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The Influence of Private Contractual Failure on Regulation: The Case of Oil Field Unitization

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This article analyzes the interdependence between regulation and private contractual failure. The analysis reveals that the feasible range of regulation is restricted by the same forces that block private agreement. The focus of the study is oil field unitization regulation in Oklahoma, Texas, and Wyoming (federal lands) from 1948 through 1975. Despite large potential gains from unitization, private negotiations fail because of lease heterogeneities and information problems regarding lease value estimates. In response, the federal and state governments have adopted strikingly different policies to encourage unitization with different results. Only the federal government's regulations are effective because they surmount information problems. Texas has the least successful regulation. The paper argues that the policy differences are due to the political influence of small firms that benefit from nonunitized production.

Virtually all domestic reservoirs involve multiple ownership, often by persons with different aims and objec-

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tives. History shows plainly how difficult it has been (in fact, impossible in some cases) to get a group of such owners to agree on a single course of action in producing a given reservoir. And yet, it is absolutely basic that a reservoir should be handled as a unit operation in order to achieve maximum oil recovery from it. [*Oil and Gas Journal*, September 17, 1962]

I. Introduction

Among economists there is general appreciation that transactions costs restrict private contracting, particularly where parties are heterogeneous, information is asymmetric, or there is a need to sequentially adjust contractual terms (Coase 1960; Meade 1971; Williamson 1984). Correspondingly, if private agreements fail under existing institutions, new institutional forms are developed to facilitate exchange.¹ Davis and North (1971) use this argument to explain the emergence of various institutions, as do Alchian and Demsetz (1973) and Libecap (1978) to explain the adoption of particular property rights arrangements. Similarly, certain regulatory policies can be viewed as an effort to reduce transactions costs, which Goldberg (1976) and Williamson (1976) argue must be understood to explain why regulation emerges in particular forms.

This article examines the link between private contracting and regulation from another direction. It analyzes the interdependence between regulatory responses and a breakdown in private contracting. The analysis reveals how the feasible range of regulations is restricted by the same forces that restrict private contracting. The endogeneity of regulation means that if consensus cannot be reached privately, there is no guarantee that regulations to facilitate agreement will be forthcoming because parties will oppose regulatory policies that weaken their bargaining position. This case study of oil field unitization provides insight into both the determination of particular regulatory arrangements and their impact on contracting success.

Wiggins and Libecap (1985) show that private negotiation for unitization generally fails and that the primary cause of contractual failure is asymmetrical information across bargaining parties regarding relative oil lease values. Faced with unsuccessful private efforts to unitize oil fields to reduce rent dissipation, the federal and state governments have adopted strikingly different regulatory policies to encourage unitization, with correspondingly different results. Here we examine

¹ The notion that economic agents influence regulatory policies is discussed extensively elsewhere (see Stigler 1971; Peltzman 1976; Johnson and Libecap 1982).

the differing unitization policies of the federal government, Oklahoma, and Texas. We also examine how the political influence of parties opposed to unitization in private bargaining crucially affected the types of regulations adopted.

Of the three, federal policy is the most effective in promoting unitization because it encourages contracting during exploration rather than after field development. Our analysis reveals that the stage of oil production in which bargaining occurs is critical for contracting success. During exploration, there is little asymmetric information across bargaining parties regarding relative lease values to block agreement. On the other hand, with field development differential information about lease productivity emerges, and disputes arise over lease value and unit shares. This finding is significant for Oklahoma and Texas because, in contrast to the federal government, those states allow for unitization only after oil fields have been discovered and fully developed. In Oklahoma, these problems are partially mitigated by regulations that permit 63 percent of the parties to coerce other firms to join the unit. In Texas, however, unanimous agreement is required. Negotiations in this contracting setting then are most effective when completed behind a veil of ignorance during exploration before development reveals differential information regarding lease values. Wyoming is largely federal land, and we show that it has a much higher proportion of unitized production than Oklahoma or Texas, and that Oklahoma has a greater share than Texas.

The observed policy differences across the three jurisdictions are due to variation in the number and political strength of firms opposed to private unitization. The study reveals that the same firms that resist private unitization agreements also oppose government policies to promote unit contracts. The ability of these firms to block effective policies, despite large aggregate gains from unitization, has broad implications: where private negotiations become mired in dispute, political consensus on effective regulatory policies to complete contracts may be difficult to achieve. Accordingly, regulations that improve efficiency may not emerge.²

Section II describes the gains from unitization and the general contracting problem facing firms attempting to unitize oil fields privately. Section III describes policy differences in Wyoming, Oklahoma, and Texas and examines their impact on the extent and nature of unitization. Section IV links private contracting problems to the political environment for unitization regulation. Section V discusses the general problem of improving resource allocation when there are important heterogeneities and informational uncertainties.

² This qualifies the more optimistic notions of Davis and North (1971). North (1981) has returned to the question why inefficient institutions persist.

II. Contracting for Unitization Agreement

A. *The Gains from Unitization*

The production of crude oil displays classic common-property conditions, because of dispersed surface ownership above oil reservoirs, the U.S. policy of reserving mineral rights to surface landowners, and the rule of capture. Landowners grant firms access to the reservoir through leases. Since oil is migratory and the rule of capture assigns property rights only on extraction, each firm has an incentive to drill and drain competitively. The result is excessive wells and rapid extraction rates, leading to premature depletion of natural subsurface pressure. With loss of pressure the natural gas dissolved in the oil comes out of solution, reducing the oil's mobility and leaving significant reserves permanently trapped. The oil that retains some mobility must be artificially lifted at high marginal extraction costs.³

Fieldwide unitization is the most complete solution to this problem. Under unitization production rights are delegated through negotiation to a single firm, the unit operator, with net revenues apportioned among all parties on the field (including those that would otherwise be producing). The operator has an incentive to maximize field rents, sharply curtailing rent dissipation. Unitization results in important economic gains: a time stream of output that more closely approximates the rent-maximizing pattern, increased oil recovery, and reduced wells and other capital costs.⁴

One can classify oil fields by their natural drive mechanism that forces oil to the surface: gravity, water, and natural gas. While unitization increases production in all types of oil fields, the output effects are particularly important for dissolved gas and gas condensate fields, common in all three states. Gas is dissolved in petroleum or is in liquid form under high pressure in such fields. If development proceeds too rapidly through competitive drilling, subsurface pressures drop, and gas goes out of solution (in dissolved gas fields) or vaporizes (in gas condensate fields). Then, because gas is lighter and travels more quickly than oil, it is expelled first, leading to a too-rapid decline in subsurface pressure per barrel of oil produced.⁵ As gas is drawn off in

³ Discussion of rent dissipation is provided in Libecap and Wiggins (1984).

