NOTES

The Influence of Offshore Leasing Regimes on Commercial Oil Activity: An Empirical Analysis of Property Rights in the Gulf of Mexico and the North Sea

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CONTENTS

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I. INTRODUCTION

This note investigates the extent to which the regulatory frameworks governing property rights, and the transaction costs these frameworks produce, impact natural resource development on government land. This note examines the legal regimes for offshore petroleum exploration and production as conducted by the governments of the United States and the United Kingdom to determine how the resource management policies of these two countries affect commercial oil activity in their respective national waters, focusing specifically on continental shelf leasing in the Gulf of Mexico and offshore licensing in the North Sea.[1] Both the United States and the United Kingdom obtain a significant amount of their domestic oil production from these offshore areas,[2] but they have chosen to pursue substantively and procedurally dissimilar lease arrangements. Most important, leases in the Gulf are much smaller than North Sea license blocks.[3] This note analyzes the primary differences between the two systems, and the incongruities and inefficiencies they produce, by examining several variables to determine the extent to which the legal regimes manipulate natural resource development. Scholars of the subject point out that a closer study of these distinctions and their influence will have "important implications for leasing policy, especially for the [Outer Continental Shelf], because changes in the block sizes will affect the probability that there will be competitive exploitation,"[4] but heretofore it does not seem the topic has been addressed in legal literature.[5] The regime in the Gulf

1. This research is limited to oil operations, although the property rights regimes that govern oil leases generally also apply equally to offshore natural gas leases. Furthermore, this research may be of value when evaluating proper public land management policies to apply to natural gas development, which is quickly becoming the most important offshore resource in both the Gulf of Mexico and the North Sea. *See, e.g.*, Richie Baud, *Gulf of Mexico Key to U.S. Gas Future*, OFFSHORE (Aug. 2003).

2. Gulf of Mexico OCS oil production accounted for 23.7% of domestic U.S. oil production in 1999; this figure is expected to reach to 35.1% in 2005 and 36.5% by 2010, despite the fact that Gulf reserves are declining. Minerals Management Service, *Proposed Final Outer Continental Shelf Oil & Gas Leasing Program 2002-2007* (April 2002), at 7, *at* http://www.mms.gov/5-year/ProposedFinalProgram/Proposed Final Program.pdf (last visited July 27, 2004). The dominance of offshore crude oil production is even more dramatic in the United Kingdom, where approximately 97% of oil production in 2000 came from offshore sources. UNITED KINGDOM DEPARTMENT OF TRADE & INDUSTRY, BROWN BOOK app. 9 (2001), *available at* http://www.dbd-data.co.uk/bb2001/book.htm (last visited April 5, 2003).

3. License blocks in the North Sea are more than ten times larger than lease blocks in the U.S, *see infra* at 100-101 & note 9. *See also* Figures 1 & 2, *infra* at 100, for a hypothetical illustration of how the size of the blocks in the two regions studied overlay offshore oil fields.

4. Dean Lueck & Philip Schenewerk, *An Economic Analysis of Unitized and Non-Unitized Production in* PROCEEDINGS OF THE 1996 SOCIETY OF PETROLEUM ENGINEERS ANNUAL TECHNICAL CONFERENCE (1996), at 7.

5. Lueck and Schenewerk point out that "existing empirical efforts have been so limited by the available data that many important questions remain unanswered." *Id.* at 6. This note tries to fill this void and represents a significant research effort into the available data. Its real scholarly value lies more in its selection, compilation, and analysis of data than in its description of the legal regimes, although the paper accurately if concisely discusses the key differences between the regimes studied and establishes the intellectual framework in which

of Mexico, as compared with the regime in the North Sea, should engender economic inefficiencies that will result in both (a) higher costs for companies through redundant capital investment in production facilities and excessive administrative compliance costs, and (b) faster depletion of oil reservoirs because of competitive extractive behavior. These two factors remain distinct and are examined separately in this note, but both factors should reflect the inefficiencies created by higher transaction costs in the U.S. system. This note empirically examines these factors and predicts that the regime governing leasing in the Gulf of Mexico will create economic inefficiencies and thus U.S. policy should be reformed to resemble more closely the offshore legal regime of the United Kingdom.

At the outset, it may be helpful to employ some simple visual examples of what the regimes look like in operation.[6] The following figures roughly illustrate how in the Gulf of Mexico oil fields can easily lie beneath a number of leases, each with potentially a different owner, whereas in the North Sea it is much less likely that an oil field will lie beneath more than one license block or be controlled by more than one owner.[7] The figures demonstrate how problems of competitive ownership can arise when the existing leasing frameworks are overlaid onto geologically identical offshore oil fields. Notice how the large oil reservoir, Field A, lies under a large number of leases in the Gulf, with possibly a different owner for each lease, while in the North Sea the field is only split between two blocks.[8] Field B faces a similar problem in the U.S. system, but not in the U.K. system where it lies wholly within a single block. The two smallest fields in the example, C and D, are completely controlled by a single license holder in the British system, but two leases control C under the American regime and only Field D lies in the hands of a single owner.

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the data will be evaluated. Research for this note involved a thorough examination of thousands of data points on oil production activity collected over several decades by agencies of the United States and the United Kingdom. Much of this research is captured in Tables I, II and III, *see infra* at 41-44. While this information is available to the public, largely through websites maintained by the Minerals Management Service in the United States, *see* www.mms.gov, and the Department of Trade and Industry in the United Kingdom, *see* www.og.dti.gov.uk, this general subject, let alone the specific quantitative analysis, has not be compared or synthesized in contemporary legal scholarship.

6. These figures are included after the text, *infra* at 134, with additional commentary.

7. These figures are designed to aid the reader in conceptualizing the differences in regimes, do not represent any actual fields or leases, and are not to scale. Despite their hypothetical nature, however, the physical layouts in these figures do approximate the actual conditions, which are readily apparent when maps of the regions are examined. *See, e.g.*, UNITED KINGDOM DEPARTMENT OF TRADE AND INDUSTRY website, Maps, *at* http://www.og.dti.gov.uk/information/maps.htm [hereinafter DTI, Maps].

8. In reality, it is likely that in Britain the license blocks would be specially cut to fit the field, resulting in unitary ownership.

FIGURE 1: GULF OF MEXICO

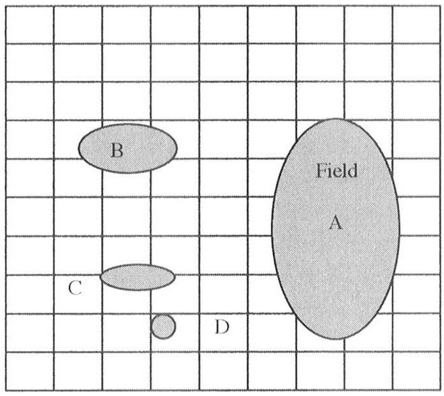
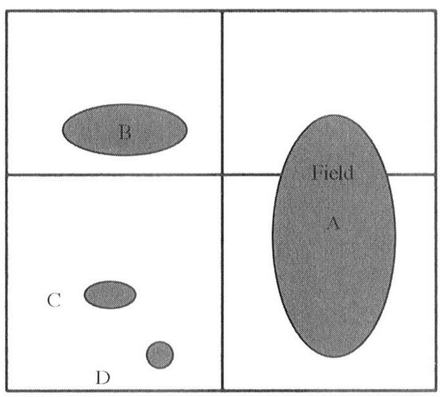


FIGURE 2: NORTH SEA



This basic configuration should allow the reader to more clearly understand the arguments and descriptions in this note.

This note is separated into five parts. Part II of this note will give a description of the two regimes. The most important differences between the U.S. and U.K. systems involve the size of the blocks leased or licensed, the level of the government's control over plans for the development of those resources, and the nature and mechanics of the leasing or licensing process. The American government auctions off small grid blocks of the Gulf of Mexico continental shelf defined by geographically uniform latitudinal and longitudinal lines that measure only about 5000 acres. The British government, in contrast, grants discretionary licenses to develop large areas of seabed of several hundred square kilometers, which is more than ten times larger than the typical leases in the Gulf,[9] and these leases can be tailored when needed to match oil field contours. In Britain, offshore oil development is more centralized and oriented towards maximizing the utilization of the resources, whereas the United States pursues more of a more free market system that leaves the private sector free to manage resources and encourages individual risk- taking by "wildcatters." This note attempts to analyze the effects of these different regimes on commercial oil activity.

