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FREE ENTRY INTO CRUDE OIL AND GAS PRODUCTION AND COMPETITION IN THE U.S. OIL INDUSTRY*

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INTRODUCTION

The thesis of this paper is that a condition of free entry into crude oil and gas production in the United States prevails and that this condition, in conjunction with the existing structure of the petroleum industry, effectively guarantees that all phases of the industry's operations—production, refining and marketing—will be competitive in the long run.¹ There is an unfortunate predilection in human nature to seek scapegoats for unhappy historical events such as the recent rise in the price of oil. U.S. oil companies are very large, their early history was characterized by monopolistic behavior, and they are still the beneficiaries of some discriminatory tax laws. But appropriate public policy toward the oil industry should be based, not on a recitation of the sins of the past, but on objective analysis of the present structure, conduct, and performance of the industry.

We believe analysis shows that workable competition currently exists in all phases of the U.S. oil industry. Because the industry is effectively competitive, we believe proposals to amend the O.C.S. Lands Act to change the method of bidding for oil and gas leases on the Outer Continental Shelf (H.R. 1614, 95th Cong., 1st sess. (1977)) or to force vertical or horizontal divestiture of the major, integrated oil companies (S. 2387, 94th Cong., 2d Sess. (1976)) are unnecessary and ill-advised.

I. MARKET POWER

Monopoly is not presently a relevant issue in relation to the U.S. oil industry. The only realistic hypothesis concerning non-competitive behavior within the industry would be that of "shared monopoly" carried out through some form of explicit collusion or through a strategy of "conscious parallelism." Following this hypoth-

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1. We exclude pipeline transportation because of federal and state regulatory control over this phase of the industry.

esis, the leading firms in the industry would operate as an informal cartel and, by means of limitations on either inputs or outputs, raise prices above the levels which would be observed under competitive conditions.

To appraise the shared monopoly hypothesis, consider the problems an informal cartel of the kind suggested above would be likely to face (ignoring, for now, the threat of antitrust prosecution and attendant civil suits for triple damages).

A cartel faces one external and four internal problems. The external problem . . . is to predict (and if possible, discourage) production by nonmembers. The internal problems are, first, to locate the contract surface; second, to choose a point on that surface (the sharing problem); third, to detect; and fourth, to deter cheating.²

Management of these internal and external problems is extremely difficult in the short run and perhaps impossible in the long run, even in the case of a formally-recognized cartel such as OPEC, which is shielded from legal and political reprisals.

The central economic threat facing a hypothetical oil industry cartel is entry by new firms. If new firms enter the industry but not the cartel, the cartel market share will decline. Entry into the cartel leads to increased problems of coordinating cartel behavior. In mathematical terms, a two-firm industry may be represented by a two-dimensional contract surface. As the number of firms in the industry rises to n , the number of dimensions required to solve for the cartel profit-maximizing output solution also rises to n . Concentration ratios (as cited below) are a shorthand method of expressing this relationship between the number of firms operating at each level of an industry's activities and the potential for collusive behavior through shared market power.

A successful cartel must control the use of at least one essential input in the production process and it must prevent potential entrant firms from gaining access to this input. The most effective barriers to entry are:

- (1) Government imposed barriers;
- (2) Ownership of sources of raw materials;
- (3) Patents;
- (4) Large capital requirements;
- (5) Economies of scale which create a limit-pricing situation;
- (6) Product differentiation; or
- (7) The threat of predatory behavior by the cartel.

2. Osborne, *Cartel Problems*, 66 AM. ECON. REV. 835, 835 (Dec. 1976).

We shall examine these potential barriers to entry, first in relation to the refining sector of the U.S. oil industry.

A. Refining

Access to crude oil is the *sine qua non* for a refinery operator. Such access has been relatively free in the U.S., as is shown in later sections of this paper.

There are no existing patent restrictions or technical-engineering barriers facing potential entrants to refining. U.S. refineries have traditionally been built by engineering-contracting firms, not by the major oil companies. New entrants are able to contract for refinery construction on the same terms as existing firms. The technology involved is widely known and easily duplicated.

Large capital requirements cannot serve as a barrier to entry into refining, given an efficient U.S. capital market. If an oil industry cartel sought to earn monopoly profits at the refinery level, it would restrict refinery outputs (and inputs) until marginal revenue for the cartel firms was equal to marginal cost assuming the sharing problem was perfectly solved. Since the price of refinery outputs at this point would exceed marginal cost, a potential entrant to refining could expect to earn greater profits than any member firm having the same cost structure. This is true because the entering firm would expand its output to the point where its marginal cost was equal to market price determined by the cartel's activity. As long as excess profits were earned in refining, additional entry would occur, ultimately undermining the cartel's strategy.

