(s) as of 12/31/84.
PFD	Market value of outstanding preferred stock.
q_C	Control q. The price of corporate control. Equals M/V
REPUR	Repurchases of common stock in dollars during 1984.
RTPT	Market value of outstanding shares of royalty trusts and master limited partnerships.
RTPTDIVS	Dividend payouts of royalty trusts and partnerships.
V	Market value of assets.
XYZV	Variable XYZ as fraction of the asset value of the company.

TABLE 5: Regression Results

Regression	Dependent Variable	Explanatory Variables									Statistics		
1	Q-C	DEBTV	RTPTV	PFDV	DIVSV	REPURV	OWNSHMAN	OWNSHOUT	CONST		N	D.F.	R Squared
	coef	0.709	0.828	1.052	5.066	-0.31	0.529	0.272	0.398		98	90	0.567
	s.e.	0.112	0.321	0.358	1.698	0.878	0.057	0.076	0.0662				
	t-stat(a=0)	6.33	2.57	2.94	2.98	-0.35	9.27	3.57	6.01				
2	E/V	DEBTV	RTPTV	PFDV	DIVSV	REPURV	OWNSHMAN	OWNSHOUT	CONST		N	D.F.	R Squared
	coef	-0.291	0.828	1.052	5.066	-0.31	0.529	0.272	0.398		98	90	0.567
	s.e.	0.112	0.321	0.358	1.698	0.878	0.057	0.076	0.0662				
	t-stat(a=0)	-2.60	2.57	2.94	2.98	-0.35	9.27	3.57	6.01				
3	Q-C	INTPAYV	RTPTDIVS		EQDIVSV	REPURV	OWNSHMAN	OWNSHOUT	CONST	V (bils)			
		4.478	4.983		7.590	2.124	0.29	0.190	0.795	-0.009	98	90	0.523
		0.700	2.33		2.231	1.434	0.160	0.171	0.178	0.0032			
		6.40	2.138		3.40	1.48	1.81	1.11	4.47	-2.84			
4	A (=V-M)	DEBT	RTPT	PFD	DIVS	REPUR	OWNINS	OWNOUT		V			
		-0.544	-1.92	-1.43	-9.31	0.317	-0.53	-0.623		0.7132			
		0.112	0.442	0.642	0.955	0.415	0.231	0.045		0.039	98	90	0.989
		-4.857	-4.34	-2.23	-9.75	0.764	-2.31	-13.85		18.287			
5	A (=V-M)	DEBT	RTPT	PFD	DIVS	REPUR	OWNINS	OWNOUT	DTEXACO	V			
		-0.588	-1.89	-1.74	-10.0	-0.23	-0.53	-0.564	2,333.2	0.7482			
		0.12	0.432	0.642	0.987	0.473	0.231	0.0448	659.6	0.0473	98	89	0.990
		-4.9	-4.37	-2.72	-10.1	-0.49	-2.31	-12.60	3.54	15.803			

Regression	Dependent Variable	Explanatory Variables								Statistics	
6	M	DEBT	RTPT	PFD	DIVS	REPUR	OWNINS	OWNOUT	V		
		0.544	1.921	1.433	9.318	-0.31	0.534	0.624	0.2867	90	0.989
		0.112	0.442	0.642	0.955	0.415	0.231	0.045	0.039		
		4.86	4.34	2.23	9.76	-0.76	2.31	13.86	7.35		
7	E	DEBT	RTPT	PFD	DIVS	REPUR	OWNINS	OWNOUT	V		
		-0.456	1.921	1.433	9.318	-0.31	0.534	0.624	0.2867	90	0.989
		0.112	0.442	0.642	0.955	0.415	0.231	0.045	0.039		
		(4.07)	4.34	2.23	9.76	-0.76	2.31	13.86	7.35		

TABLE 6

Estimates of Investment q, q_I

(Uses Unadjusted SEC Reserve Disclosure Data)

	Majors* (14)	Independents (242)	Pipeline/ Utility (29)	Diversified (104)	All Firms (400)
1980	0.69	0.91	1.04	0.89	0.76
1981	0.55	0.76	0.64	0.64	0.59
1982	0.46	0.76	0.60	0.75	0.54
1983	0.48	0.88	0.67	0.76	0.57
1984	0.52	0.99	0.86	1.00	0.65
5YR AVG:	0.54	0.86	0.76	0.81	0.62

*Acquired and merged firms are included in end-of-year corporation.