⁴ Measures of any increase in rents due to changes in the time pattern of production are not available, since output was restricted in Oklahoma, Texas, and Wyoming by state prorationing rules. Because unitization increased the production potential of the affected fields, state agencies, such as the Texas Railroad Commission, were faced with a reallocation problem. With a fixed state production target, any increase in allowed output from newly unitized fields under the prorationing rules would require a corresponding reduction elsewhere. Reaction from potential losers to proposed output reallocation was sharp. As a result, the agencies tended to limit the increase to any unit. See, e.g., *Oil and Gas Journal* (January 7, 1957; June 17, 1957).

⁵ For example, on the Kelly-Snyder field in Texas extraction on numerous leases between 1947 and 1952 led to a 46 percent drop in subsurface pressure from 3,122

condensate fields, it clogs pore spaces in the reservoir, permanently trapping large quantities of oil. Oil also becomes more viscous and requires more pressure to move it. This results in the premature need for artificial pumping or reinjection of water or gas to drive the oil to the surface, which causes sharply higher marginal extraction costs than if pressures had been maintained.⁶ *Oil Weekly* (April 13, 1942; May 3, 1943) estimated that early unitization of solution gas fields would increase recovery from two to five times that of unconstrained production. Similarly, on the Fairway field in Texas it was predicted that unitization would increase oil recovery by 130,000,000 barrels (*Oil and Gas Journal*, December 7, 1964).

Where complete fieldwide agreement fails, smaller subunits are possible. The gains from complete relative to incomplete units, however, are still significant. *Oil and Gas Journal* (June 17, 1957) estimated 44 percent recovery of original oil in place for fully unitized fields, compared with 39 percent for partially unitized fields. For a small, 100,000,000-barrel reservoir the undiscounted difference in output values in 1957 was over \$15,000,000. The potential cost savings from unitization are also indicated by redundant well drilling under competitive production. As of 1937 the American Petroleum Institute estimated that unnecessary wells on East Texas alone cost over \$200,000,000 (American Bar Assoc. 1938, p. 256). As we show in Section IV, dense drilling continued for 40 more years in East Texas. Even where fields are partially unitized, capital costs are increased. For instance, efforts to completely unitize the 71,000-acre Slaughter field of west Texas failed, and ultimately 28 separate subunits or operating areas were established, ranging from 80 to 4,380 acres. To prevent migration of oil across subunit boundaries some 427 offsetting water injection wells were sunk along each unit boundary at a cost per well of approximately \$360,000, for a total of \$156,000,000.⁷ These wells and related expenses were unneeded for production.

psi to 1,675 psi and a corresponding rise in gas/oil ratios from 870 cu ft per barrel to 1,163 cu ft per barrel. This drop in pressure brought concern about the viability of the Kelly-Snyder field, one of the largest in the state (*Oil and Gas Journal*, October 27, 1952).

⁶ There was a rush to unitize the gas condensate Knox-Bromide field in Texas before gas pressures fell below dew (solution) point. The potential problem of viscous oil was emphasized: "Once the liquid clogged the sand near the well bore, there would be no practical way to unclog it" (*Oil and Gas Journal*, March 26, 1962).

⁷ Increased well costs on the Slaughter field of Texas were calculated by counting the otherwise unnecessary injection wells along unit boundaries as shown on Slaughter field maps (August 22, 1967, company records, Houston, Slaughter Western RKM unit file). Costs per well are from company records, Slaughter estate unit file. We were granted access to the unitization files of one of the largest producing firms in Texas. Confidentiality was requested by the company. Copies of the relevant documentation can be obtained from the authors.

Such practices were routine, particularly in Texas where multiple units were common (see, e.g., *Oil and Gas Journal*, July 9, 1956; March 1, 1965).

Aggregate data reveal additional evidence of the higher capital costs from failure to unitize in the United States. Unitization is common only on federal lands, and, as a result, in 1980 the United States had 88 percent of the world's active wells, but only 14 percent of world production. Moreover, U.S. wells produced only an average of 16 barrels per day, the lowest of the 53 countries for which data are available. Canada's wells, by contrast, averaged 71 barrels per day, Venezuela's 426, and Saudi Arabia's 13,124 (*International Petroleum Encyclopedia* 1982, pp. 334–35). With these potential gains from unitization in mind, we examine the contracting problem faced by firms in reaching unit agreements.

B. Unitization Contracting Issues

The central issue in unitization contracting is agreement on an allocation formula for assigning unit revenues and costs among firms. Shares are based on estimates of each lease's contribution to the unit. In negotiations two serious problems arise: first, unitization contracts must assign once-and-for-all shares at the time the contract is completed; and second, general uncertainty and asymmetrical information regarding relative lease values block consensus on value estimates that determine unit shares.

Once-and-for-all unit shares form a permanent allocation rule, agreed to at the time the unit contract is completed, based on preunitization estimates of relative lease value. Our analysis of unitization in Oklahoma, Texas, and Wyoming from 1948 through 1975 reveals that contingent updates of unit shares after the unit is operating do not occur. This is because changes in reservoir dynamics and field production after unitization make it generally impossible to determine the lease from which the oil originated or the lease from which it would have been produced without unitization. Such determination is a prerequisite for any revision of lease value estimates and the corresponding unit shares. Before a field is unitized, extraction occurs from each productive lease, but after unitization, the production pattern is fundamentally altered. The field becomes the producing unit, not the lease, and wells are placed to maximize aggregate field returns. Many existing wells are plugged or used solely for injection of water, natural gas, or other substances to drive the oil to the unit's producing wells. These policies change the flow of oil migration in the reservoir, and the lease as a producing unit loses its signifi-

cance. Postunitization production, then, cannot be used to infer relative lease values.

While preunitization lease values determine unit shares, information problems block consensus on the estimates. The level of information depends on the stage of production in which contracting occurs. Adelman (1972, pp. 20–36) develops the crucial distinction between exploration and field development and the information available to firms at each stage. In exploration little is known regarding the location of oil and its commercial extraction possibilities. At that time all leases are relatively homogeneous, and unitization agreements are comparatively easy to reach, using simple allocation formulas. Since no party knows whether the formula is to its particular advantage or disadvantage, negotiators can focus on the aggregate gains from unitization. Information problems and distributional concerns, however, arise with development as reserves are proved and expanded. With the initial discovery well and the drilling of subsequent wells, lease heterogeneities emerge. Reservoirs are not uniform, and the information released from a well is descriptive of only the immediate vicinity. Hence, through drilling their individual leases, firms gain knowledge of their portion of the reservoir; the full extent of the deposit and the productive potential of other areas will be revealed only through the drilling activities of other firms.