Economies of scale do not prevent entry into refining either. It is possible for a limit-pricing situation to arise in an industry having very large economies of scale. In this case, a new entrant is forced to achieve a high level of output in order to operate at an efficient scale. Its entry at this scale of output will lower market prices below the break-even level of costs, assuming existing firms in the industry maintain their levels of output. But this kind of limit-pricing situation typically requires that the optimum scale of plant for any firm must constitute at least 25-30 percent of industry output. Oil refining in the U.S. does not fit this model.

The largest operating oil refinery in the U.S. (as of January 1, 1978) was the Exxon Baytown, Texas refinery which has a daily capacity of 640,000 barrels, or only 3.8 percent of U.S. capacity.³

3. *Oil and Gas Journal*, March 20, 1978, at 113-134. Environmental constraints on new refinery construction implicitly favor expansion of existing plants. The Baytown refinery is unique, furthermore, in being located at the heart of the U.S. oil transportation system. Purely engineering considerations, therefore, have little to do with the large size of the refinery.

Data concerning new refinery construction in the U.S. contradict the limit-pricing hypothesis. The most recent survey of industry construction plans indicates that seven new grassroots refineries are currently either planned or under construction in the U.S. Four of the new refineries will have capacities of 30,000 barrels per day or less; the other three are in the range of 183,000 to 250,000 barrels per day.⁴ Under the survivor principle, uneconomic plant sizes would not be chosen.⁵ It must be concluded that economies of scale are not a factor inhibiting entry into U.S. refining.

Product differentiation arises at the marketing level of the oil industry, not in refining. This issue will be considered below.

Potential predatory behavior by existing firms is not a valid entry barrier in oil refining. Such behavior is illegal under the Robinson-Patman amendments to the Clayton Act.⁶ The legal and civil penalties which can be meted out for predatory price cutting are substantial. An industry whose behavior is as closely monitored as the oil industry could hardly escape notice if it undertook to drive new entrants from the field through the use of predatory pricing tactics. In fact, significant new entry into U.S. refining has occurred, as is shown in the data relating to new refinery construction cited above and in the more general evidence that thirteen major new independent refiners have entered the industry since 1950 (each of which has constructed 50,000 barrels per day or more of new capacity).⁷ The capacity of these thirteen independent refiners totaled about 2 million barrels per day in 1975, approximately 15 percent of U.S. capacity.

Data relating to trends in industrial concentration in U.S. refining are presented in Table 1. These data indicate that refining is not a concentrated industry, by any of the visual standards. They further indicate that concentration levels in refining have declined since 1960 and have continued to decline since the Arab embargo, as measured by market shares of both the Big-4 and Big-8 firms. The fact that concentration levels in refinery *runs* are consistently higher than same year concentration levels for refinery *capacity* throws further doubt on the cartel hypothesis, because it indicates that large refiners on the average have higher output-capacity ratios than do

4. *Oil and Gas Journal*, April 25, 1977, at 124-131. None of these refineries is being built for a company among the top twenty in U.S. refining capacity.

5. It should be noted that small refineries receive a subsidy in the form of additional crude oil entitlements, at the expense of larger refiners, assuming the parent company's total refining capacity is less than 175,000 barrels per day. F.E.A. Regulations, Par. 13,650, Nov. 1974.

6. Section 2(a).

7. W. JOHNSON, *COMPETITION IN THE OIL INDUSTRY*, 94 (1976).

smaller refiners. This outcome would not have occurred if large refiners had attempted to restrain outputs to obtain monopoly rents.

TABLE 1
CONCENTRATION RATIOS—SEGMENTS OF THE
U.S. ENERGY INDUSTRY

	1954	1955	1960	1965	1970	1975	1976
Proven Crude Oil Reserves ^{A and C}							
Big-4					37.2	36.2	38.7
Big-8					63.9	55.5	57.3
Proven Natural Gas Reserves ^A							
Big-4						26.9	26.2
Big-8						39.7	38.6
U.S. Crude Oil Production ^A							
Big-4		18.1	20.8	23.9	26.3	26.0	25.5
Big-8		30.3	33.5	38.5	41.7	41.2	40.5
U.S. Natural Gas Production ^A							
Big-4		21.7	16.8	20.8	25.2	24.2	23.5
Big-8		33.1	28.4	33.6	39.1	36.8	35.6
U.S. Oil Refinery Capacity ^B							
Big-4			32.0	30.4	32.5	29.9	29.7
Big-8			55.0	54.3	57.5	53.5	51.8
U.S. Oil Refinery Runs ^B							
Big-4		33.1	33.2	31.0	34.2	32.9	32.7
Big-8		57.7	56.8	55.3	61.0	57.7	56.9
U.S. Gasoline Sales ^B							
Big-4		31.2			30.7	29.5	29.3
Big-8		54.0			54.6	50.3	49.9

Sources:

^AAmerican Petroleum Institute, "Concentration Levels in the Production and Reserve Holdings of Crude Oil, Natural Gas, Coal and Uranium in the U.S.," 1955-1976, Discussion Paper No. 4R, September 1977.

