A GAME THEORETIC EXPLANATION OF THE DIFFERING VIEWS OF MAJORS AND INDEPENDENTS ON UNITIZATION

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ABSTRACT

One of the most perplexing questions concerning the field of oil and gas regulation is why majors and independents have taken such different views in regard to unitization. Majors tend to support unitization and independents tend to oppose unitization. It would at first seem that a company's size would not be particularly relevant to its position on unitization. If one studies the frequency of firms entering into unitization agreements one finds that for majors, unitization is best modeled as a repetitive game and for independent producers as a one shot game thus leading to very different strategies.

INTRODUCTION

In the development of an oil field it is common to find two or more operators that control mineral rights that allow them both to withdraw hydrocarbons from the same reservoir. This, coupled with the rule of capture[1], has created a situation in which one operator is able to impose the negative externality of uncompensated drainage on others who are withdrawing hydrocarbons from the same source of supply. This creates incentives for all of those operating from a common source of supply to withdraw as many hydrocarbons as possible as quickly as possible so as to minimize the amount of uncompensated drainage they experience from under their lease and to benefit as much as possible from uncompensated drainage they inflict on other leases. The inefficiencies this system creates are obvious and well documented.[2]

Furthermore, ultimate recovery from an oil and gas reservoir is often greatly enhanced when the reservoir is operated as an integrated whole from its discovery rather than piecemeal as a collection of leases. Simply drilling a hole and puncturing the reservoir will generally only produce ten percent or less of the oil in place.[3] Various substances such as water, natural gas or carbon dioxide can be injected into the reservoir to either maintain pressure, push the oil out, or wash the oil out.[4] However, when substances are injected into an underground formation, the substances migrate through the formation based on the physical properties of the reservoir and not the division of the surface estate. Techniques that ultimately enhance oil recovery from the entire reservoir may severely retard recovery from particular wells in that reservoir.[5] If the operator of one lease injects substances into a reservoir that inhibit production from a well held by another operator, the operator injecting the substances will be liable for damages, without regard to the ultimate effect on recovery from the

reservoir.[6] In many cases enhanced oil recovery programs are simply not possible due to potential liability in the absence of some form of agreement between the owners of all the affected interests.[7]

It is obvious that one possible solution to the common pool resource problem described above would be for the parties to negotiate a private contractual solution. A unitization agreement is such a solution. Under a unitization agreement all of the owners of interest in an oil field pool their interests, appoint one operator to produce, and all parties share the profits. One of the most interesting facts concerning the process of unitization is that major integrated oil companies have generally been more favorably disposed to unitization than small independent oil producers.[8]

In most cases unitization would seem to benefit all lease holders in an entire field. The gains from unitization can be enormous.[9] It has been noted that in the Fairway field that unitization would ultimately increase recovery by 130,000,000 barrels[10]. It has also been noted that in some fields early unitization can increase ultimate recovery 2 to 5 times.[11] This type of increased recovery would obviously be of an enormous benefit to all lease holders in a field and would seem to benefit both majors and independents alike. However, this may not be the case since majors would be most likely to control vast acreages in many fields while independents would be more likely to control smaller leases in a smaller number of fields. This would position them very differently in the negotiation process for a unitized operating agreement.

It has been demonstrated that in a single unitization negotiation the party with the smaller tract actually is in the most advantageous position in negotiations for a unitized operating agreement and is able to extract significant economic rents for his participation in the agreement.[12] This advantage is essentially based on the fact that the holder of the smaller tract is not in the position of needing the agreement as badly as the other party and can thus more easily walk away from the agreement. This is the position that the independent producer is very likely to be in when holding smaller tracts and not needing to enter into unitization negotiations with the same parties frequently. However, this is not the position in which the major producer will find himself.

Examination of Unitization Agreements

An examination of 100 unitization agreements covering fields all over the mid-continental region of the United States and Alaska found that firms tend to have to deal with one another repeatedly.[13] The chart found in Table 1 illustrates the results of this exercise with respect to the majors. As can be seen from Table 1, British Petroleum was present most often, having a working interest in 41% of the agreements, while Phillips Petroleum was present the least, having a working interest in only 20% of the agreements

From this table the probability that a firm will meet another firm again during unitization negotiations was computed. As can be seen from Table 2 the probabilities of major oil companies having to deal with each other repeatedly in unitization negotiations is essentially 1. This means that any model of unitization negotiations with respect to major producers is best modeled as a repetitive game rather than as a one shot interaction.