Part III of this note presents the analytical framework and theoretical background of how the predictions will be tested. It begins with the Coase theorem, which posits that in a perfect system the legal regimes governing property are of no consequence because private parties will simply contract around them to reach the optimal outcome; but, as Coase admitted, we do not operate in a perfect world, and transaction costs will often prevent optimum efficiency through private action. Thus, legal frameworks do indeed matter. Transaction costs in the Gulf regime, it is predicted, will influence the efficiency of commercial oil activity. This section also includes a brief introduction to the special nature of property rights in oil and some solutions to the challenges of competition among oil producers, namely unitization to prevent unnecessary overinvestment and a race to capture the resource.

Part IV of the note will explain and examine the data collected and test it to see if the predictions supported by the analytical framework are correct. First, the research approaches the issue of inefficient allocation of investment in production and of higher costs of compliance by focusing on the quantity of parcels leased and the number of producers involved in operations (both in relation to the amount of oil produced and in absolute terms) and on the frequency with which oil fields lie underneath multiple leases controlled by unrelated parties.[10] The British process should both limit inefficient competition and remove incentives for a race to the resource because of the larger size of the blocks and the centralized but flexible approach to development. In contrast, in the Gulf a more hands-off attitude will encourage overinvestment as more producers fight to find and then assert dominion over resources lying beneath their smaller scattered holdings before neighboring oil operators win the race to extract the resource.[11] Second, this note examines the historic depletion rates, measured by annual

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9. One square kilometer equals approximately 250 acres. Therefore, the average license block in the North Sea, at around 250 km^2 or 61,775 acres, is roughly 12 times as large as a leasing block in the Gulf of Mexico, which is only around 5000 acres. For conversion information, see Area Conversion Calculator, *available at* http://www.metric-conversions.org/area/square-kilometers-to-acres.htm (last visited July 27, 2004).

10. Because capital costs are difficult to measure given the paucity of publicly available information on each company's expenditures on individual leases, the note's thesis operates on the assumption that higher costs will be associated with more diffuse and possibly redundant leasing, exploration, and production activity.

11. The potential for a "race to the resource" can be attributed to the nature of oil (it is migratory) and the somewhat unusual "rule of capture" common law legal regime that governs oil extraction from oil fields lying beneath land owned or leased by more than one owner or leaseholder. *See infra* at 109.

percentage depletion of reserves, of both selected prominent oil fields in the Gulf of Mexico and the North Sea and system-wide, to test the prediction that the U.S. regime will encourage faster reservoir decline rates because of the risk of competitive, inefficient behavior among producers when an oil field straddles more than one leasing area. The data evaluated in this note largely represents the author's own research into the subject.

Finally, Part V summarizes and attempts to explain the research findings. The results of the research appear to support the prediction that the U.S. regime leads to high administrative compliance costs and unnecessarily redundant capital investment, with more producers operating on scattered leases instead of efficiently organized production on one license block per field; in the Gulf, it seems, private parties could not overcome the higher transaction costs of the regime and organize themselves efficiently to extract the resources effectively.

Surprisingly, however, the depletion rates in both a representative sample of fields and system-wide indicate that competitive extractive behavior does not result in faster exhaustion of oil reserves in the Gulf of Mexico. This unanticipated discovery challenges conventional assumptions about competitive extractive behavior, but it may be explained, as this note discusses in its conclusion, by private cooperative arrangements and unitization agreements that reduce antagonism in commercial oil activity in the Gulf and the North Sea.

After attempting to explain the findings of the research, the note concludes that U.S. policy remains problematic and that, even though the depletion rates were not found to be higher in the Gulf as predicted, the Minerals Management Service, as the agency in charge of administering the U.S. leasing rules or, to the extent that reform develops new legislation, the United States Congress, should adjust the legal regime by increasing the size of the leases. This reform would diminish overall transaction costs, limit the risk of wasteful competition for the resource, reduce the unnecessarily high administrative compliance costs inherent in the system, and help prevent inefficient overinvestment of capital in exploration and production in situations where oil reservoirs underlie more than one lease. While the research indicates oil producers operating in the Gulf of Mexico have overcome to some extent the competitive pressures to exploit the resource as quickly as possible, as measured by depletion rates, the U.S. regime should nevertheless be modified to increase overall efficiency in commercial oil activity and reduce the possibility of competitive friction among producers. Moreover, the research expressed in this note provides a strong foundation for further and perhaps more technical research into this important natural resource management issue.

II. DESCRIPTION OF THE REGIMES

The property rights arrangements in the Gulf of Mexico and the North Sea differ fundamentally in their approaches to commercial oil exploration and production leasing. Generally, the dimensions of oil drilling concessions in the North Sea are much larger than counterpart leases in the Gulf of Mexico. Furthermore, the U.K. government takes a more active role in the administration of oil exploration and production operations, while the U.S. tends to defer to private action. These foundational differences date to the earliest efforts at producing oil in the North Sea. The United States Congress recognized the contrast between the U.S. and British systems as early as 1976. At the time, North Sea oil was a topic of burning interest to the U.S. Congress.[12] A Select House Committee on the Outer Continental Shelf noted that, "the government framework and laws applicable to North Sea oil and gas activity are significantly different from those in the United States."[13] The report explained that the "British favor more rapid development of their oil resources," and the "[British] Government is authorized to participate in the exploration and development of the resources" while issuing licenses to private parties "on a discretionary basis" to develop blocks that measure "between 80 and 100 square miles each."[14] This somewhat dated American assessment of the British system still captures the primary differences between the two systems: government policy, administrative procedure, and size of leasing blocks. This note asks how these differences in leasing/licensing programs will affect commercial oil and gas activity.

After years of federalism-related controversy over ownership, Congress finally took affirmative action to assert control over the Outer Continental Shelf in 1953.[15] The passage of the Outer Continental Shelf Lands Act (OCLSA)[16] paved the way for commercial oil and gas activity on federally owned submerged lands. The original OCSLA as passed in the early 1950s "made clear that it was in the national interest of the United States to proceed vigorously with the exploitation of offshore oil and gas resources. . . ,"[17] but environmental concerns in the 1970s prompted Congress to restructure the OCS leasing process with the 1978 OCSLA amendments.[18] The amendments sought to "balance orderly energy resource development with protection of the human, marine, and coastal environment"

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12. In the 1970s, the newly discovered oil in the North Sea represented "the biggest new play for the world oil industry, and its single greatest concentration of capital investment and effort." DANIEL YERGIN, THE PRIZE: THE EPIC QUEST FOR OIL, MONEY, AND POWER 667-668 (1991).

13. *See North Sea Petroleum Operations in the United Kingdom & Norway: A Study: Hearings Before the U.S. House of Rep. Ad Hoc Select Comm. on the Outer Continental Shelf*, at 4 (1977).

14. *Id.* at 10.

15. *See* E. Edward Bruce, *The History, Status, and Future of OCS Leasing*, *in* OIL AND GAS OPERATIONS IN FEDERAL AND COASTAL WATERS 1-2 (Rocky Mountain Mineral Law Foundation 1989). *See also* Lynn S. Sletto, *Comment: Piecemeal Legislative Proposals: An Inappropriate Approach to Managing Offshore Drilling*, 33 GOLDEN STATE U. L. REV. 557, 558-560 (2003).

16. 43 U.S.C. § 1331.

17. *See* Bruce, *supra* note 15, at 2.

18. 43 U.S.C. § 1811. *See also* Sletto, *supra* note 15, at 562-65.

while preserving "free enterprise competition."[19] Although other interests, such as the environment, will be considered in formulating policy, the dominance of private enterprise continues to be strongly guarded by the U.S. government.[20] These amendments and their mandates still largely govern U.S. continental shelf policy today.