^BAmerican Petroleum Institute, "U.S. Petroleum Market Shares: 1950-1976 Individual Company Data," Discussion Paper No. 3R, September 1977.

^CThomas D. Duchesneau, *Competition in the U.S. Energy Industry* (Cambridge, Mass.: Ballinger Press, 1975), p. 39.

B. Marketing

Barriers to entry arising from product differentiation have been recognized as a significant potential source of monopoly power since the classic work of Bain.⁸ It has been argued that the source of cartel power for the large oil companies in the U.S. has been their domina-

8. J. BAIN, BARRIERS TO NEW COMPETITION (1965).

tion of major brand gasoline retailing.⁹ But the validity of this argument in respect to the U.S. oil industry is seriously undermined by the combined facts of relatively low absolute levels of concentration in gasoline marketing over the period 1954-1976 and declining market shares for the Big-4 and Big-8 gasoline retailers over this same period (as shown in Table 1). Because this argument has been urged with particular vigor since the Arab embargo of 1973—the assertion being that major refiners have denied independent marketers their usual access to gasoline supplies—it is significant to note that concentration ratios in marketing continued to decline in 1975 and 1976.

Major oil companies may have succeeded in creating the image of a superior product as a result of many years of advertising and developing networks of branded retail stations. But this perceived product differentiation has not shut out independent marketers. The quality image of the branded stations has been achieved at a cost. Through economies in marketing, independent retailers have been able to sell their lesser-known products at a discount of two to five cents per gallon. Consumers have therefore been given a choice between a higher priced “quality” product and a lower priced “no frills” product. The rise in the market share of independent retailers since 1954 shows that any efforts by major oil companies to preempt gasoline marketing through product differentiation have not succeeded.

There are presently no technical or financial barriers to entry into gasoline marketing in the U.S. Paradoxically, the only real barrier to entry has been created by government regulations. Gasoline allocation regulations, initially promulgated by the Federal Energy Office, still survive in the new Department of Energy (DOE). These rules require potential new gasoline marketers to obtain DOE approval before opening a new service station in any area. The approval will not be given unless the government believes the market area involved is not adequately served by existing retailers.¹⁰ By this rule, the federal government has conferred on existing marketers some of the cartel power they could not have obtained by means of a strategy of product differentiation.

C. Access to Crude Oil

We have argued that monopoly power in the U.S. oil industry has not been obtained through restrictions on refinery construction (or outputs) nor through control over gasoline retailing. We have not yet

9. F. ALLVINE & J. PATTERSON, *COMPETITION, LTD.* (1973).

10. Furthermore, the D.O.E. must notify “potentially aggrieved parties” (i.e. other service stations in the market area) before deciding on the approval. See 10 C.F.R. § 211.12 (e)(2) (1977), and 10 C.F.R. § 205.39 (1977), and Appendix thereto.

dealt with the most important potential source of cartel power for the industry: control over crude oil supplies. It is apparent that new entrants to refining must have a secure and competitive source of raw material inputs in order to risk entry to the oil industry. In the absence of new entry to refining, constraints on the supply of gasoline could eventually result in the creation of monopoly power at the marketing level. Thus access to crude oil supplies is the crucial factor affecting present and future competition in the oil industry.

It might be argued that the ending of oil import quotas in 1973 has, by itself, created the conditions necessary for competitive access to crude oil supplies, when combined with the entitlements program of the U.S. government (which was introduced to equalize the cost of imported and domestic crude oil for all U.S. refiners). This supposition is incorrect, for reasons involving both external and internal political policies.

First, total dependence on foreign crude oil would expose a new refinery to the vagaries of international politics, and especially to the risk of another Arab-Israeli war. While future embargoes on the export of foreign oil to the U.S. are believed to be unlikely, it must be remembered that the 1973 embargo was also said to be unlikely or even impossible.