The production potential and commercial value of a lease are a function of objective variables such as the number of wells and current and past production as well as subjective geological variables, including the amount of oil below lease lines, net oil migration, oil viscosity, permeability of the surrounding medium, and subsurface pressure. These latter variables are the source of contracting problems. Information about them and their significance for lease value estimations depend critically on subjective interpretation by company engineers and nonverifiable company records. While it is difficult to achieve consensus among firms on the implications of such information for lease value, it is nonetheless used by each firm to form private value estimates. The resulting asymmetry in lease value calculations, based on differential information and interpretation among firms, is the primary cause of breakdown in unit share negotiations.

The estimation of static reservoir characteristics such as thickness and porosity illustrates the information problems involved. Each calculation is based on only a small number of observations at well bores. The interpolation of reservoir structure between wells, however, is sensitive to the specific functional forms employed by company engineers. Procedures and estimates vary across firms. For instance, in unit negotiations on the Prentice field in west Texas there were differences in porosity estimates of 60–100 percent. Such disparities helped

to delay unit agreement for 9 years (letter, December 11, 1962, Prentice N.E. unit file, company records). The estimation of dynamic reservoir characteristics, such as remaining oil reserves, involves even greater complications.

In addition to the problems of estimating static and dynamic geological characteristics, firms have proprietary information that affects value estimates. Lease production is influenced by firm management policies, details of which are available only from company records. While they are available to the firm's engineers and geologists, they can be easily misrepresented and may not be considered reliable by other firms. Thus, there are important differences in the data and lease values privately assembled and calculated by individual firms and those publicly available for unit negotiations. These differences inhibit agreement between the lease owner and other firms on unit shares.

If private information indicates that estimates of lease values, based on public information, are too low, the firm may not join. If the firm expects future production data to confirm its private value estimates and if its gain in unit share offsets its portion of reservoir damage from delay, the firm will not join. While one can hypothesize a host of solutions to these information problems, in practice they do not appear. Our analysis of unitization contracting from 1948 to 1975 reveals that information problems repeatedly stalled negotiations, suggesting that there were only limited means of eliciting agreement. In addition to these information issues, the firm may also decide to delay joining, if it can obtain concessions from other parties by holding out. In the meantime, nonunitized production shares are determined by relative lease production capabilities, subject to constraints imposed by regulatory authorities.

The central factor affecting the probability of withholding leases in anticipation of subsequent share increases is uncertainty regarding the public estimates of lease value used to assign unit shares. One can think of such estimates as a Bayesian prior that is updated by private information and private assessment of public information. If there is great uncertainty about public estimates, the Bayesian prior is held less strongly, making it more likely that private information or private assessment of public information will lead to divergence in public and private lease value estimates. Owners of leases with highly uncertain public value estimates will strongly prefer to join if their private information is unfavorable. However, if private value estimates exceed public estimates, leading to an expected share revision large enough to offset reservoir losses, then the firm will prefer to delay unit formation.

The most productive, longest-lived leases on a field are most apt to

be withheld because they have the greatest uncertainty regarding value. Those leases are more subject to future changes in subsurface conditions and, accordingly, have greater variance in lease value estimates and a higher probability of large divergence between public and private values.⁸ Firm size, however, also affects the decision to withhold productive leases from the unit. For firms with large field holdings the gains from delay on one lease are likely to be offset by losses on others, reducing the probability that delay will bring a sufficiently large increase in rental share to offset field damage from delay. For small firms with limited field acreage, these aggregate effects are largely external, so they are more likely to withhold their highly productive leases, which have high variance in value estimates. Differences in lease value estimates also block consensus on side payments to draw potential holdouts into agreement because all firms have incentives to claim favorable private information.

These information problems decline over time as more public and private information is released through development and expected lease lives shorten; uncertainty about lease values is reduced, and estimates collapse around true parameter values. At that point consensus on fieldwide units becomes more likely. Empirically, we observe that private units are typically agreed to late in field development.

Besides the information issues that particularly affect the owners of small, productive leases, we also show below that small firms had other reasons for opposing unitization. Small lease owners were given preferential drilling permits by regulatory authorities. Those policies allowed such leases to be more densely drilled than larger leases, and with more wells per acre, small lease owners could drain neighboring areas. In unit negotiations such lease owners insisted on protecting their regulation-imposed advantage as a condition for joining.

These information and holdout problems suggest that unanimous agreement for early unitization, when aggregate gains are largest, will be uncommon once development has begun and asymmetric information has been released. If only a few firms do not join, a partial unit can be voluntarily created, but this significantly reduces aggregate gains compared to a fieldwide unit. A minimum threshold of leases must join before a unit can be effective. For firms with numerous leases and significant acreage in a field, this threshold requirement offsets the incentive to withhold productive leases. Since large firms internalize a greater proportion of the aggregate gains from early

⁸ General contracting issues and the increased residual variance associated with value estimates for highly productive leases are discussed in detail in Wiggins and Libecap (1985).

unitization, they are motivated to expedite agreement by placing all of their leases into the unit. Small firms with limited acreage, on the other hand, will hold out.

A number of implications follow from this discussion: (i) Leases with the greatest uncertainty regarding value will be more likely to desire a delay in unit formation, and these leases tend to be the most productive on a field. (ii) Large firms with diversified lease holdings on a field will be less likely to delay unit formation, *ceteris paribus*. (iii) Small firms with limited, very productive leases, on the other hand, are more likely to oppose unitization. (iv) Voluntary, private unit agreement will come late in field life. Here, we use these implications for analyzing the impact of private contracting problems on government policy. Since there are clear efficiency gains from unitization and major obstacles to private agreement, there is a potential role for regulatory policy to complete unit contracts. The discussion above, however, shows that the same parties that delay private agreement also have an incentive to oppose regulations that promote unitization.

III. Regulatory Policies, Their Impact, and Political Sources

A. Policies in Different Jurisdictions

Of all unitization policies, those adopted by the federal government toward federal lands are by far the most successful. All private production rights on federal lands are assigned through the Mineral Leasing Act of 1920 as amended (30 U.S.C., secs. 181–287). Firms can obtain leases for up to 20 years under that law, but the aggregate leased acreage held by a firm cannot exceed 246,080 acres in any state. If firms agree to unitize their leases, however, the leases are automatically extended for the life of the unit and are exempt from the statutory acreage limit (30 U.S.C., sec. 226[j]). Unit plans are approved and actively monitored by the Bureau of Land Management.