The Minerals Management Service (MMS) presently oversees the operational aspects of the Gulf of Mexico leasing program out of its district offices in Louisiana and Texas, overseeing over one billion acres of federal offshore lands and collecting over U.S. $10 billion a year in revenue.[21] The MMS divides the Gulf of Mexico into Planning Areas, which are then subdivided by drawing grid lines to create 5000 or 5760 acre blocks that serve as the "basic leasing subdivision" for offshore oil activity.[22] Leases for these blocks are offered in a series of leasing rounds, subject to a very specialized set of guidelines and complicated procedures.[23] Federal law mandates the use of a competitive bidding process.[24] The MMS is charged with managing the leasing rounds, each coordinated as part of a five-year plan as required by the OCLSA.[25] For each leasing round a final notice of sale package is prepared.[26] Lease sales, which must be conducted in "strict compliance" with final notices of sale, are generally held in New Orleans. All bids must be received by the date set out in the final notice of sale, after which they are publicly opened and read aloud by midnight.[27] Bids are then evaluated to ensure they "provided 'fair market value' for the public resources."[28] Bids consist of annual rental amounts and one time "bonus payments."[29] Title to a federal petroleum exploration or production lease in the Gulf of Mexico entitles the leaseholder to explore or produce oil in accordance with general regulations governing offshore operations.[30] Oil production leases in the Gulf of Mexico are issued for five, eight, or ten years, depending on water

19. *See* R. SCOTT FARROW, MANAGING THE OUTER CONTINENTAL SHELF LANDS: OCEANS OF CONTROVERSY 27 (1990).

20. *See* 43 U.S.C. § 1333 (a) (3).

21. *See* MMS, Gulf of Mexico Region website, *at* http://www.gomr.mms.gov/homepg/whoismms/aboutmms.html (last visited July 27, 2004).

22. Blocks off the coast of Louisiana are 5000 acres, and all other regular blocks are 5760 acres. Where longitudinal boundaries skew the size of a block, "sliver blocks" are created that vary in size from a few acres to several thousand. *Id.* at 32.

23. 53 Fed. Reg. 10596 (Dep't of the Interior Apr. 1, 1988) (to be codified at 30 C.F.R. pts. 250 and 256).

24. KENNETH W. DAM, OIL RESOURCES: WHO GETS WHAT HOW? 147 (1976) (citing 43 U.S.C. § 1337).

25. *See* Notice of Availability of the Proposed Final 5-Year OCS Oil and Gas Leading Program for 2002-2007, 67 Fed. Reg. 19447 (April 19, 2002); *see also*, Farrow, *supra* note 19, at 96.

26. MMS, *Oil and Gas Leasing Procedures Guidelines*, OCS Report MMS 2001-076 (October 2001), *at* http://www.gomr.mms.gov/homepg/whatsnew/techann/2001-076.pdf (last visited July 27, 2004).

27. *Id.*

28. *Id.* at 35, 42-47 (describing a very complex process used to determine fair value).

29. The most recent bidding produced over $300 million in high bids. MMS Press Release, (March 19, 2003), *at* http://www.gomr.mms.gov/homepg/ whatsnew/newsreal/030319.html.

30. *See generally* MMS, Overview of OCS Regulations, *available at* http://www.gomr.mms.gov/homepg/regulate/regs/reg_sum.html (last visited April 16, 2003).

depth.[31] The lease term may be extended and leases are transferable within regulations and with approval.[32] In addition to annual rent and the original bonus payment, leaseholders are obligated to pay annual royalties based on production to the U.S. Government,[33] generally twelve and one half percent for deep water and sixteen and two thirds percent for shallow drilling.[34]

The situation is somewhat different across the pond. The British experience with offshore petroleum development can be traced to more recent origins. Phillips Petroleum discovered the first oil field in the North Sea in 1969,[35] whereas the first true offshore oil rig in the U.S. was put into operation back in 1947.[36] Moreover, the treacherous conditions of the North Sea required much larger expenditures of effort, time, and money.[37] Despite these challenges, however, North Sea oil development, "one of the greatest investments projects in the world" and a "technological marvel of the first order [,] . . . was carried out in an amazingly expeditious manner."[38]

Government policy in the United Kingdom can also be contrasted with the United States' approach. Parliament always controlled North Sea development tightly, though it continually relied on the private sector for support.[39] Depending on the political inclinations of the government in Westminster, British offshore petroleum projects experienced varying degrees of direct government involvement, including for a time participation in the sector by a state-owned oil company. Generally, however, "the government did not want to interfere with the decisions of private companies."[40] Preference for British companies in licensing rounds and the existence of a national oil company ended during the Conservative political era of the 1980s.[41] Even with the somewhat socialistic tendencies of the Labour government in the 1970s,[42] Britain was primarily concerned with the rapid and economically successful exploitation of resources.

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31. MMS OCS Report 2001-076, *supra* note 26, at 50. Five year leases apply for water depths under 400 meters, eight year terms apply for depths of 400 to 800 meters, and ten year leases apply for depths greater than 800 meters. *Id.*

32. *Id.* at 57.

33. *Id.* at 56; 30 C.F.R. § 202.52 (2004).

34. 30 C.F.R. pt. 260; *see also* MMS, *General Federal and American Indian Lease Terms*, *at* http://www.mrm.mms.gov/Stats/pdfdocs/lse_term.pdf (last visited June 10, 2004).

35. YERGIN, *supra* note 12, at 668, 784.

36. *Id.* at 429.

37. *Id.* at 574.

38. *Id.* at 669.

39. SVEIN S. ANDERSEN, THE STRUGGLE OVER NORTH SEA OIL AND GAS 172 (1993)("The government interest was secured by combining general administrative competence and oil industry expertise."). As in the U.S., "the search for oil and gas was initiated by private companies. . . [who were] active in getting governments around the North Sea to set the ground rules needed to make the exploration for oil and gas a practical proposition." *Id.* at 44.

40. *Id.* at 172.

41. BRENT F. NELSEN, THE STATE OFFSHORE 106-7, 155-68 (1991).

42. Even during the 1970's, the British maintained a "deep rooted respect for contractual obligations." ANDERSEN, *supra* note 39, at 94.

Furthermore, basic sovereignty issues are somewhat different. Offshore production in the North Sea remains unaffected by the claims and concerns of states in a federal system, a traditional political concern in the United States. The Crown owns oil resources under the United Kingdom Continental Shelf (UKCS).[43] Under the 1998 Petroleum Act, "Her Majesty has the exclusive right of searching and boring for and getting petroleum . . . beneath the territorial sea adjacent to the United Kingdom."[44] Despite this royal prerogative, the right to explore and produce oil has been vested in the Secretary of State,[45] who in turn has delegated the power to the Department of Trade and Industry (DTI) in accordance with his discretion under the Petroleum Act.[46] Currently, DTI's Energy Command administers the UKCS offshore licensing program.[47]

The British licensing system also consists of "rounds," currently held every year,[48] but the procedures, details, and underlying policy diverges significantly from the program administered by the MMS for the Gulf of Mexico. In a word, and in line with government policy, the British licensing system can be described as more "flexible" than the U.S. regime, which follows a very formulaic and unbending bureaucratic framework. In the words of the DTI, in Britain:

> [m]ost Licences follow a standard format, but DTI is flexible in this and ready to consider adapting new licences to suit special scenarios. The Secretary . . . has discretion in the granting of licences, which he exercises to ensure maximum exploitation of this valuable national resource. . .[49]

British rounds also involve competitive bidding for selected blocks of UKCS land. DTI maps the North Sea in order to legally define the license areas, using a cartographic method similar to the one used by the MMS.[50] The blocks, however, are much bigger in the North Sea, typically 250 square kilometers.[51] The British Government puts up for license all blocks for which the required environmental assessment has been completed.[52] Once licensed, the previously geographically uniform blocks technically remain, but the actual license is often cut to fit the

43. Petroleum Act of 1998, 1998 Chapter 17, Part I, § 2.
44. *Id.* at § 2(1) & (2).
45. *Id.* at § 3(1).
46. *Id.* at § 4.
47. DTI, Overview, *at* http://www.og.dti.gov.uk/upstream/licensing/overview.htm (last visited July 27, 2004).
48. DTI, Licensing: Award of Licenses, *at* http://www.og.dti.gov.uk/upstream/licensing/licawards.htm (last visited July 27, 2004). (last visited April 16, 2003) ("We are committed to a regular timetable of one onshore and one offshore Licensing Round each year.").
49. DTI Website, Overview, *supra* note 47.
50. *See* DTI Website, Guidance Notes on the Use of Co-ordinate Systems in Data Management on the UKCS, *available at* http://www.og.dti.gov.uk/regulation/guidance/co_systems/index.htm (last visited July 27, 2004).
51. Nelsen, *supra* note 41, at 91, Table 5.1; DTI website, *at* http://www.offshore-sea.org.uk/sea/dev/html_file/sea3_consult.cgi?sectionID=6 (last visited July 27, 2004).
52. Email from Michael Hawkins (DTI)(April 17, 2003) (on file with author).