Second, total dependence on foreign oil would put a new refinery under the threat of changes in U.S. policy toward imports. For various reasons—balance of payments, strategic non-dependence, etc.—the federal government might in the future invoke restrictions in imports of crude oil by means of quotas, high tariffs or other limitations. Such restrictions would severely damage the operations of a new refinery wholly dependent on imported crude oil.

Since potential new entrants to refining quite likely would not perceive access to foreign crude oil as being either secure or competitive, some form of access to domestic crude oil would have to be available in order for entry to occur. Domestic crude oil supplies could be obtained in two ways: first, by means of purchases from domestic producers through either short or long-term contracts; and second, by developing future production within the firm through participation in the domestic oil and gas lease market. Short-term oil supply contracts offer no security to an entering refiner. Because of the uncertain regulatory environment, suppliers may be unwilling to enter into long-term crude supply contracts. Further, crude producers tend to be tied into pipeline systems and buyers, and they may not be willing or able to shift supplies to new entrants. Thus, new refiners could obtain neither secure nor competitive supplies of crude oil in the direct contract market. Access to the domestic oil

and gas lease market is the only alternative which offers a new refiner both security of supply and competitive cost of raw materials.

II. THE DOMESTIC CRUDE OIL LEASE MARKET

The market for crude oil leases may be divided into two general categories: developed and undeveloped properties. Purchasers of an undeveloped property engage in exploration, and if oil is discovered in commercial quantities, they make decisions about the rate of development and production. Buyers of developed properties gain immediate access to crude oil production. Prices of the two kinds of properties (assuming they have the same expected production potential) are approximately equal after adjustment for cost and risk.

Existing firms might attempt to discourage entry into refining by buying up developed and undeveloped crude oil properties.¹¹ Both kinds of properties would have to be controlled since exploration and development, like refinery construction, are usually carried out by contractors and not by the major oil companies. Potential entrants to refining would have access to these contractors on the same terms as the major oil companies. Therefore, in order to maintain output restrictions, existing refiners would be forced to absorb newly offered crude oil properties into their reserve inventories. Their ability to maintain this policy would be undercut by two factors. First, the federal government has set an initial term of five years on all its crude oil leases (the major source of new oil properties in the U.S. at present) and has further imposed "due diligence" requirements on all leaseholders.¹² Second, oil properties which are not presently in production often encounter "common property" problems when contiguous properties are under production. Since crude oil will migrate to the lands under production in these cases, the holder of lease inventories will suffer unacceptable losses if he refuses to produce from his lands.¹³ In addition to these factors, an important economic consideration would affect the ability of lease buyers to profitably follow the strategy of adding all newly offered oil properties to their land inventories: if the in situ price of oil was expected to rise at a slower rate than the existing rate of interest, the cost of carrying this oil would be an offset against the monopoly rents which

11. Restrictions on output could not profitably be effected through large-scale storage of crude oil or products since such storage is prohibitively expensive.

12. O.C.S. Regulations, 30 C.F.R. §250.33 (1977).

13. This factor forced the federal government to produce from its lands in Wyoming (Teapot Dome) and California (Elk Hills) earlier than was desired; it also convinced the government to conduct the O.C.S. lease sale offshore from Santa Barbara, California in 1968.

could be earned through output restrictions. On the other hand, if the in situ price was expected to rise faster than the rate of interest, these gains from conservation would be augmented by any monopoly gains.

The limited data relating to crude oil reserves holdings by the Big 4 and Big 8 oil companies (Table 1) do not support the hypothesis of preemptive lease buying. Additional evidence on this question is provided by an analysis of the conditions of competition in the domestic lease market.

Suppliers in the domestic crude oil lease market fall into four principal categories:

1. The federal government controls the supply of potential producing properties on the Outer Continental Shelf (OCS), an area beginning at the three mile limit for all states except Texas and Florida, and extending seaward to the limit of operability. It also controls onshore lands in the public domain and influences the leasing of Indian lands onshore.

2. States control the supply of offshore lands within their jurisdiction as well as some onshore lands, particularly in Alaska and Texas.

3. Other legal entities within some states (i.e., the City of Long Beach, the University of Texas, American Indians, native associations in Alaska) control potential oil properties.

4. Privately owned lands continue to be a major source of onshore leases.¹⁴ The Federal Energy Administration (FEA) has estimated that a continuing decline in the rate of oil production from existing (1976) wells will mean that only one third of current production will continue into 1985. This drop in production will be replaced, according to the FEA, as follows: 40 percent from new fields, 40 percent from expansion of known fields, and 20 percent from tertiary recovery. The new fields are expected to be developed almost entirely in two areas: OCS and state lands offshore and Alaska onshore.¹⁵ Since all offshore and Alaska lands will be leased under competitive leasing procedures, entry of new producers over the next decade will be extremely difficult to forestall.