TABLE – 1*

(Presence at Unitization Negotiations)

Company	Percentage of Times Party to Agreement
Texaco	25%
Shell	28%
Mobil	37%
Phillips	20%
Chevron	24%
Exxon	24%
Arco	36%
Kerr McGee	32%
British Petroleum	41%

In an examination of 100 unitization agreements the following companies were present for the stated percentage of negotiations. Independents were present on all agreements, however, no independent was repeatedly present outside of their localized area of operations.

Table – 2
(Probabilities that Companies Meet 2 or More Times in 100 Negotiations)

Company	Texaco	Shell	Mobil	Phillips	Chevron	Exxon	Arco	Kerr McGee	British Petroleum
Texaco		.99295	.999939	.994079	.997495	.997495	.99992	.99976079	.999979888
Shell	.999295		.999982	.996858	.999048	.99048	.999976	.9999162	.99999494
Mobil	.999939	.999982		.9995452	.999909	.999909	.9999999	.99999663	.999999928
Phillips	.994079	.996858	.999542		.992694	.992694	.999431	.99865852	.99980752
Chevron	.997945	.999048	.999909	.992694		.997348	.999881	.99966148	.999968276
Exxon	.997945	.999048	.999909	.992694	.997348		.999881	.99966148	.999968276
Arco	.99992	.999976	.999999	.999431	.999881	.999881		.99999516	.999999884
Kerr McGee	.999761	.999916	.999997	.999859	.9999661	.9999991	.999995		.99999922
British Petroleum	.999998	.999995	.9999999	.99808	.999698	.999698	.999999	.99999922	

As can be seen from the above table the probability of any major oil company having to deal again with any other major in unitization negotiations is essentially one.

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EXAMINATION OF THE NEGOTIATING PROCESS.

     In one shot games and games with finite ending points cooperative outcomes do not produce a stable equilibrium and usually lead to non cooperative outcomes. However, in games where the number of iterations is unknown and unknowable, a cooperative equilibrium may be sustainable and stable.

     It is now well documented in game theoretical research that the behavior of actors in a one shot game may be very different than in a repetitive game.[14] If a game is played over and over again, it often becomes more advantageous for individuals to cooperate than would be the case in a one shot game.[15]

     Consider a game in which two parties know that they will have to deal with each other repeatedly for an unknown number of iterations and in which each party has two possible strategies it may either cooperate or defect.

     Where;

         C = cooperate Firm 1
         c = cooperate Firm 2
         D = defect Firm 1
         d = defect Firm 2

π_{cj} = payoff to Firm j when both firms cooperate

π_{dj} = payoff defecting Firm j when the other firm cooperates

π_{cj}^{*} = payoff to cooperating Firm j when the other firm defects

π_{p} = payoff to Firm j when both firms defect

δ = discount rate

The game can be described as follows:

Firm 2

	c	d
C	$\pi_{c1}\ \pi_{c2}$	$\pi_{c1}^{*}\ \pi_{d2}$
D D	$\pi_{d1}\ \pi_{c2}^{*}$	$\pi_{p1}\ \pi_{p2}$

Firm 1

If it can be shown that both one round and an infinite series of defections can be deterred, then (C,c) can provide a sustainable and stable equilibrium.

     If a player defects for one round and the other player responds by defecting in the next round, the payoff for the defecting player j will be,

$$(1)\ \ \pi_{dj} + \delta\pi_{cj}^{*}.$$

Whereas if Firm j had continued to cooperate then the payoff for Firm j would be,

$$(2)\ \ \pi_{cj} + \delta\pi_{cj}.$$

So if

$$(3) \quad \pi_{cj} + \delta\pi_{cj} > \pi_{dj} + \delta\pi_{cj}^{*},$$

then one term defections from the cooperative strategy will be deterred.