pattern of an existing oil or gas field.[53] The size of the licensed areas helps reduce overlap, and rarely do known oil reservoirs lie under more than two or three licenses; often they exist under only one licensed area.[54] The irregular pattern of licenses results from relinquishments of unused acreage by license holders or, for older fields, remains as a holdover of now privatized BNOC license interests that followed the boundaries of a field.[55]

Two types of licenses are available: production and exploration. Production licenses, "in spite of their name. . . don't cover just production - they cover the full life of a field from exploration to decommissioning."[56] They are the most common type of license, and over 1000 have been issued since the 1960s.[57] These production licenses can be compared with the MMS leases offered in the Gulf of Mexico,[58] except the licenses cover "typically a couple of hundred square kilometers,"[59] instead of the 5000 or 5760 acres under the U.S. regime. This means the blocks in the North Sea are approximately ten times larger than leasing blocks in the U.S. system. DTI issues production licenses for set durations, but they may be automatically renewed, depending on the achievement of certain exploration or production goals. All licenses include "model clauses," or set license terms formulated by the British Parliament through legislation.[60] The DTI has also promulgated guidelines for the development of oil fields discovered or already existing under a licensed block,[61] and the Secretary (through the DTI) retains significant discretion in determining how oil exploration and production will proceed. License holders pay progressive annual rental rates for their rights.[62]

In summary, the American and British regimes for offshore oil development differ with respect to their history and operation, yet share some key similarities.

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53. *Id.*

54. *See* DTI, Maps, *supra* note 7.

55. Email from Michael Hawkins, DTI (April 17, 2003) (on file with author).

56. DTI Website, Licensing: License Types, *available at* http://www.og.dti.gov.uk/upstream/licensing/lictype.htm, (last visited July 27, 2004).

57. *Id.*

58. The United Kingdom issues exploration licenses, which have no comparable counterpart in the Gulf of Mexico, for three-year periods and allow for exploration anywhere on the UKCS except those areas covered by production licenses. *Id.*

59. *Id.* Production licenses originally follow the boundaries of a geographic block, but relinquishments and deals between producers cut the licensed areas into shapes that often follow the contours of oil reservoirs.

60. *See* The Petroleum Current Model Clauses Order, Statutory Instrument 1999 no. 160 (Jan. 27, 1999), *available at* http://www.hmso.gov.uk/si/si1999/19990160.htm (last visited July 27, 2004).

61. For details, *see* DTI website, Guidance Notes on Regulating Offshore Oil and Gas Development, *at* http://www.og.dti.gov.uk/regulation/guidance/reg_offshore/index.htm (last visited, July 27, 2004).

62. Rates for traditional licenses start at 150 GBP per square km the first year, 300 GBP the second year, and rising over time in annual increments of 900 GBP until reaching a maximum of 7500 GBP per square km. *See Announcement of United Kingdom Onshore and Offshore Oil and Gas Licensing Round, Offshore (Seaward)*, OFFICIAL J. OF THE E.U. C27/3, 27/5 (Feb. 5, 2003), *available at* http://www.og.dti.gov.uk/upstream/licensing/21_11_rnds/OJannounce.pdf (last visited July 27, 2004).

For the purposes of this note, however, the differences are more striking than the parallels. Lease size in the Gulf of Mexico remains minute in comparison to the expansive licensed areas in the North Sea. Moreover, the attitude of the British government towards offshore oil is one of flexibility and maximization of resource yields in partnership with the private sector, whereas the U.S. tends to defer extraction strategy almost completely to private industry with little central government planning for individual extraction projects.

These differences in property rights arrangements should lead to higher transaction costs in the U.S. regime. Foremost, the much greater number of leases in the U.S. system means that oil exploration and production in the Gulf of Mexico is more competitive and lease holding is needlessly diffuse and complicated. Since the leases do not follow the contours of oil fields, and are often smaller than the geographic boundaries of undersea oil deposits, control over production from a field is often fractured among many lease holders. Given the larger size of leases in the North Sea, fractured ownership, and the transaction costs associated with it, should be lower under the U.K. regime. As discussed below, the U.S. system has the potential to create a competitive environment whereby neighboring leaseholders race to capture the resource resulting in inefficient depletion of common pools. The U.S. system poses increased administrative obstacles as well: each lease must be bid upon separately, and much more effort is required to unify a similarly-sized area of the continental shelf under one lease holder.

The concept of "transaction costs," a somewhat vague and un-definable term commonly employed in economic and legal literature,[63] is used in this note as a catch-all term for the costs, measured by money and effort as well as foregone opportunities, that result from the kind of legal, commercial, or geo-political obstacles inherent in any property rights or legal liability regime which make it more difficult to negotiate towards or achieve a certain desired outcome. In the context of offshore oil, higher transaction costs stem from concerns such as: redundant capital investment in unnecessary exploration and production facilities operated by neighboring leaseholders extracting from a common pool; higher administrative compliance costs, in both time and fees, created by the need to bid on and maintain numerous leases; the increased likelihood of litigation over disputes among disparate leaseholders; the costs associated with inefficient competitive extraction; transactions costs connected with the need to negotiate unitization agreements among common pool owners; and duplicative overhead and transportation costs among the competing operators, among other similar issues. Put simply, it is likely more complicated, competitive, and costly to explore and drill for oil in the Gulf of Mexico given the U.S. regime. Many of

63. *See generally* William J. Aceves, *Institutionalist Theory and International Legal Scholarship*, 12 AM. U.J. INT'L L. & POL'Y 227, 243 n. 87 (1997); *see also infra* notes 80 & 83 and accompanying text.

these transaction costs are lower, or completely absent, under the U.K. regime due to the nature of the property rules operating in the North Sea.

III. THE ANALYTICAL FRAMEWORK

Theoretically, the legal offshore oil leasing arrangements established in the United States and the United Kingdom would not have any impact on the efficiency of commercial exploration and production operations. The theorem introduced by economist Ronald Coase[64] would predict that, absent transaction costs, parties would negotiate the optimal and most efficient outcome regardless of the legal regime in place. In reality, however, the legal regulations governing private sector action often impact the efficiency of that activity. Transaction costs are, as Coase admitted, unavoidable. This note examines the comparative impact of Gulf of Mexico leasing and North Sea licensing programs on commercial oil activity in those regions; thus, in Coasian terms, this study explores how the transaction costs associated with these regimes create inefficiencies, namely sub-optimal rates of pool depletion and overinvestment in capital assets. Since petroleum in particular involves some special considerations, both geophysically and with regard to the controlling legal rights associated with it, this note will first briefly detail the unique problems associated with oil production.

Because of oil's inherent qualities[65] and the traditional legal rules applied to its ownership, competition often results when two or more producers own rights to an oil reservoir, as when several offshore leases cover a single oil field. The legal framework that has come to govern oil ownership is known as the "rule of capture."[66] This rule was developed in response to the unique nature of petroleum as a mineral, namely that it is both migratory or "fugacious" – it "may move from place to place within sedimentary rock" – and fungible, meaning that "it is difficult to determine whether a given. . . barrel of oil produced has been drawn from under one tract. . . or another."[67] The rule of capture holds that ownership of oil vests in the person who extracts it. More specifically, under the rule of capture:

> There is no liability for capturing oil and gas that drains from another's lands. The owner of a tract of land acquires title to the oil and gas that he produces from wells drilled thereon, though it may be proved that part of such oil and gas migrated from adjoining lands.[68]

64. *See* Ronald H. Coase, *The Problem of Social Cost*, 3 J. L & ECON. 1 (1960).

65. Crude oil is the liquid form of petroleum, a hydrocarbon that exists inside formations of sedentary rocks formed millions of years ago by ancient seas, and it has the ability to migrate from one location to another. *See* JOHN S. LOWE, OIL AND GAS LAW IN A NUTSHELL 1 (1995).