III. THE STRUCTURE OF THE LEASE MARKET

A. Buyer Concentration

Concentration data are reported in Table 2 for acreage, bonus

14. Oil producing firms are rarely owners of oil lands. They are lessees and pay royalties to the land owners (lessors) listed above. As lessees, they have less discretion concerning the rate of development and production, and a smaller economic incentive to attempt to restrict output.

15. FEA NATIONAL ENERGY OUTLOOK, 63-65 (1976).

bids, and production for OCS leases. Acreage and bonus bids are both proxies for ownership of the resources in question: oil and gas. Both proxies are reported because, while larger acreage may correspond with larger ultimate production, larger bonus payments may correspond with greater likelihood of finding oil or gas in producible quantities. Concentration ratios are reported on a year-by-year basis, 1954 to 1976, for each year in which more than 100 leases were bid on. Big-4 and Big-8 firms were chosen on the basis of rankings in crude oil production, U.S. and worldwide, for 1969-1970.¹⁶

Concentration data reveal considerable variation in C_4 and C_8 ratios for bonus payments on a yearly basis, but the trend has been generally downward (Table 2). Concentration ratios in acreage show a definite downward trend except for a large rise in C_8 in 1964.

Concentration ratios for production show increases from the initial values of 1960 (the first year calculated) to maximum values in 1965 ($C_4=.64$ and $C_8=.86$), with declines occurring thereafter. One probable explanation of the 1965 "hump" is that, due to the high risk of entry into offshore oil and gas production, Big-8 firms may have had an initial comparative advantage in locating reserves or in developing leases to maximum productivity.

Summarizing the concentration data, all ratios for the 1970's are below the four-firm and eight-firm levels of 50 percent and 70 percent frequently used to demarcate non-competitive market structures. Though individual ratios rose above these levels in certain years (particularly 1964 and 1968), the weighted average ratios over the entire period for bonus payments, acreage, and production are all below these critical levels. Most importantly, the ratios are much lower in recent years than in the 1964-69 period.

These OCS lease concentration ratios may be compared to averages computed for 292 U.S. manufacturing industries by Mueller and Hamm, who reported Big-4 concentration to be 41.5 percent and Big-8 concentration to be 54.3 percent in 1970.¹⁷ Relative to the Mueller-Hamm averages, we find concentration ratios in all our applications to be low on a weighted average basis, except for the C_8 ratios for liquid production and for acreage leased (which are still below the Bain critical level of 70 percent).

16. These eight firms correspond exactly with those currently cited in antitrust action by the Federal Trade Commission (F.T.C. Docket #8934). If firms had been selected on the basis of total acreage acquired over the 1954-76 period (rather than by production), the only change would have been the replacement of Shell by Sun Oil Company.

17. Mueller & Hamm, *Trends in Industrial Market Concentration, 1947 to 1970*, 65 REV. ECON. STATISTICS 512, (1974).

TABLE 2
CONCENTRATION IN THE OCS OIL AND GAS LEASE MARKET,
1954-1976

Year	Number of Leases Issued	Bonus		Acreage		Liquid Production		Gas Production	
		C ₄ Yearly	C ₈ Yearly	C ₄ Yearly	C ₈ Yearly	C ₄	C ₈	C ₄	C ₈
1954	109	.418	.653	.506	.710				
55	121	.244	.508	.274	.664				
56	**	**	**	**	**	see note	see note		
57	**	**	**	**	**	***	***		
58	**	**	**	**	**				
59	42	*	*	*	*				
60	147	.142	.440	.163	.568	.430	.732	.073	.458
61	**	**	**	**	**	.395	.849	.138	.471
62	420	.436	.652	.354	.612	.441	.785	.118	.445
63	57	*	*	*	*	.473	.803	.136	.513
64	124	.418	.750	.212	.817	.554	.827	.200	.534
65	**	**	**	**	**	.642	.866	.320	.622
66	42	*	*	*	*	.621	.855	.436	.758
67	158	.278	.582	.301	.551	.573	.819	.385	.668
68	197	.563	.672	.472	.585	.545	.790	.356	.671
69	36	*	*	*	*	.500	.726	.284	.585
70	138	.149	.264	.141	.299	.431	.684	.232	.510
71	11	*	*	*	*	.362	.633	.233	.504
72	178	.196	.387	.194	.428	.340	.633	.236	.490
73	187	.231	.412	.151	.425	.289	.623	.218	.461
74	348	.305	.580	.258	.491	.268	.577	.192	.393
75	321	.301	.542	.280	.588	.267	.575	.208	.397
76	246	.274	.503	.315	.558	.288	.572	.206	.392
Weighted Average		.287	.508	.294	.570	.376	.657	.232	.474

*fewer than 100 tracts bid on

**no lease sales

***not calculated prior to 1960 due to small levels of production

Note: All concentration ratios are calculated using firm shares of jointly owned leases.