On federal lands unitization typically occurs as follows. First, a potentially productive geological formation is identified and the overlying acreage is unitized for exploration, usually within 6 months. Once unitized, prospecting occurs with costs and returns allocated among the unit parties according to leased acreage, since subsurface characteristics are not yet known. As oil is discovered, the proven areas are separated from unproven areas by the bureau. Leases in proven areas, called participating areas (PAs), share in the returns from the unit on an acreage basis. Leases in unproven areas do not share until their area is proven to have commercial reserves, reducing the hazard

to holders of potentially rich leases of rent transfers to less productive leases. The PAs can be expanded or contracted as new production information appears, and the unit is collapsed around the PA when the productive limits of the field have been determined. The unit remains intact through primary production, when output is from natural subsurface pressure, and continues through secondary recovery, when injection of gas or water is necessary to stimulate output. A majority rule is used in forming units. The unit operator must drill throughout the exploratory unit. Firms that believe their leases are neglected can drill wells, demand inclusion in the PA if recoverable oil is found, and receive reimbursement for a multiple of their drilling costs.⁹

Since federal policy encourages early exploratory units before commercial petroleum deposits have been found, it allows for large potential gains from unitization. Early units can restrict the total number of wells drilled and control the pace of production. The allocation arrangements are preset early in field development before information uncertainties and asymmetries appear regarding the interpretation of particular lease characteristics. During exploration very little is known regarding subsurface conditions, and individual bargaining positions are relatively homogeneous. This is the key policy that separates federal regulation from practices in Oklahoma and Texas.

It is important to note that on older federal fields not unitized prior to development, unitization negotiations are protracted and frequently break down in the same way as in Oklahoma and Texas, even though the acreage exemptions still apply. Negotiations are smooth only with exploratory units.¹⁰ Hence, information uncertainties and asymmetries are the primary sources of contractual failure in unitization. While we do not model agency behavior, there is clear motivation for federal policy to encourage unitization. As the principal landowner in areas where its regulations apply, the federal government captures a significant share of the increased field rents that result from efficient development. It receives both cash bonuses and royalties from its leases to private firms, and that income stream would rise if field values increased.

⁹ Data on federal policy are based on interviews with Bureau of Land Management personnel, North Central Region, Casper, Wyoming.

¹⁰ Lists of Wyoming units were assembled using data from the Bureau of Land Management, Casper; the Interstate Oil Compact Commission (1960, 1962); and the International Oil Scouts Association (1948–75). From these sources unitized and field discovery dates can be compared. Only on old fields, typically discovered prior to 1940, do discovery dates precede unitization. For example, the Salt Creek field, Wyoming's largest, was discovered in 1917 and was not unitized until 1939. Examination of bureau unitization files for such fields reveals the same negotiation problems encountered in Texas and Oklahoma fields.

Oklahoma has a compulsory unitization statute. The law allows the Oklahoma Corporation Commission to force all leaseholders on a reservoir into a unit if 63 percent of the operators (weighted by acreage) agree to unitization (1945 Oklahoma Sess. Laws at 162; 1951 Oklahoma Sess. Laws at 136). Significantly, Oklahoma law requires that units cover only proven acreage in developed fields, a requirement that effectively rules out early unitization. Accordingly, information uncertainties and individual bargaining positions are established prior to unit negotiation. The Corporation Commission has less motivation than the federal Bureau of Land Management to actively monitor units to encourage early unitization.¹¹ Oklahoma lands are private, and the state government does not directly share in increased field rents (royalties).

Of all major producing states only Texas adheres to a unanimity rule in forming units. Texas law also requires that units cover only developed acreage, so there are no early units. In Texas, units are typically formed only late in field development when artificial injection becomes necessary (*Oil and Gas Journal*, April 20, 1959). Owing to the problem of reaching unanimous agreement after information asymmetries have developed, the Railroad Commission commonly approves subunits written around nonjoiners. Because most oil lands are private, the Railroad Commission's motivation for regulation parallels that of the Corporation Commission.¹²

B. *The Impact of Regulatory Differences*

Table 1 summarizes the pattern of unitization in Oklahoma, Texas, and Wyoming between 1948 and 1975.¹³ These data indicate sharp differences in the extent of unitization across the three states. Wyo-

¹¹ Oklahoma and Texas both have severance taxes on the value of production, but this does not provide the same regulatory motivation as the federal government's royalty interest.

¹² Texas antitrust laws effectively made unitization illegal until 1949 (Hardwicke 1948, p. 57).

¹³ A list of units in Oklahoma, Texas, and Wyoming was compiled from records of the Texas Railroad Commission, the Oklahoma Corporation Commission, the Bureau of Land Management, the Wyoming Oil and Gas Conservation Commission, and the Interstate Oil Compact Commission. Because we are interested only in fieldwide units, we culled partial units from the data. That is a problem only in Texas. Partial units were identified by locating multiple unit entries per field on Texas Railroad Commission unit lists. The International Oil Scouts list annual output by field by state. Accordingly, we matched field output with the compiled fieldwide unit list to calculate total unitized production. The data were then presented as a share of total annual state production. Caution, though, is necessary because unit names and field names do not always coincide, particularly in Oklahoma. In those cases it was difficult to assign production to the units, since production data are by field. Accordingly, it is possible that the Oklahoma unit share for some years is too low.