66. This rule was first laid down in the United States by *Westmoreland v. DeWitt*, 130 Pa. St. 235 (1889). *See* ROBERT E. SULLIVAN, HANDBOOK OF OIL & GAS LAW 45 (1955). *See also* Gary D. Libecap & James L. Smith, *The Economic Evolution of Petroleum Property Rights in the United States*, 31 J. LEGAL STUD. 589 (2002).

67. LOWE, *supra* note 65 at 8.

68. *Id.* at 9. Several subsequently developed legal rules, such as correlative rights, modify the rule of capture,

The rule of capture therefore encourages the development of oil resources by limiting liability and rewarding extraction.[69] The rule does not, however, necessarily encourage *efficient* extraction. In many ways, the rule of capture represents the traditional tragedy of the commons.[70]

When a reservoir lies beneath two or more parcels of land (or, for the purposes here, offshore lease or license areas), the rule of capture encourages the producers to extract as much as they can as fast as they can, in order to assert dominion over the resource. Until the producers possess it outside of the ground, ownership is uncertain and adjacent landowners may claim the resource themselves if able to extract it first. The economic inefficiencies associated with common pool extraction problems are well established in the academic literature.[71] The rule of capture creates a "race to produce" that has long characterized the petroleum industry, leading to "damaging overproduction and excessive capitalization."[72] Indeed, a leading scholar has commented "many oil and gas reservoirs cannot be operated efficiently under the common law."[73]

Certain measures, however, can be taken to minimize or even eliminate the inefficiencies associated with common pool extraction. Generally speaking, several solutions have been formulated, including well spacing rules and production rate regulations,[74] but the most economically efficient method is a process called unitization. "With unitization, all the tracts in the field are combined so that the entire reservoir can be treated as a single production unit," usually with one participating producer designated as the manager of operations.[75] By treating the entire field as a single operating unit, unitization achieves the efficiencies that the

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and limit the scope of liability protection. *See id.* at 10-15. For the purposes of this note, however, merely a basic understanding of the rule of capture is sufficient to frame the problems discussed.

69. *Id.* at 9.

70. *See* Barton Thompson, *Tragically Difficult: The Obstacles of Governing the Commons*, 30 ENVTL. L. 241, 243-44 (2000). *See also* Rance L. Craft, *Comment: of Reservoir Hogs and Pelt Fiction*, 44 EMORY L. J. 697, 704 (1995); Arthur Mizzi, Comment, *Caspian Sea Oil, Turmoil, and Caviar*, 7 COLO. J. INT'L ENVTL. L. & POL'Y 483, 496-97 (1996).

71. *See* Libecap & Smith, *supra* note 66 (tracing the evolution of petroleum property rights); Lueck & Schenewerk, *supra* note 4; JACQUELINE WEAVER, UNITIZATION OF OIL AND GAS FIELDS IN TEXAS (1986) (representing an exhaustive study of unitization in Texas). Lueck and Schenewerk point out, however, that "existing empirical efforts have been so limited by the available data that many important questions remain unanswered." Lueck & Schenewerk, *supra* note 4 at 6. *See generally* Rance L. Craft, Comment, *Of Reservoir Hogs and Pelt Fiction*, 44 EMORY L. J. 697, 704-13 (1995). For a discussion of unitization of fields that straddle international borders, *see* David M. Ong, *Joint Development of Common Offshore Oil & Gas Deposits*, 93 A. J. INT'L. L. 771, 772-774 (1999).

72. GARY LIBECAP & JAMES L. SMITH, REGULATORY REMEDIES TO THE COMMON POOL: THE LIMITS OF OIL FIELD UNITIZATION, 22 ENERGY J. 1 (January 1, 2001).

73. Weaver, *supra* note 71, at 25. Weaver further comments that the "efficient recovery of oil and gas often requires the careful control of production rates and well placement and often results in the large-scale displacement of fluids from one person's tract to another. The common law rule of capture and trespass conflicts with these conservations essentials." *Id.* at 34-35.

74. *See* LOWE, *supra* note 65, at 18-27.

75. Weaver, *supra* note 71, at 25.

common law and other regulations are unable to accomplish.[76] Recognizing the special nature of oil and the inadequacies of the common law in effectively dealing with its extraction and ownership, the United States has enacted regulations allowing for, and in some cases requiring, unitization of oil reservoirs located on government lands on the continental shelf.[77] In the absence of these regulations, the achievement of voluntary unitization through private agreement often remains elusive[78] and complete field unitization is not widespread in the United States.[79] These difficulties further indicate that high transaction costs frustrate private attempts to unitize joint fields on a voluntary basis.[80]

Applying the Coase Theorem, one would predict that in theory private parties operating in the Gulf of Mexico and North Sea would be able to negotiate optimal arrangements for the exploration of petroleum resources and in the extraction of those resources, regardless of the size of the leases in relation to the geophysical nature of the oil reserve being exploited. Oil companies would seek to obtain operating control over entire petroleum fields or enter into unitization agreements to reduce common pool extraction problems and would avoid duplicative efforts in both exploration and production through negotiated property rights arrangements. Such a theory suggests that commercial activity would be pursued in the same manner and with the same results (absent technological considerations) in both the Gulf and North Sea despite the differences in leasing regimes. Private parties, assuming that they operate as rational decision makers in the economic sense, would simply contract around the regimes in place to achieve the optimal

76. *Id.* at 34-35.

77. *See* 30 C.F.R. § 250 (2004); *see also* MMS Website, Unitization, *available at* http://www.gomr.mms.gov/homepg/pd/unitization.html (last visited April 30, 2003). The only reported federal case dealing with compulsory unitization under the OCSLA remains *Clark Oil Producing Co. v. Hodel*, 667 F. Supp. 281 (E.D. La. 1987), which was decided before the adoption of 30 C.F.R. Section 250. In *Hodel*, the government successfully argued that it had the authority to force unitization in "competitive" fields to prevent the drilling of unnecessary wells and to " 'sustain efficient reservoir depletion.' " *Id.* at 285-86. From the information available through the MMS, it is unclear how often compulsory unitization agreements have been implemented under Subpart M authority, but it appears that none have been challenged given the absence of case law or Federal Register references on the subject. MMS has the authority to order compulsory unitization, but it is unclear they have used it. *See, e.g.*, Notice of Proposed Rule Making, 61 Fed. Reg. 28525, 28528 (June 5, 1996).

Voluntary unitization agreements under Subpart M have been reached, but it is not clear exactly how many, although the MMS expects no more than twelve per year will be requested. *See* 55 Fed. Reg. 48918 (Nov. 23, 1990).

78. *See* Lueck, *supra* note 4, at 426 (1995) ("Private "unitization" contracts sometimes have emerged to coordinate the actions of those with surface access to oil and gas. In many cases, however, the cost of forming units is prohibitive."). *See* Jacqueline Weaver, *The Federal Government as Useful Enemy: Perspectives on the Bush Energy/Environmental Agenda from the Texas Oilfields*, 19 PACE ENVTL. L. REV. 1, 7-8 (2001).

79. Gary Libecap, *Environmental Regulation & Federalism*, 38 ARIZ. L. REV. 901, 995 (1996).

80. Hold out problems and especially transaction costs, among other issues, explain the difficulty of voluntary unitization. *See* Mizzi, *supra* note 70, at 496-97. "Transaction costs can inhibit unitization due to communication difficulties between individual producers or because the number of producers is so large that it is difficult to reach an agreement. For this reason, transaction costs generally increase as the number of producers increases." *Id.* at 497.

arrangements. Presumably, economically rational actors would also seek to preserve the value of the resource at the most efficient level.

The regulations in place in the two countries studied, however, have the potential to create transaction costs that make efficiency difficult to achieve through inter-party negotiation in the private sector. The migratory nature of petroleum reserves and the concomitant traditional property rights rule of capture can create sub-optimal extraction in non-unitized fields that are accessible from more than one leasing block.[81] High transaction costs may preclude the effective unitization and joint operation of such fields at optimal production levels, notwithstanding federal regulations promoting unitization of such reserves.[82] Incentives to find and produce the petroleum resources in order to claim the economic benefits may discourage cooperation between private parties.