C₄: includes Exxon, Texaco, Gulf and Chevron.C₈: includes C₄, Shell, Mobil, Standard Oil of Indiana and Atlantic Richfield.Derived from: a) U.S. Bureau of Land Management, *OCS Statistical Summaries*.b) U.S. Geological Survey, *LPR 11.8.1* (process date 9/22/77).

B. Conditions of Entry into the Lease Market

The potentially significant barriers to entry into the OCS lease market are (1) the capital cost of the bonus payment which must be tendered prior to development or production; and (2) the high risk

of a dry hole or an uneconomic discovery leading to a total loss of both bonus payments and exploration-drilling costs. The device of joint bidding is a means of reducing these barriers to entry.

The record of entry into the OCS lease market is reported in Table 3. Twenty firms participated in winning bids in the first OCS lease sale (1954). The number of firms participating in winning bids had doubled by 1966 and doubled again by 1972. Through 1976, 137 separate firms had participated in winning bids for OCS leases.

The practice of joint bidding has greatly increased over time. From 1954 through the February 6, 1968 lease sale, 33 percent of all winning bids were joint bids. In subsequent sales (through 1977), the share of joint winning bids increased to 54 percent. This increase in successful joint bidding occurred at the same time that the share of leases won by the Big-8 firms showed a modest decline from 66 percent in the 1954-1968 period to 59 percent in the 1968-1977 period.¹⁸ This suggests that joint bidding has produced pro-competitive results by lowering barriers to entry.

TABLE 3
RECORD OF ENTRY INTO THE OCS OIL AND GAS LEASE MARKET,
1954-1976

<i>Year of Lease Sale</i>	<i>Number of Tracts Bid On</i>	<i>Number of Firms Winning Bids (Solo or Joint)</i>	<i>Number of Firms Entering Market For First Time</i>	<i>Cumulative Number of Firms In Market</i>
1954	116	20	20	20
1955	121	21	5	25
1959	*	*	3	28
1960	173	24	2	30
1962	436	31	9	39
1963	*	*	1	40
1964	101	15	0	40
1966	*	*	0	40
1967	172	34	9	49
1968	237	46	18	67
1969	*	*	1	68
1970	148	41	4	72
1971	*	*	0	72
1972	192	55	11	83
1973	193	59	8	91
1974	435	74	11	102
1975	395	91	25	127
1976	271	71	10	137

*Fewer than 100 tracts bid on

Derived from: U.S. Department of Interior, Geological Survey, Conservation Division, *LPR 11.8.1* (process date 9/22/77).

18. BUREAU OF LAND MANAGEMENT, SUMMARY OCS STATISTICS (1954-1976).

Our interpretation is supported by an analysis conducted by Wilcox which found a significant negative relationship between firm size (asset value) and the percentage of tracts won through joint bidding, indicating that "smaller firms more frequently utilize the joint bidding structure than larger firms."¹⁹

An analysis by Dougherty and Lohrenz concluded that joint bids tend to occur on leases with a higher average number of bids per lease and a higher average bid per acre. They further found that "joint bidding is a method whereby bidders with limited financial resources moderate their risk while competing for the more expensive and sought-after leases," and on these leases they "tend to bid higher on the average than their solo-bidding competitors."²⁰ Markham's analysis of the history of bidding for OCS oil and gas leases in 1968 reached a similar conclusion: "... the evidence does not support the hypothesis that joint bids are at the expense of solo bids; indeed, if one were forced to guess, the better guess is that joint bids increase rather than reduce the total number of bidders."²¹

The theoretical expectation that joint bidding should increase participation by small firms in OCS leasing by lowering front-end capital requirements and spreading risk over more tracts is born out in the empirical analyses cited above. Furthermore, any potential anti-competitive consequences of joint bidding by large firms, which are fully able to bid separately on a large number of tracts, have been obviated by a 1975 regulation issued by the Interior Department banning joint bids among firms that individually produce more than 1.6 million barrels of crude oil equivalent per day.²² The net impact of joint bidding, therefore, is to increase the number and size of bids (on average) and to increase the share of bids won by smaller firms.