TABLE I

PRODUCTION FOR FIELDWIDE UNITS AS A SHARE OF TOTAL STATE OUTPUT (%)

Year	Wyoming	Oklahoma	Texas
1948	58	9	0
1949	56	9	0
1950	51	10	1
1951	53	11	2
1952	64	15	2
1953	54	15	2
1954	48	16	4
1955	55	25	4
1956	57	26	4
1957	69	26	5
1958	71	22	5
1959	65	18	6
1960	64	24	7
1961	71	28	11
1962	76	27	11
1963	75	33	11
1964	70	28	11
1965	70	30	16
1966	74	31	18
1967	73	35	16
1968	74	31	12
1969	69	35	11
1970	67	35	14
1971	72	35	14
1972	83	34	16
1973	84	35	17
1974	85	34	19
1975	82	38	20

SOURCE.—Lists of unitized fields in Wyoming, Oklahoma, and Texas were compiled from files at the Texas Railroad Commission; the Wyoming Oil and Gas Conservation Commission; the Bureau of Land Management, North Central Region Office; and the Oklahoma Corporation Commission. Output data are from the International Oil Scouts Association, *International Oil and Gas Development Yearbook*.

ming had 50 percent of its production from fieldwide units as early as 1948, the Oklahoma share was 9 percent, and Texas had no fully unitized production. While the Oklahoma share remains well below that of Wyoming, it is larger than the share in Texas through 1975. These raw data, however, are influenced by a number of other factors, such as the stage of depletion of a state's fields and their size. As fields age and primary production becomes depleted, differences in public and private estimates of lease values converge to true values. Thus, disputes about values decline and negotiations can be completed. Hence, unitization should become more widespread as fields become depleted. Unfortunately, data on the stage of individual reservoir depletion are not generally available. The aggregate stage of depletion of reservoirs in a state, however, can be indicated by the ratio of cumulative production in the state to cumulative production

plus remaining estimated reserves (American Petroleum Inst. 1977) Initially, this ratio will be zero, and as the state's reservoirs age, it will approach one. Average reservoir size in a state also influences unitization, since large reservoirs tend to have more heterogeneities across leases and a greater number of producing firms; both should retard agreement. The best available aggregate measure of size is average output per field in each state.

In general, unitization policies in each of the three states will affect the impact of these variables on the extent of unitization. Texas, which has no compulsory unitization law, can be used as a benchmark. In Texas, small changes in field size should not create significant differences in the extent of unitization because of the constraints of the unanimity rule. When field sizes are large, as in Texas, small size changes will not reduce the number of operators sufficiently to bring agreement. Depletion of production, on the other hand, should be a more important determinant of unitization. When an individual field reaches depletion, operators have an incentive to unitize. Oklahoma's law, which does not require unanimity, should substantially alter both of these relationships. As field sizes decline it becomes more likely that the required 63 percent agreement will be reached. Similarly, since depletion is not uniform across a field, only 63 percent of the leases must be depleted before agreement can be reached. The impact of the size and depletion variables in Wyoming is less clear because of federal policy to encourage unitization at exploration. Since a large percentage of production is unitized prior to development, depletion may be less important than in Texas. Nevertheless, federal policy does include compulsion, which should increase the impact of depletion. Early unitization should also reduce the impact of field size in agreement. For the intercept variable, as defined in equation (1), the difference between Wyoming and Texas, however, is clear. The ability to form exploratory units before information asymmetries should lead to a greater share of unitized production independent of either depletion or field size.

We use a simple regression model to test these hypotheses and measure the impact of regulatory policies on differences in the extent of unitization. Let

$$\begin{aligned}
 Y_{it} = & \beta_0 + \beta_1 \text{SIZE}_{it} + \beta_2 \text{DEP}_{it} + \beta_3 \text{WYO} + \beta_4 \text{WYODEP}_{it} \\
 & + \beta_5 \text{WYOSIZE}_{it} + \beta_6 \text{OK} + \beta_7 \text{OKDEP}_{it} \\
 & + \beta_8 \text{OKSIZE}_{it} + \epsilon_{it},
 \end{aligned} \tag{1}$$

where Y_{it} = proportion of state i production from fully unitized fields in year t ; SIZE_{it} = average field output in state i in year t ; DEP_{it} = cumulative production/cumulative production + remaining reserves

for state i in year t ; WYO = Wyoming intercept dummy; OK = Oklahoma intercept dummy; and ϵ_{it} is a randomly distributed error term with zero mean and is independent of the independent variables. The other variables are obtained by multiplying the respective intercept dummies for Wyoming and Oklahoma by their size and depletion variables; for example, $WYODEP_{it} = WYO \times DEP_{it}$. With this format Texas, with the least regulation, becomes the base line, and the differential impacts of regulatory policies in Oklahoma and Wyoming are shown in the estimated intercept and slope dummies. To obtain the point estimate for an Oklahoma variable, for instance, add the Oklahoma coefficient to the Texas coefficient.

The regression was estimated for the period 1948–75, and the results and the estimated partial effects of Wyoming and Oklahoma policies beyond those of Texas are reported in table 2.¹⁴ The coefficients are estimated with an autoregressive process to correct for autocorrelation.¹⁵ The estimated coefficients for the depletion and size variables reported in part A of table 2 generally support the hypotheses presented above. In Wyoming, where unitization typically occurs during exploration, the field size and depletion dummy coefficients are not significant, implying that neither has an impact beyond that observed for Texas. The primary effect of federal unitization policy appears, as hypothesized, in the intercept dummy, which is large and significant. The individual dummy coefficients for Oklahoma also strongly support the hypotheses. Oklahoma's size coefficient is the only one that is statistically significant. The different voting rules also affect the impact of depletion in the two states. The coefficient for depletion in Texas is 0.64 and is significant (.01 level), while the difference between Oklahoma and Texas is 0.91 and is highly significant. The point estimate for Oklahoma is 1.55 (0.91 + 0.64). The overall effects of unitization regulations in Wyoming and Oklahoma relative to those in Texas are calculated by multiplying the estimated intercept and slope coefficients by selected values for the right-hand variables in equation (1) and summing them for each state. Part B of table 2 reports those calculations for 1975, the latest period for which we have data, and for the sample means. The results indicate that federal regulation increased the share of unitized production in Wyoming over that in Texas by 59 percent in 1975 and by 58

¹⁴ While the dependent variable is theoretically bounded, only four of the 84 observations were on the boundary (the first four observations for Texas). Accordingly, ordinary least squares (OLS) regressions were used.

¹⁵ Original OLS estimates had a D-W statistic of 1.067, suggesting autocorrelation of the residuals. Statistical analysis of the residuals indicated a second-order autoregressive process. Correction for the autocorrelation was made for the estimations reported in table 2.