However, even if the conditions in equation (3) are satisfied this still does not preclude the possibility that one firm might prefer an infinite number of defections. If Firm j were to choose an infinite number of defections the firm's payoff would be,

$$(4) \quad \pi_{dj} + \sum_{i=1}^{+\infty} \delta^{i}\pi_{pj} .$$

Which can be rewritten as,

$$(5) \quad \pi_{dj} + \frac{\delta\pi_{pj}}{(1-\delta)} .$$

If Firm j were instead to choose an infinite series of cooperation then the firm's payoff would be,

$$(6) \quad \sum_{i=1}^{+\infty} \delta^{i}\pi_{cj} .$$

Which can be rewritten as,

$$(7) \quad \frac{\delta\pi_{cj}}{(1-\delta)} .$$

Therefore if,

$$(8) \quad \frac{\delta\pi_{cj}}{(1-\delta)} > \pi_{dj} + \frac{\delta\pi_{pj}}{(1-\delta)} ,$$

an infinite series of defections will be deterred

If both a defection on a single round and an infinite number of defections are deterred then all intermediate combinations of defections will also be deterred because they will invariably unravel back to an infinite series of defections. For a major oil company that has every reason to view unitization negotiations as an infinitely repeated game, the question becomes whether the payoffs from these negotiations satisfy the conditions set out in equations 3 and 8.

As can be seen, what is required to satisfy equations (3) and (8) is that the gains from cooperation be fairly large and the payoffs from defection fairly small in

comparison. This is usually satisfied for any oil producer with sufficient capital to cover its share of the setup costs.

However, before an independent can extract economic rents from a major seeking to unitize a field, the threat of refusing to make the agreement must be credible. For a major oil company the ranking of the payoffs would be as follows,

$$(9)\ \pi_c > \pi_c^* = \pi_p > \pi_d\ .$$

The increased profits over time only accrue if the major is able to unitize the field and actually implement the enhanced oil recovery program. The major would rank defection as the least attractive alternative due to retaliation by the other majors in future unitization negotiations. The preferences of the major are known to all participants in the negotiating process. The true preferences of the independent may match that of the major or they may not. If an independent is well capitalized then in all probability the independent's ranking of the various outcomes will mirror the major's. On the other hand, a poorly capitalized independent's payoffs are as follows,

$$(10)\ \pi_d > \pi_p = \pi_c^* > \pi_c\ .$$

It may at first seem counterintuitive to argue that the payoff from cooperation is the lowest payoff and perhaps may be negative. As figure one illustrates the unitized field will ultimately produce more oil and greater profits even though the initial cash flows are negative. Enhanced oil recovery projects involve the building of a fairly significant infrastructure. For example, in order to initiate the enhanced oil recovery program discussed in the Block 31A plan of unitization, a pipeline for carrying carbon dioxide had to be built from Southwestern Colorado to the Permian Basin in West Texas.[16] A small poorly capitalized company would obviously have a very difficult time in paying its share of the setup costs for such an operation. All unitization agreements contain an equalization clause. In any field some parties will have created more infrastructure on their leases than others. Parties that have put relatively less into developing their leases pay the difference to those who have put relatively more into their leases. Parties that use the latest technology and new equipment will be advantaged over those that cut corners and use older equipment. Thus a poorly capitalized independent may need to make an equalization payment to the better capitalized operator. Better capitalized independents will tend to prefer unitization and more poorly capitalized independents will seek to avoid unitization.

Most independents are small closely held corporations and without publicly available financial statements. A major will not know whether he is dealing with a well capitalized independent or a poorly capitalized one, so the independent's threat not to cooperate is credible. Since unitization negotiations between a major and an independent are generally not repeated the major will never know whether he is dealing with a well capitalized independent who actually prefers unitization, or a poorly capitalized independent that does not prefer unitization.