Although there is no evidence in the record implying dominance of the OCS lease market by major oil companies, a suspicion still remains that such companies may have attempted to withhold production in order to capture monopoly gains. This possibility is greatly reduced by a stipulation in all federal and most state leases which permits cancellation of the lease if no production has been

19. S. Wilcox, *Joint Venture Bidding and Entry into the Market for Offshore Petroleum Leases*, 106-107 (unpublished Ph.D. dissertation, University of California, Santa Barbara, March 1975).

20. E. Dougherty & J. Lohrenz, *Statistical Analysis of Bids for Federal Offshore Leases*, 1976 J. PETROLEUM TECH., 1137, 1781.

21. Markham, *The Competitive Effects of Joint Bidding by Oil Companies for Offshore Leases*, in INDUSTRIAL ORGANIZATION AND ECONOMIC DEVELOPMENT 124 (Markham & Papanek, eds., 1970).

22. Promulgation by the Secretary of Interior, Oct. 1, 1975. 43 C.F.R. §11.3300 (1977).

developed within five years.²³ The lessee could attempt to produce from a lease at less than the maximum efficient rate, but even this possibility is constrained by the right of the government to insist upon "prompt and diligent" development of production.

The only proven instance of monopoly restraint over domestic crude oil production which created artificially high prices occurred under state controls through market demand prorationing. This exercise of market power was authorized by federal government legislation. Moreover, the federal government directly supported the program by cutting allowable production from its OCS leases. This program was not a reflection of private monopoly, but one of government monopoly exercised on behalf of the crude oil production industry in the U.S.²⁴

The evidence reported here indicates that entry into the OCS lease sale market is relatively free and that the joint bidding device facilitates additional entry, primarily by small firms. With the exception of federal onshore lands not on a "known geological structure," federal and state oil leases are sold under competitive auction bidding conditions similar to those governing the OCS, generating similar free entry and competitive pricing results. We have discovered no evidence that lease buyers are constrained from entering these lease markets.

C. Constraints on the Supply of Leases

The supply of new crude oil leases is not subject to direct control by the private oil industry. Private oil companies might conceivably influence the rate of leasing through lobbying activities within federal or state governments, but there is no evidence in the record to indicate that such power was ever sought or exercised. Indeed, the record indicates the opposite—that the oil industry has consistently urged an accelerated leasing program. Leasing restraint, particularly since 1969, has come about primarily because of the objections of environmental groups.

The record of leases supplied offers little evidence of intentional supplier restraint by the federal government. OCS lease offers are initiated by the Bureau of Land Management (BLM) which publishes a Call for Nominations in the *Federal Register*, indicating an interest

23. The five-year rule may also constrain the optimum allocation of resources over time. Under competitive conditions, if producers of oil expect its in situ value to increase at a rate greater than its opportunity cost (the interest rate on investments of similar risk), they should reduce current production in favor of future production. By forcing earlier production, the five-year rule contradicts the goal of conservation.

24. The market demand prorationing system was effectively ended in 1972.

in leasing lands in a specified area. Interested parties are invited to nominate tracts for lease within this area. These nominations are reviewed by BLM which may add additional tracts to the sale list as well as delete any tracts which are deemed to pose environmental or other risks. The sale is then scheduled.²⁵ Over the 1954-75 period of OCS leasing, 49.1 percent of all tracts offered for lease received no bids.²⁶ This large percentage indicates an absence of government restraints on the supply of potential producing properties. Recent delays in federal lease sales have been created by Congressionally-mandated requirements for environmental studies and by the actions of federal judges in granting injunctions against development, not by a desire on the part of sellers of leases to withhold properties from the market.

VI. BEHAVIOR AND PERFORMANCE OF THE LEASE MARKET

The observed condition of relatively free entry into the lease sale market is of critical importance in evaluating competition in all phases of the petroleum industry. With free entry into the lease market, and consequent free entry into crude oil production, any attempt by private firms to reduce output in order to raise prices would produce only short-term monopoly profits.

If refiners attempt to reduce output and raise prices, they must either (1) accumulate inventories of crude oil or products, or (2) reduce the flow of crude oil by controlling its production. Storage of large quantities of crude oil or products is prohibitively expensive; even the federal government has rejected conventional storage methods for its strategic crude oil reserves. Long-run control of crude oil output by private firms is impossible given entry into the lease market.