TABLE 2
REGRESSION ESTIMATES OF IMPACT OF POLICY DIFFERENCES
A. REGRESSION RESULTS*

	INDEPENDENT VARIABLES		
	Intercept	Depletion	Size
Texas (base line)	-31.30 (11.17)	.64 (.15)	-1.36E-06 (8.72E-06)
Wyoming (dummies)	44.78 (21.02)	.14 (.22)	1.09E-05 (2.03E-05)
Oklahoma (dummies)	-56.35 (23.80)	.91 (.28)	-1.02E-04 (2.44E-05)

B. ESTIMATED PARTIAL EFFECTS OF WYOMING AND OKLAHOMA REGULATION

1975:

$$\text{Wyoming: } \hat{\beta}_3 + \hat{\beta}_4(\text{WYODEP}_{1975}) + \hat{\beta}_5(\text{WYOSIZE}_{1975}) = 59.29 \quad (3.78)$$

$$\text{Oklahoma: } \hat{\beta}_6 + \hat{\beta}_7(\text{OKDEP}_{1975}) + \hat{\beta}_8(\text{OKSIZE}_{1975}) = 13.82 \quad (4.02)$$

Sample Means:

$$\text{Wyoming: } \hat{\beta}_3 + \hat{\beta}_4(\overline{\text{WYODEP}}) + \hat{\beta}_5(\overline{\text{WYOSIZE}}) = 58.33 \quad (2.24)$$

$$\text{Oklahoma: } \hat{\beta}_6 + \hat{\beta}_7(\overline{\text{OKDEP}}) + \hat{\beta}_8(\overline{\text{OKSIZE}}) = 37.08 \quad (3.15)$$

NOTE.—Standard errors are in parentheses.

* Dependent variable is percentage of state production from fully unitized fields. $R^2 = .97$; $F(8, 73) = 546.888$; $t = 1948-75$.

percent using the sample means. Both estimates are significant at the .01 level. Regulatory policies in Oklahoma resulted in approximately 37 percent more unitized production than in Texas on average for the sample period and 14 percent more in 1975 (both are significant at the .01 level).

These estimates show consistently larger shares of unitized production in Wyoming than in either Oklahoma or Texas, and they emphasize the importance of timing of unit negotiations. Only federal policy allows for unitization prior to field development and the emergence of information uncertainties and asymmetries that impede contracting. The estimates also confirm that the 63 percent rule in Oklahoma significantly increases the proportion of unitized production over that in Texas, where unanimous agreement is required.

The compulsory rule in Oklahoma and Wyoming should also lead to more complete units because holdouts can be forced into agreement. Texas policy encourages fragmented subunits over reservoirs, since compulsion is not possible. The evidence is consistent with the implication. While we do not have complete lists of all multiple or incomplete units in the three states, available evidence based on a

survey of the *Oil and Gas Journal* from 1950 to 1970 indicates that multiple units are characteristic only of Texas. There were feature articles on 21 Texas fields, and of those at least 16 had subunits.¹⁶ On the other hand, the same survey included lengthy discussions of the unitization of six fields in Oklahoma with no reference to multiple units.¹⁷ For Wyoming, analysis of 25 unit files at the Bureau of Land Management and in company records shows no evidence of incomplete or fragmented units.¹⁸ The unitization files at the Oklahoma Corporation Commission provide more comprehensive data on Oklahoma's willingness to compel unitization once 63 percent of the lease owners agree. A random sample of 261 fields, for which the percentage agreement was reported in Oklahoma Corporation Commission files, shows that in 134 cases, 51 percent of the total, there was less than 100 percent approval. The percentage agreement for those cases ranged from 67 percent to 99 percent.

IV. The Political Economy of Unitization Regulation

This section examines the reasons for differing unitization policies in Oklahoma, Texas, and Wyoming. The strikingly different regulatory policies and results among the jurisdictions shown above provide an important case for examining the forces that mold regulation. Of particular interest is the fact that there was a clear-cut policy choice to enhance economic efficiency, and in Oklahoma and Texas at least, the petroleum industry was extremely influential; yet regulations differed sharply. This means, then, that the sources of support and opposition for unitization policies must be examined in more detail. The theoretical discussion in Section II provides the basis for separat-

¹⁶ Subunits include those found on the Slaughter field with 28 units (*Oil and Gas Journal*, April 15, 1963); the Scurry Reef field units of Sharon Ridge, Diamond M, and SACROC (*Oil and Gas Journal*, August 1, 1960); as well as numerous units on the Wasson, Levelland, Seeligson, and Goldsmith fields (*Oil and Gas Journal*, March 3, 1965; April 12, 1954; November 11, 1957; November 22, 1965). Indeed, by 1971, 310,000,000 barrels or 26 percent of Texas production came from the 15 largest subunits. Additionally, analysis of detailed company records of the unitization of seven Texas fields reveals all seven to be incompletely unitized.

¹⁷ Two articles on the West Cement and Velma Simms reservoirs pointed to use by the Corporation Commission of the compulsory unit statute to force parties into the units (*Oil and Gas Journal*, May 19, 1952; November 24, 1958). Further, analysis of company records on the unitization of 11 Oklahoma reservoirs shows that while negotiations were lengthy, once the required 63 percent agreement was reached, the Corporation Commission approved the unit. Of the 11 unit files, 10 included discussions of a lack of unanimous agreement and corresponding use of the compulsory statute to force the unit.

¹⁸ Unit files from Bureau of Land Management, North Central Region, Casper; and company records, Denver.

ing the firms that would favor or resist early field unitization and policies to promote it. That discussion shows that property rights to field rents can be fundamentally altered through the unit allocation formula. Hence, a firm's stand on compulsory unitization rules to break private contracting deadlocks depends on its preunitization property rights to oil and how it views unitization will affect them. If the firm expects that its share of unitized field rents under the allocation rule is less than its share of nonunitized field production, it will resist policies to coerce joining. These concerns are most likely to affect small firms, and the sources of their opposition depend on the stage of production.

A. *Political Opposition and Support for Unitization Regulation*

We argued above that during exploration unitization agreements can be completed with little discord. Since reservoir information is limited, firms do not have any *ex ante* expected advantages from natural geological conditions. A simple sharing rule based on surface acreage is then possible. This smooth agreement will not occur, however, if there are regulatory advantages provided by state agencies to particular firms that could be undone by the unit sharing rule. Indeed, in Oklahoma and Texas that was the case. Libecap and Wiggins (1984) show that prorationing rules adopted in Oklahoma and Texas in the 1930s to allocate production were designed explicitly to favor small firms. While both states had minimum well-spacing rules, small lease owners were given routine exemptions, particularly in Texas. Moreover, the quota or prorationing rules heavily weighted wells, so that there were more wells and higher output levels per acre allowed on small leases than on large ones. Small firms lobbied for these favorable rules and worked to maintain them. Compulsory unitization legislation, such as that used on federal lands, would have precluded the prorationing advantage of small firms, since unit sharing was on the basis of proven acreage.