Figure 1
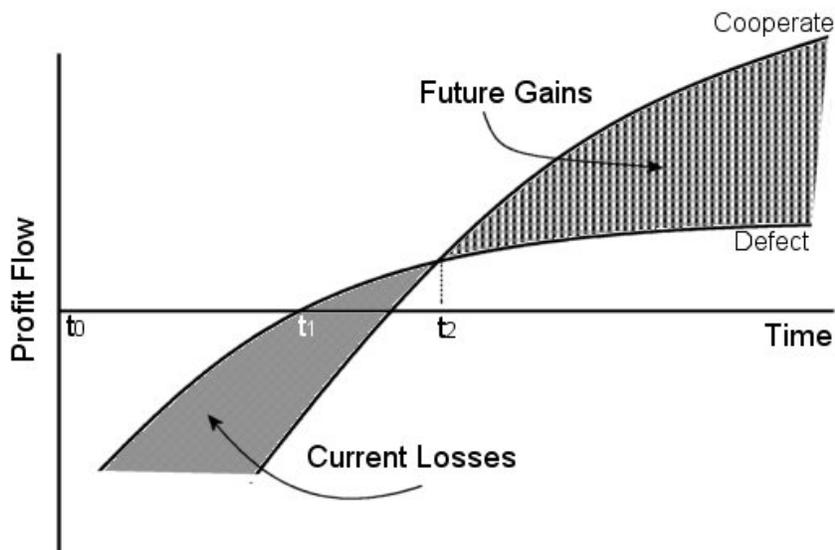
In Texas, independent oil and gas producers tended to have more political power relative to majors, whereas in Oklahoma the reverse was the case.[17] The resultant Texas oil and gas code has been described as pro independent.[18] In Texas, 100% of the parties must agree to the unitization agreement for a plan of unitization to be approved.[19] Oklahoma, on the other hand, requires only 63% of the affected parties to agree to a plan for unitized operations before the state will approve it.[20] It is clear that Oklahoma's statute would reduce the bargaining power of those who wish to block unitization while Texas' statute will tend to increase it.

An examination of rates of unitization in Texas and Oklahoma provides evidence that a large number of independents actually block or hinder unitization negotiations. Table 3 compares the rates of unitization in Texas and Oklahoma. All of the fields in Texas and Oklahoma that have produced over 30 million barrels were included, as well as a random sample of 300 oil fields in Texas and 300 fields in Oklahoma. In Oklahoma 91% of the large fields were unitized compared to under 46% of the large fields in Texas. From the random sample of 300 fields in Oklahoma over 25% were unitized, whereas only 4% of the 300 fields in the random sample from Texas were unitized. The results presented in Table 3 support the supposition that when independents are present and their bargaining power is not limited by statute, as it is in Oklahoma, the presence of independents tends to hamper unitization. The percentage of ownership interests that must agree to the plan of

unitization is only real difference between the Oklahoma unitization statute and the Texas statute.

Table 3
(Percent of Fields that Are Unitized)

	Texas Sample	Texas Large Fields	Oklahoma Sample	Oklahoma Large Fields
unitized	3.98	45.87	25.08	91

DISCUSSION AND CONCLUSIONS

If one engages in unitization negotiations very rarely and tends to hold smaller tracts it has been previously demonstrated that this party will hold an advantageous position in unitization negotiations.[21] This is the position that the independent producer will most likely find himself in. It has also been demonstrated that if one engages in unitization negotiations repeatedly with the same parties and may also tend to be a holder of larger tracts, then cooperation may well be the best avenue for that firm. This is the position in which the major producer will most likely find himself. It has been shown that the probability of a major producer having to deal with another major producer again is essentially one.

This means that pressing an advantage too hard in a particular field may well not benefit the major in the long run as they will most likely be punished for this behavior in subsequent negotiations and the benefit of holding out will be outweighed by future losses. For the independent producer, as Smith has illustrated, the opposite may well be the case.

If one's main advantage in a negotiation process is the ability to extract economic rents by withholding agreement until a substantial premium has been paid for cooperation, it is clear that a statute such as Oklahoma's that requires only 63% agreement before a unitization agreement can be approved will significantly weaken that advantage. However, a statute such as the one Texas has passed that requires 100% agreement will enhance the bargaining position of the independent producer. If the Texas law relating to the regulation of oil and gas is truly pro independent, then one would expect the law to take on a form that would maximize that competitive advantage of the independent producer, as it has. If majors have relatively more power in Oklahoma as opposed to Texas then one would expect a unitization statute that is more favorable to majors to take hold in Oklahoma, as it has.

The differing positions taken by majors and independents in regard to unitization is most probably a function of the different bargaining positions they generally hold during unitization negotiations.