IV. EMPIRICAL ANALYSIS

Based on this analysis of the incentives associated with the production of oil as impacted by the regimes governing the Gulf of Mexico and the North Sea, this note predicts that the differences in regimes will result in: (a) higher costs for companies through redundant capital investment in production facilities and excessive administrative compliance costs, and (b) faster depletion of oil reservoirs because of competitive extractive behavior. Since it is impossible to directly measure transaction costs, which are largely theoretical economic obstacles to optimal efficiency,[83] this note focuses on several proxy variables that indicate the existence of higher transaction costs or at least attempt to measure their impact. It is, unfortunately, a way of evaluating symptoms and is admittedly an imperfect barometer of a complex economic problem. Nevertheless, the framework employed in this note allows for a testing of predictions of how transaction costs impact commercial oil activity. Several variables are studied in attempting to test these predictions and further understand the impact of transaction costs on commercial oil activity. It is important to first explain the relevance of each factor evaluated and its connection with the underlying theory.[84] Much of this research, particularly the field specific analysis, involved an exhaustive review of more than twenty years worth of detailed annual field data that has previously not been

81. *See* Lueck & Schenewerk, *supra* note 4, at 7 (Suggesting that studying empirical data for oil reservoirs would have "important implications for leasing policy, especially for the OCS, because changes in the block sizes will affect the probability that there will be competitive exploitation and the demand for units.").

82. Under 30 C.F.R. section 250, the MMS may approve, or require, operators on adjoining leases to enter into unitization agreements to prevent waste of the resource and protect correlative interests or federal royalty interests. Oil and Gas and Sulphur Operations in the Outer Continental Shelf, 30 C.F.R. § 250.1304 (2004); *see* MMS website, Unitization, *at* http://www.gomr.mms.gov/homepg/pd/unitization.html (last visited Feb. 17, 2003).

83. The concept of "transaction costs" remains difficult to define. *See* Aceves, *supra* note 63, at 243 n. 87.

84. For ease of reference, the results of the research are captured in Tables I, II & III. *See infra* at 126-129.

analyzed in this format.[85]

In Part A of this Section, as a way to measure the impact of transaction costs on capital investment and administrative compliance, this note looks at (1) number of leases; (2) number of operators; and (3) frequency of competitive fields. This note predicts there will be a larger number of active leases and operators in the Gulf of Mexico than in the North Sea in absolute terms and in relative terms the North Sea operators will produce more oil both per lease and per operator than in the Gulf of Mexico. While it seems obvious that in the Gulf more leases will exist and that these leases will be less productive because of the smaller size, in theory the individual operators in the Gulf should extract about as much oil as their counterparts in the North Sea because, absent transaction costs, private parties will negotiate for the most efficient allocation of investment to exploit the natural resources. Additionally, evaluating the number of leases and the oil produced per lease illuminates the level of administrative costs associated with each regime, and also serves as a rough proxy for redundancies in overhead expenses and other unnecessary business expenditures. The third, and critically important variable studied is the frequency of competitive fields. This note predicts that in the specific fields studied reservoirs will most likely cover multiple leases in the Gulf while similar fields in the North Sea will usually fall under only one owner. In researching this variable, the note looks at a selected group of prominent fields in both areas and cross checks these fields with current lease and license ownership data.

Next, in Part B of this section, this note looks at the depletion rates of both the regimes, first by analyzing a number of selected fields in both regimes and in terms of system-wide depletion rates. The depletion rates in the Gulf of Mexico should be higher than those in the North Sea, both system-wide and when annual depletion rates are calculated for specific fields. The system-wide rates reflect overall trends and are obtained from a simple calculation of current rates of production as a function of original reserves and remaining reserves. The field specific depletion rates, however, involve a much more in depth analysis of year-by-year production from carefully selected fields in both regions that represent the largest comparable fields in the two regimes. Depletion rates are important because, as discussed above,[86] the rule of capture encourages neighboring producers to engage in a wasteful race for the resource that usually results in a less than optimal conservation.[87] Each owner will throw up rigs and invest in

85. As such, many of the calculations, and the insights they illuminate, are a result of the author's own research, but all the inputs are based on publicly available information. This information simply has not been collected and evaluated in this manner.

86. *Infra* at 110.

87. Common pool problems are solved by unitization, but this note argues that the transaction costs of the U.S. regime will prohibit private unitization, thereby creating higher depletion rates in the Gulf. "[U]nitization replaces the shortsighted wasteful patterns that exist under multiple ownership and the rule of capture with a pattern of development carefully conceived to maximize the value of oil and gas to the owners and to society.

production equipment to capture the oil before his neighbor does, with little thought for efficient production, and it is empirically proven that in these competitive situations oil fields decline at a much faster rate.[88] In the Gulf of Mexico, where competitive fields are more likely, oil fields should be quickly depleted as a result of this race, whereas the North Sea fields should experience more stable and slower decline rates.

A. ADMINISTRATIVE COMPLIANCE AND CAPITAL COSTS

Three variables indicative of inefficient capital investment and superfluous administrative costs associated with offshore commercial production were measured: (a) the number of producers holding leases or licenses; (b) the number of active leases in the systems; and (c) how often oil fields cover more than one lease or license in the selected fields examined. This note looks at the first two figures both in absolute terms and in relation to the amount of oil produced. While only serving as an admittedly imprecise proxy for inefficient capital outlays and bureaucratic compliance expenses, the number of producers and active leases can illuminate the major divergences between the regimes and to some extent should capture, or at least aid in the prediction of, the economic effects of unnecessary capital investment, redundancies, and higher administrative costs from duplicative procedural maneuvering and regulatory compliance. Quite simply, ten companies operating on several dozen leases to produce the same amount of oil as extracted by one company operating on one or two licenses may very well involve some duplicative efforts, unnecessary overhead redundancies, and overall inefficiencies from overcapacity. Producers, in an effort to extract the resource lying beneath their leases, will likely engage in a race to the resource with wasteful consequences. This phenomenon is captured in the third variable studied, the prevalence of multiple leased or licensed tracts situated above an oil field, which ties in closely with the depletion rate analysis and further aids in measuring inefficient overinvestment. Significant differences in the two regimes quickly become apparent upon examination of the data, and the results support the general prediction that the Gulf has higher transaction costs.

1. Number of Leases And Producers in Absolute Terms and in Relation to Oil Production

The number of lease or licensed areas and the number of producers holding title to leases and licenses, in both absolute terms and relative to amount of oil

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Thus, unitization is an unmixed blessing. It benefits producers, consumers, and society." Richard J. Pierce, Jr., *State Regulation of Natural Gas in a Federally Deregulate Market: The Tragedy of the Commons Revisited*, 73 CORNELL L. REV. 15, 75 (1987).

88. *See* Libecap & Smith, *supra* note 71, at 1. *See also* RAYMOND M. MYERS, THE LAW OF POOLING AND UNITIZATION: VOLUNTARY, COMPULSORY 2, 21 (1967).

produced, comports with the prediction that lease sizes and procedures in the Gulf of Mexico will result in less oil produced per lease and per operator. The absolute number of active leases in the Gulf is approximately 7500,[89] whereas there are only 428 licensed areas in the North Sea.[90] On a barrels of oil produced per lease or license basis, the Gulf produces approximately 57,000 barrels per lease[91] and the North Sea produces on average around two million barrels per lease,[92] quite a dramatic difference, but this finding should be obvious given the different size of the leases. From the administrative cost angle, at the very least, the administration of more than 7000 leases, each of which must be assigned through a strict and complex bureaucratic process and renewed at set intervals, produces more compliance costs than the management of only around 425 licenses, and this similarly generates higher compliance costs by operators, who have to contend with bureaucracy for each block they want to lease. More importantly, the total number of producers operating in the Gulf currently stands at about 390,[93] while only 185 companies operate in the North Sea.[94] Theoretically, no additional producers should operate in the Gulf simply because more leases exist, especially given the fact that the Gulf produces much less oil overall; the finding that more companies are operating in the Gulf supports the contention that the Gulf regime engenders unnecessary duplication of efforts. Each operator in the Gulf produces approximately one million barrels of oil per year,[95] while

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89. *See* MMS website, *at* http://www.gomr.mms.gov/homepg/fastfacts/WaterDepth/WaterDepth.html (calculated as the sum of all active leases at all depths. These statistics are subject to change weekly, but for the purposes of this paper the statistics used correspond with spring 2003).