In addition to these regulation-imposed advantages, small lease owners had other reasons for opposing compulsory unitization after field development. At that time differences in public and private value estimates blocked private agreement on unit shares. The most productive, long-lived leases have the greatest uncertainty regarding value and, hence, are most likely to be considered by owners to be undervalued by public information and the allocation formula. Larger firms, disadvantaged on one lease or on one field by unitization, will nonetheless internalize much of the aggregate gains from widespread agreements, so they will support compulsory unitization

regulation. Small firms, on the other hand, with limited but productive leases will not have these offsetting effects and will oppose compulsory unitization of established fields. A majority-imposed allocation rule and forced minority joinder clearly can make small firms worse off by reassigning property rights to field rents. Accordingly, any government policies to promote unitization when private agreements fail will depend critically on the political power of small firms.

B. Small Firms and Compulsory Unitization Efforts on Federal Lands and in Oklahoma and Texas

The federal government was able to adopt its comparatively efficient policies with no recorded political opposition for two reasons: (i) there were relatively fewer small firms and leases on federal lands, and (ii) small firms on federal lands had less influence on policy than did the numerous small firms in Oklahoma or Texas. The number of small firms on federal lands was limited because leases were typically large. The Mineral Leasing Act of 1920 allowed individual leases of up to 2,560 acres for prospecting and 640 acres for production. Firms could hold multiple leases for a total of 246,080 acres in each state, but that limit was relaxed if the acreage was unitized. The federal government reserved the mineral rights underlying its land and issued large leases because it did not gain from strategic drilling, which was practiced on private land as firms tried to encourage oil flow to their leases. On private lands in Oklahoma and Texas, however, lease size was determined by land ownership, which was much more fragmented, and landowners often further divided their lands into multiple leases to encourage rapid production and drainage. The result was that very small leases were common in Oklahoma and Texas. To illustrate, on the Oklahoma City field in 1930 there were approximately 85 leases of less than 50 acres, 111 leases of between 50 and 350 acres, and only one of 640 acres (*Oil Weekly*, September 25, 1930). The East Texas field was even more fragmented with many leases under 5 acres. Accordingly there were fewer small firms that benefited from favorable prorationing rules on federal lands than in Oklahoma or Texas. Moreover, those firms had comparatively little influence on federal policy since federal lands represented only a small portion of total U.S. oil production in the 1930s. In 1936, for instance, federal lands accounted for just 3 percent of U.S. production, and most of that came from large leases (American Petroleum Inst. 1971, p. 118). Further, the larger federal political process was more costly to influence for small, scattered firms on federal lands than for small firms in Oklahoma or Texas in lobbying for state policies.

Unitization policies were first added in 1930 as an amendment to the Mineral Leasing Act. It was passed in response to rapid extraction and competitive production on the North Dome Kettleman Hills field of California, one of the largest fields on federal land. Competitive extraction was reducing federal royalty income on Kettleman Hills and prospects elsewhere on federal lands (*Oil and Gas Journal*, July 3, 1930).

This smooth adoption of unitization was not repeated in either Oklahoma or Texas, where small lease owners were more prevalent than on federal lands. Small firms resisted private unitization agreements and were the core of opposition to regulations promoting unitization. The conflict between large and small firms over unitization was based on both information problems and prorationing rules that allowed greater production per acre for small lease owners than for large firms. Prorationing rules favoring small firms resulted from their intense political pressure on the legislatures and regulatory agencies in Oklahoma and Texas. To limit drainage and general losses from dense drilling, large firms responded by lobbying for minimum well-spacing rules, forced pooling of leases, and compulsory unitization. Forced pooling allowed small leases to be consolidated into larger tracts for drilling to reduce well densities.

Oklahoma adopted formal minimum well-spacing rules and compulsory lease pooling in 1935 and 1941, respectively (American Bar Assoc. 1938, pp. 209–10; Meyers 1967, p. 312). Spacing and compulsory pooling resulted in relatively uniform drilling on new fields and narrowed the advantages of small leases to only those arising from their natural position on the reservoir. Those policies, in turn, tended to reduce opposition to compulsory unitization in Oklahoma. Compulsory unitization legislation, supported by the Mid Continent Oil and Gas Association, an organization of large firms, was unsuccessfully introduced in both 1941 and 1943. A bill finally was passed in 1945. It required, however, that 85 percent of the leases approve unitization before the remainder could be forced to join. It also exempted all fields discovered 20 years prior to the act's enactment and, more important, allowed unitization only on fully developed reservoirs (1945 Oklahoma Sess. Laws at 162). Those provisions reflected the opposition of small firms, who feared losing their strategic advantage because of either dense drilling and preferential prorationing rules or limited information on lease characteristics. Immediately after passage of the 1945 law, two major Oklahoma fields, West Edmond Hunton Lime and West Cement Medrano, were unitized by the Corporation Commission. Resistance to forced unitization on these fields led to unsuccessful efforts to repeal the law in 1947 and a subsequent state supreme court test (American Bar Assoc. 1949, p.

400). The intensity of repeal efforts, which resulted in floor votes in both houses of the Oklahoma legislature, underscores the importance of strategic advantages and information problems. The opposition is all the more striking when the aggregate gains from unitization are considered. With unit management West Cement Medrano output increased by 70,000 barrels or \$180,000 per *day* by 1951 compared to levels that would have been obtained without unitization. The incremental output resulted simply from plugging high gas/oil ratio wells, producing all output from low ratio wells, and recycling produced gas back into the reservoir instead of selling it (Oklahoma Corporation Comm., West Cement Medrano files). By 1951 opposition to the Oklahoma compulsory unitization statute was largely spent, and the original law was amended with little controversy to lower the required majority for forced units from 85 to 63 percent (1951 Oklahoma Sess. Laws at 136).

In Texas there was more opposition by small firms to regulatory change for wider well spacing, forced pooling of leases, and compulsory unitization than in Oklahoma. There were widespread exemptions to spacing rules, particularly on the East Texas field, that gave advantages to small leases. Forced pooling of leases did not pass until 1965, 24 years after Oklahoma, and even then, it only followed court rulings that outlawed some preferential quotas for small tracts. Significantly, compulsory unitization was never enacted. Voluntary units formed in Texas could be only for secondary recovery or pressure maintenance. The relative success of large firms in Oklahoma in securing spacing, pooling, and unitization legislation was due to a lower incidence of small firms compared with Texas. Available evidence suggests that in 1930 the average Texas producer was only 63 percent of the size of the average Oklahoma producer.¹⁹ This difference in the incidence of small firms was exacerbated by the late 1930 discovery of East Texas. Within three years there were 1,000 primarily new firms on East Texas, three times as many as were reported for all of Oklahoma in 1930. By 1948 there were approximately 3,400 small, independent producers in Texas, with many of them located on the East Texas field (American Bar Assoc. 1949, p. 448). Further, because of the influence of small producers East Texas was prorated on a per well basis, while other Texas fields generally had quotas based on 50 percent acreage and 50 percent wells. The benefits received by small firms on East Texas from the prorating rule are

¹⁹ This excludes the 10 largest firms in both states. Data are based on production reports in *Oil Weekly* (March 20, 1931). Comprehensive data were not available for Oklahoma for the very small firms, those with output less than \$5,000, and those firms were not used in calculations.

reflected in their drilling practices. By 1933 small firms averaged one well per 9 acres, while the 24 largest firms averaged one well per 14 acres. Hence, small East Texas operators, in particular, had an incentive to resist wide spacing, pooling, and unitization efforts.