End Notes

[1] "...the rule simply is that the owner of a tract of land acquires title to the oil or gas which he produces from wells on his land, though part of the oil or gas may have migrated from adjoining lands. He may thus appropriate the oil and gas that have flowed from adjacent lands without the consent of the owner of those lands, and without incurring liability to him for drainage. The nonliability is based upon the theory that after the drainage the title or property interest of the former owner is gone." <u>Elliff v Texon Drilling Co.</u>, 210 SW 2d 558 561(1948)

[2] Wiggins, Stephen N. and Garry D. Libecap, "Oil Field Unitization: Contractual Failure in the Presence of Imperfect Information." <u>American Economic Review</u> 75 no. 3 (1985): 368–385, Weaver, Jacqueline L., <u>Unitization of Oil and Gas Fields in Texas.</u> Washington D.C.: Resources for the Future, 1986, McDonald, Stephen L., <u>Petroleum Conservation in the United States: An Economic Analysis</u>, Baltimore, Maryland: Johns Hopkins Press, 1971.

[3] Fred I. Stalkup, <u>Miscible Displacement</u> (New York: Henry L. Doherty Fund of AIME Society of Petroleum Engineers, 1984), 2

[4] Larry W. Lake, <u>Enhanced Oil Recovery</u> (Englewood Cliffs, New Jersey: Prentice Hall, 1989), 1.

[5] Paul G. Willhite, <u>Waterflooding</u> (Richardson, Texas: Society of Petroleum Engineers, 1986), 2–13

[6] <u>Rail Road Commission v. Manziel</u>, 361 S.W. 2d 276

[7] Interstate Oil and Gas Compact Commission, <u>Oil and Gas Production</u>, Oklahoma City, Oklahoma: Interstate Oil and Gas Compact Commission, 1965), 116.

[8] Wiggins, Stephen N. and Libecap Garry D., "The Influence of Private Contractual Failure on Regulation: The Case of Oilfield Unitization." <u>Journal of Political Economy</u> 93 no. 4 (1985): 690–714.

[9] See <u>The Oil and Gas Journal,</u> Tulsa, Oklahoma, "Goldsmith Plan Approved," October 20, 1952, 81; "Big Goldsmith Unit in Operation," March 2, 1953, 39; "Phillips Now Handling 250 M.M. s.c.f.d. of Gas At Its Goldsmith Gasoline Plant," November 8, 1953, 86–88; "Goldsmith Pressure Maintenance Project Is living Up to Its Promise," March 1, 1954, 75–77; "Operators Stack Units in Goldsmith," June 18, 1956, 202–206; "Operators Stack Units in Goldsmith," November 22, 1965, 34–35.

[10] W.L. Horner, "Engineering Computations of Participation In Unit Agreements," <u>Oil and Gas Journal,</u> June 21,1954: 144–145.

[11] Wiggins, Stephen N. and Libecap Garry D., "The Influence of Private Contractual Failure on Regulation: The Case of Oilfield Unitization." <u>Journal of Political Economy</u> 93 no. 4 (1985): 694

[12] Smith, James L., "The Common Pool, Bargaining, and the Rule of Capture." <u>Economic Inquiry</u> 25 no. 4: 631–644.

[13] Data on file with author

[14] Robert Axelrod, <u>The Complexity of Cooperation: Agent Based Models of Competition and   Collaboration</u>, (Princeton, New Jersey: Princeton University Press, 1997), 10–29.

[15] Axelrod, <u>Complexity of Cooperation,</u> 11.

[16] Bloc 31 Plan of Unitization, on file with the Texas Railroad Commission

[17] Wiggins, Stephen N. and Libecap Garry D., "The Influence of Private Contractual Failure on Regulation: The Case of Oilfield Unitization." <u>Journal of Political Economy</u> 93 no. 4 (1985): 690–714

[18] Weaver, Jacqueline L., <u>Unitization of Oil and Gas Fields in Texas.</u> Washington D.C.: Resources for the Future, 1986.

[19] Technically Alaska and Washington state have statutes that are more favorable to unitization than Oklahoma, but Washington state has very little production, and Alaska has very little production of off-state land, so an examination of these two states would not be particularly illuminating. Another reason to avoid a study of production on state land in Alaska is that the lease which must be signed with the state of Alaska requires unitization of a field in which hydrocarbons are discovered. Oklahoma Oil and Gas Code, sec. 111

[20] Oklahoma Oil and Gas Code, sec. 111

[21] Smith, James L., "The Common Pool, Bargaining, and the Rule of Capture." <u>Economic Inquiry</u> 25 no. 4: 631–644.