90. Email from DTI (March 21, 2003) (on file with author).

91. As calculated by author, based on 427 million barrels divided by 7483 active leases. *See* MMS website, Annual Summary of Production, *at* http://www.gomr.mms.gov/homepg/pubinfo/repcat/product/pdf/ Region Production by Year 1997-2000.pdf (last visited July 27, 2004).;MMS website, Gulf of Mexico Region, Offshore Statistics by Water Depth, *at* http://www.gomr.mms.gov/homepg/fastfacts/WaterDepth/WaterDepth.html (last visited July 27, 2004) (number of active leases).

92. As calculated by author, based on 841 million barrels production in 2000 divided by 428 active leases. For 2000 production information, *see* Brown Book, *supra* note 2 (841,703,900 barrels in 2000 calculated as 114,830,000 tonnes from offshore fields converted into barrels at 1 metric tonne oil = approximately 7.33 barrels oil). For conversion information, *see* Main Conversions Used in Petroleum Products, *at* http://petroleum.nic.in/psconv.htm [hereinafter Main Conversions]; Amos Mutiga, *Energy Data Conversions*, Table 3.6, p. 5 *available at* http://www.afrepren.org/datahandbook/pdfs/conver.pdf. Number of leases statistic from Email from DTI (March 21, 2003)(428 active leases) (on file with author).

93. OCSBBS Website, *at* http://www.ocsbbs.com/ocsbbs/private/gulfwide_activity_lists.asp (using figures from spring 2003).

94. DTI Website, *at* http://www.og.dti.gov.uk/dti-lift/lift6.htm (using numbers from spring 2003). This number is somewhat misleading as it includes all of the affiliates of companies operating in the North Sea. There are only 75 licensed parent corporations holding licenses in the British regime. When adjusted for this fact, the per operator production is actually 11.5 million barrels per producer. From the nature of the data available, it is not possible to determine how many U.S. companies are direct affiliates of larger parents, but it appears that many more leaseholders in the U.S. are smaller, independent oil companies.

95. As calculated by author, based on 391 active leaseholders (*see supra* note 93) divided by 427 million barrels per year production (*see supra* note 91).

North Sea operators produce on average over 4.6 million barrels of oil each.[96] These figures highlight the higher degree of efficiency achieved in the North Sea, where a producer on average produces four and one half times as much oil than in the Gulf of Mexico and where licenses produce approximately 35 times more oil than a typical leasing grid block in the Gulf.

Overall, although the United Kingdom extracted more than 841 million barrels of oil from the North Sea in 2000,[97] compared with a total production of around 427 million barrels from the Gulf of Mexico,[98] the British system accomplished this production using less than 500 licenses[99] compared with more than 7000 leases in the U.S. system.[100] The North Sea also required less than half the number of oil companies than in the Gulf, meaning each company reaped on average much larger amounts of oil. Although not a perfect measurement of overinvestment in capital, these results support the theory that the North Sea regime promotes more efficient investment in assets for production, lower transaction costs in terms of regulatory compliance, and lower acquisition costs associated with filing requests and bidding on multiple leases to get a similar amount of oil.

2. Frequency of Competitive of Fields

Another critically important variable involved the frequency of oil fields being covered by multiple leases and disparate leaseholders.[101] This factor is important because it indicates the likelihood of antagonism developing between neighboring leases with disparate owners fighting to exert control over the common pool resource. Although a lack of publicly available information makes determining exactly how much each producer is spending on each lease impossible, drilling in common offshore pools in a race for the resource would typically lead to suboptimal investment in exploration and production equipment as rival operators sink as many wells as possible on their side of the line to capture the oil.[102]

To determine whether the Gulf regime causes increased instances of competition among neighboring leaseholders, this note examines the number of leases or licenses that are situated above 30 major Gulf fields and 24 North Sea fields of

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96. As calculated by author, based on 184 active license holders (*see supra* note 94) divided by 841 million barrels per year production (*see supra* note 92).

97. *See* Brown Book, *supra* note 2, at App. 9 (841,703,900 barrels in 2000 calculated from 114,830,000 tonnes from offshore fields converted into barrels at 1 metric tonne oil = approximately 7.33 barrels oil).

98. *See* MMS Website, MMS Annual Summary of Production, *at* http://www.gomr.mms.gov/homepg/pubinfo/repcat/product/pdf/Region%20Production%20 by%20Year %201997-2000.pdf (426,908,351 barrels in 2000).

99. Email from DTI (March 21, 2003) (on file with author).

100. MMS website, supra note 89 (number of active leases is equal to 7483 using spring 2003 numbers).

101. *See* Table IV & V, *infra* at 134.

102. Commentators have noted that this problem of inefficient well placement over common pools is one of the fundamental difficulties associated with the rule of capture. *See* Libecap & Smith, *supra* note 66, (2002).

comparable importance[103] and discovered that the Gulf regime does indeed dramatically increase the frequency of potentially competitive fields. A total of 278 leasing grid blocks cover the 30 fields examined in the Gulf of Mexico;[104] in the North Sea, 42 licenses cover the 24 fields.[105] Only four of the 30 fields in the Gulf of Mexico examined are covered by leases held by a single company.[106] This situation contrasts sharply with the North Sea, where a single owner (or a consortium of owners operating in concert) controlled all but five fields studied.[107] Accordingly, a significant majority of fields in the Gulf (26 of 30 fields)[108] could be considered "competitive," whereas only a few fields in the North Sea can be characterized as competitive (five out of 24 fields).[109] In the Gulf some fields had up to 11 different leaseholders.[110] As previously mentioned, holding more than one lease is possible, so a single owner may hold several leases that cover a field, but the leaseholder must compete in the bidding process and no guarantee exists that the operator will own enough adjacent leases to cover a field sufficiently. The largest field studied covered a total of 25 lease blocks.[111] None of the fields in the Gulf fell under only one lease block, highlighting the ineffectiveness and inappropriateness of the 5000 acre regime. These figures support the hypothesis that competitive extractive behavior is more likely in the Gulf of Mexico than in the North Sea and ties in closely with the next variable studied, oil field depletion rates. The presence of a more competitive environment in the Gulf of Mexico should support the theory that the Gulf will experience higher depletion rates of oil reserves, but, strikingly, the research does not support this prediction, as discussed in IV.B.

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103. The data set for these figures is different from the data set used to calculate depletion. The fields used to determine the annual depletion rates comprise a more narrow set of fields controlled for year of discovery. The fields studied for the purposes of determining the number of leases or licenses are the 30 largest fields in terms of cumulative historic production in the Gulf of Mexico and 24 similar fields in the U.K.

104. OCSBBS Website, *at* http://www.ocsbbs.com/ocsbbs/private/gulfwide_activity_lists.asp (using figures from spring 2003).

105. DTI website, *at* http://www.og.dti.gov.uk/information/index.htm (using figures from spring 2003).

106. As determined by the author from a combination of MMS information, especially MMS maps detailing oil field contours in the Gulf of Mexico. It is important to distinguish between a "field," which is defined by the geology and hydrology of the oil deposits, and a "lease," which in the Gulf is set by longitude and latitude. Fields may lie underneath several leases and often do in the Gulf.

107. As determined by the author from a combination of DTI information, especially maps detailing the oil field contours in the North Sea. *See* DTI, Maps, *supra* note 7.

108. Of the Gulf of Mexico fields studied, only fields EI126, MC194, and SP065, and GB426 are covered by leases owned by a single oil company. Every other field studied involved fields covered by leases owned by multiple leaseholders.

109. In sharp contrast, only fields Ninian, Hutton, Fulmar, Dunlin, and Balmoral in the North Sea are owned by what appear to be competing interests. *See* Table V, *infra* at 132. Note that in the North Sea, licenses are typically held by a consortium of oil companies operating together, which makes it appear that the fields are more competitive in Table V when in reality the consortium is treated as a single owner operating under a joint operating agreement in a non-competitive environment.