Concentration ratios in petroleum refining are below the Mueller-Hamm average for all U.S. manufacturing. Big-4 and Big-8 concentration ratios in refining capacity were 29.7 and 51.8 percent, respectively, in 1976.²⁷ In that same year, 55 separate refining companies in the U.S. had refining capacity exceeding 30,000 barrels per day.²⁸ With existing concentration ratios and a large number of operating firms, successful collusion among firms to restrict output is probably impossible since colluding firms would be forced to yield market share to non-colluding rivals. Collusive behavior among refiners is

25. O.C.S. Regulations, 30 C.F.R. § 250 (1977).

26. Calculated from Bureau of Land Management, O.C.S. Statistical Summaries.

27. See Table 1.

28. NATIONAL PETROLEUM REFINERS ASSOCIATION, U.S. REFINING CAPACITY ON JANUARY 1, 1971-77 (1977).

constrained in the long run by free access to crude oil supplies through the lease market.

Performance in the lease sale market is predictable from structural data cited above. Modest concentration and free entry conditions lead to an expectation of normal profits (an absence of monopoly profits) in oil and gas production from such leases.

To test the hypothesis that the OCS lease market has produced competitive results, we have analyzed the private profitability of all OCS oil and gas leases sold in the first twelve lease sales conducted by the federal government over the period 1954-1962. Eight hundred thirty-nine individual leases were included in our analysis. Bonus, rental and royalty payments as well as oil and gas production and revenue on each lease through 1976 are known precisely from U.S. Geological Survey (USGS) records. Exploration, development, and production costs were estimated on the basis of engineering data, plus knowledge of the precise number and depth of wells drilled on each lease through 1976 (again from USGS data). Future production from leases still in production in 1976 was estimated using a constant percentage decline forecast for production.

Future oil prices were assumed to be the 1976 price plus 5 percent per year through 1985 with a maximum price of \$18.29 per barrel. In 1986, all leases were assumed to receive a price of \$18.29 per barrel, with this price increasing 5 percent per year thereafter. The future natural gas price assumed for each lease was the 1976 price plus 20 percent per year through 1985, with a maximum price of \$3.00 per thousand cubic feet (MCF). The price in 1986 was assumed to reach \$3.83 per MCF on all leases, increasing at 5 percent per year thereafter.

Leases were assumed to shut down in the first year in which marginal costs exceeded marginal revenues from the lease. All leases were assumed to shut down in the year 2010.

The preliminary results of our analysis are found in Table 4. In the aggregate (all 839 leases), lessees earned a 9.49 percent *before-tax* rate of return on their investments. Non-Big-8 firms earned higher rates of return than Big-8 firms. Joint bidding firms earned higher rates of return than solo bidding firms. Reflecting their greater risk, wildcat leases earned higher rates of return than drainage leases.

For all categories of leases shown in Table 4, rates of return are low relative to other business earnings. For example, all manufacturing firms in the U.S. earned an average 19.2 percent rate of return before taxes over the period 1954-1975.²⁹ The low rates of return

29. Calculated from FEDERAL TRADE COMMISSION, QUARTERLY FINANCIAL REPORTS OF MANUFACTURING CORPORATIONS (1954-76).

reported in Table 4 are convincing evidence that the OCS lease market is highly competitive; indeed, it could be argued that oil producers paid too much for these leases, in comparison with opportunity costs. Monopsony profits clearly were not earned.

TABLE 4

INTERNAL RATE OF RETURN (BEFORE TAXES) ON OCS
OIL AND GAS LEASES IN THE GULF OF MEXICO, 1954-62

All leases (839)	9.49%
Big-8 leases (500)	8.76%
Non-Big-8 leases (339)	10.29%
Solo bid leases (616)	8.38%
Joint bid leases (223)	11.51%
Wildcat leases (811)	9.63%
Drainage leases (28)	6.77%

Note: These results are preliminary and are subject to revision due to subsequent corrections in the USGS data base, or to different assumptions in our analysis.

V. CONCLUSIONS

The structure of the crude oil lease market is competitive. Concentration ratios in OCS lease acquisition are low for the Big-4 and about average for the Big-8 oil companies. Entry into the lease sale market is relatively free.

Free entry into all lease markets where federal or state governments are the suppliers, plus relatively low concentration ratios in oil refining and marketing, mean that collusive behavior to restrain outputs and increase prices is unworkable in the long run. Successful collusion would require either (1) storage of crude oil or products, or (2) control over access to crude oil supplies. The former is prohibitively expensive; the latter does not exist.

Performance in the OCS lease sale market shows no evidence of monopsony profits. To the contrary, the rate of return earned on 1954-1962 OCS leases is below normal. The competitive bonus bidding system has returned more than normal economic rents to the public owners of OCS oil and gas resources. Free entry into domestic crude oil production has led to a competitive structure in oil refining and marketing in the U.S., producing workably competitive performance at all levels of the U.S. oil industry.