The Railroad Commission set maximum well densities but routinely granted exemptions to small lease owners.²⁰ Dense drilling followed. A 1-acre lot in Kilgore had 27 producing wells, and 1-acre tracts with five to 10 wells were common (American Bar Assoc. 1949, p. 493). Between 1938 and 1948 of the 100 well-spacing exemption cases heard by appellate courts in Texas, 99 concerned East Texas (American Bar Assoc. 1949, pp. 489–90). As late as 1959 the Railroad Commission did not formulate well-spacing rules until 18 months after a new field's discovery, sufficient time to allow narrow spacing practices to become established (*Oil and Gas Journal*, May 1, 1959).

Both dense drilling and allowables per well provided small Texas firms with strategic advantages. Hence, they opposed regulatory changes that would weaken their ability to drain. Compulsory lease pooling efforts were resisted by the Texas Independent Producers and Royalty Owners Association (TIPRO), an organization of small firms (*TIPRO Reporter*, February 1949). Moreover, TIPRO helped block changes in prorationing rules from a per well to an acreage basis (*TIPRO Reporter*, September/October 1950). Preferential allocations to small lease owners continued through 1962, when quotas per well were finally overturned in two court cases, *Atlantic Refining Co. et al. v. Railroad Commission* (346 S.W.2d, 801 [1961]) and *Halbouty v. Railroad Commission* (357 S.W.2d, 364 [1962]). After those rulings, bills were quickly introduced in the Texas legislature to subsidize small lease drilling. While they failed, their consideration illustrates the political power of small firms (*Oil and Gas Journal*, May 8, 1961).

Voluntary unitization legislation was introduced in the legislature in 1947, but it failed because of opposition by TIPRO and other small firm groups (*Oil and Gas Journal*, June 14, 1947; *TIPRO Reporter*, December 1948). In 1949 a new voluntary unitization bill was introduced, and it was passed only after the unanimity rule was strengthened and provisions inserted to protect nonsigners if portions of fields were unitized (*Oil and Gas Journal*, June 2, 1949). There were repeated efforts to enact a compulsory unitization bill for the next 26 years, but they failed in the face of entrenched opposition by small oil producers.

This analysis of the political environment for unitization reveals

²⁰ This was to allow all property owners access to the oil beneath their land. Granting sufficient oil to cover costs also allowed small firms to legally drain neighboring areas when oil below their lease was limited.

that the same small, strategically located firms that resisted private agreement also molded policy responses. In Texas, small landowners and firms were numerous and influential, particularly because of the East Texas field, and, as compared to Oklahoma's experience, they successfully delayed spacing, compulsory pooling, and prorationing rules that would have facilitated unitization. Their influence blocked compulsory unitization statutes and led to administrative practices where units could be approved only for pressure maintenance and secondary recovery. In Oklahoma small firms were less politically powerful, and the state's early spacing and pooling regulations limited strategic advantages to small leases from prorationing rules. While small firms could not prevent enactment of a compulsory unit law, their opposition did lead to exemption of old fields and to a requirement that only fully developed fields be unitized. The record in Oklahoma, however, shows that the compulsory provision was commonly used to force holdouts into units. In Texas, on the other hand, fragmented units or subunits were common owing to the unanimity rule. In contrast to either Oklahoma or Texas, federal policy was adopted with no evidence of political opposition. Because of the larger size of federal leases, there were fewer small firms than in Oklahoma or Texas, and their political influence on federal policy was smaller. Moreover, among the three government agencies there were differing incentives for promoting unitization. As landowner the federal government benefited directly from more efficient production, since it received both lease bonuses and royalty payments.

V. Concluding Remarks

This paper examines the breakdown of private contracting and the regulatory response to efforts to unitize oil fields. The incentive to contract lies in avoiding rent dissipation associated with common-pool crude oil production. The potential aggregate gains from unitized, single-firm production are large: extraction rates can more fully consider user costs and follow rent-maximizing patterns; capital costs can be reduced through elimination of excessive wells and surface storage; and total oil recovery can be increased since subsurface pressures can be better maintained through controlled oil withdrawal. Private unit negotiations typically fail, nevertheless, because of lease heterogeneities and associated information problems regarding estimates of lease values and holdout strategies. Consensus cannot be reached on net profit shares based on the estimated contribution of individual leases to unit production. These contracting problems become apparent once development has proceeded sufficiently to reveal the sharp differences in production capacities and rents across leases.

The regulatory policies on federal lands surmount these information problems by encouraging unitization prior to development. In Oklahoma and Texas, however, unitization can occur only when fields are fully developed. Successful negotiation requires compensation to reflect strategic advantages, once lease heterogeneities are established. Uncertainty and information asymmetries regarding lease values block agreement on the compensation that must be paid. Hence, unitization occurs much less often in Oklahoma or Texas than on federal lands, though Oklahoma's compulsory unit law results in more unitized production than in Texas. Additionally, Wyoming and Oklahoma laws avoid fragmented or multiple units, which are common in Texas.

More generally, our analysis suggests that policy approaches to contracting problems must concentrate on agreement early, before information advantages lead to differential rents to holdouts. Our study of unitization contracting suggests that when private contracts fail as a result of information asymmetries among firms or, hypothetically, among consumers and firms, regulatory policies may not yield an efficient solution because of political opposition from vested interests. Where such political opposition is influential, regulatory assistance to facilitate contracts may not be forthcoming, as in Texas, or limited, as in Oklahoma. The federal lands case is of general interest because federal policies are effective and, apparently, relatively independent of the political influence of small firms that were influential in Oklahoma and Texas. These observations raise doubt about government's ability to enact policies to increase efficiency when there are serious redistributive consequences and the groups harmed are a major political force.

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