110. SS230, *see* Table IV, *infra* at 130.

111. MP041, *see* Table IV, *infra* at 130.

B. OIL FIELD DEPLETION

Oil depletion rates can serve as a proxy for measuring competitive extractive behavior, a phenomenon associated with multiple producers drawing from a common petroleum pool. The research examines two types of oil depletion figures: (a) annualized depletion rates for selected fields in both regimes;[112] and (b) system-wide depletion rates for the entire North Sea and Gulf of Mexico regions. The data from the selected fields studied yielded results that do not tend to support the basic prediction regarding depletion rates and the system-wide numbers, both historically and prospectively, also fail to sustain the hypothesis that the United States regime will encourage faster depletion of resources. The conclusion of this note addresses why this might be the case.[113]

1. Background Information on Fields Studied

A "field" represents a geologic reservoir of oil that, since it follows natural contours, is likely to not conform to geographic lease conventions. Indeed, this forms the basis for the predictions presented in this note: an oil field is more likely covered by multiple leases in the Gulf of Mexico,[114] and thus an increased risk that disparate neighboring leaseholders will compete to extract the oil from the field is present. In a perfect system, these private parties would negotiate for the optimal level of production and investment, but high transaction costs in the Gulf regime would frustrate these attempts and the U.S. government typically does not interfere with the commercial strategy of individual offshore leaseholders by asserting its authority to correct the problems.[115] The potential for competitiveness in these Gulf fields has been borne out by the research contained in Part IV.A above, which determined that a large percentage of fields are indeed split among a number of unrelated owners.[116] In the North Sea, by contrast, the dramatically larger size of the license blocks, and the ability to tailor licenses to field dimensions, makes it much more likely that a field will be controlled under a single license, thus eliminating competitive pressures. In the North Sea, transaction costs are lower mainly because license holders generally do not face competition from neighbors and, furthermore, the British government remains committed to maximizing efficiency in extracting the resource.

The fields studied in this note were chosen from among hundreds of fields

112. *See* Tables II & III, *infra* at 128-129.

113. *See infra* at 122.

114. *See* Figures 1 & 2, *infra* at 134.

115. *But see* 30 C.F.R. § 250.1304 (2004) (mandating voluntary or compulsory unitization on federally managed Gulf of Mexico leases). As discussed *infra* at 110-111 & n. 76, however, little evidence exists that the MMS has exercised its authority under this provision to force unitization and it does not appear that private agreements reached under the framework of section 250 are common.

116. *See infra* at 112-116.

catalogued by the MMS and DTI. The fields examined represent the largest 20 fields[117] in the Gulf discovered since 1971 in terms of historic cumulative production and 19 similarly prominent fields in the North Sea, which were discovered since 1971 with comparable characteristics.[118] The average age for the U.S. fields studied is 22.75 years, and the average age for U.K. fields studied is 20 years.[119] All of the fields are still active. The two data sets represent a good cross-section of the largest fields in production terms in the two regions over the last few decades, and the fields represent oil reservoirs in both areas that are found at different depths and that have different dimensions. The size of the sample somewhat controls for the variables among the fields and a fair comparison can be made.

2. Depletion Calculation Methodology

I have computed the average annual depletion rate per year based on the number of years the fields have been producing. This figure is calculated by first determining the Average Annual Production amount expressed in barrels, which is arrived at as follows:

$$\frac{\text{Total Cumulative Production}}{\text{\# of Years Since Discovery}} = \text{Average Annual Production}$$

Next, the Average Annual Production figure is divided by the original proved reserves for the field to achieve the Average Annual Decrease in Reserve, using the following formula:

$$\frac{\text{Average Annual Production}}{\text{Proved Reserves}} = \text{Average Annual Decrease in Reserve (Depletion)}$$

117. These fields are referenced by the MMS as fields EC271, EC321, EI330, EI361, GB426, GC019, GC065, HI573A, MC109, MC194, MC281, MC807, MP073, MP311, SM128, SM130, SM269, SP049, SP078, and WD109. This list represents every Gulf of Mexico field with a cumulative production total over 100 million barrels of oil, up to 1999. *See* MMS website, *Reserve History for Proved Fields Gulf of Mexico Outer Continental Shelf*, *at* http://www.gomr.mms.gov/homepg/offshore/fldresv/99-HIST.PDF (last visited June 10, 2004). A field covers several smaller leases and approximates the much larger U.K. field-lease designations, where one field is more likely to be inside a single license block. This information is captured in Table II: United States, *infra* at 128.

118. See Roger D. Blanchard, *The Impact of Declining Major North Sea Oil Fields Upon Norwegian and United Kingdom Oil Production*, *available at* http://dieoff.org/page180.htm, (last visited July 27, 2004). Beginning with a list prepared, albeit for a different purpose, by Dr. Blanchard in his paper, I examined the fields in detail and selected 24 still active fields for which sufficient data is available and narrowed the list to 19 fields for which the best data were available. These fields include Auk, Piper, Forties, Thistle, Ninian, Heather, Claymore, Brent, Buchan, South Brae, Fulmar, N.W. Hutton, Dunlin, Tartan, Hutton, N&S Cormorant, Abroath, Magnus, and Beryl. This data is captured in Table III: United Kingdom, *infra* at 129. For the field data, see Brown Book, *supra* note 2, at App. 9.

119. As calculated by the author based on the figures contained in Tables II & III, *see infra* at 128-129. Age is based on number of years of production through 1999.

This figure, expressed as a percentage, represents the average percentage amount of original reserves that are removed from the reservoir each year; this number is used to measure depletion of the reservoir over time.

3. Depletion Rate Findings

Somewhat surprisingly, the depletion rates for the Gulf of Mexico demonstrate that the rate of production in the studied fields reduce the total reservoir at a slower rate than in the North Sea. On average, operators reduced oil fields in the Gulf by 3.66%,[120] whereas reservoirs in the North Sea were depleted by an average of 4.51% a year,[121] based on what percentage of the total estimated reservoir reserves have been drawn down each year. The range of depletion rates extends from 2.51% to 5.62% in the Gulf,[122] and from 3.44% to 6.25% in the North Sea.[123] Median rates were 3.65% and 4.24%, respectively,[124] slightly narrowing the difference. At such rates it would take on average about 27 years to deplete these U.S. fields, but only around 22 years to deplete the North Sea fields evaluated.[125]

The system-wide rates also tend to contradict the original predictions regarding depletion rates and competitive extractive behavior, but the margin of difference remains quite small. In fact, the remarkable discovery in the data is that the two system-wide rates are quite similar despite disparate property regimes. The Gulf of Mexico originally contained an estimated 14.38 billion barrels of oil,[126] whereas the British controlled regions of the North Sea held approximately 24.85 billion barrels of oil.[127] These figures only include oil in proven, discovered fields. About 11.40 billion barrels of oil have already been extracted from the Gulf of Mexico,[128] while around 20.50 billion barrels have come from the North Sea.[129] Approximately 80% of known oil reserves in the Gulf have been depleted,[130] and the British have drawn down about 82.5% of

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120. As calculated by author, *see* Table II: United States *infra* at 128.

121. As calculated by author, *see* Table III: United Kingdom *infra* at 129.

122. *See* Table II: United States, *infra* at 128.

123. *See* Table III: United Kingdom, *infra* at 129.

124. *See* Tables II & III, *infra* at 128-129.

125. As calculated by the author from the percentage depletion figures given in Tables II & III, *see infra* at 128-129.

126. *See* T. Gerald Crawford et al., *Estimated Oil & Gas Reserves, Gulf of Mexico as of Dec. 31, 1999* (Feb. 2002) *available at* http://www.gomr.mms.gov/homepg/whatsnew/techann/2002-007.pdf at p. v & 6 (last visited July 27, 2004) (figures covering 1009 proven fields with cumulative production measured through 1999).

127. *See* DTI website, UKCS Oil Reserves 2003 *at* http://www.og.dti.gov.uk/information/bb_updates/chapters/Table4_3.htm [hereinafter UKCS Oil Reserves] (3390 million tones = 24.85 billion barrels, based on 1 million tonnes = 7.33 million barrels of oil).

128. *See* Crawford et al., *supra* note 126.

129. *See* UKCS Oil Reserves, *supra* note 127 (3390 million tones = 24.85 billion barrels, based on 1 million tons = 7.33 million barrels of oil).

130. As calculated by author, based on cumulative production (11.40 billion barrels, *see supra* note 127) as a

their proven and discovered stocks of oil.[131]

The British have more total oil left at about 4.35 billion proved barrels,[132] but they are pumping it out much faster than their American counterparts, who have less than 3 billion proved barrels remaining.[133] In the year 2000, overall production in the Gulf of Mexico represented approximately a 3% reduction in the total discovered (proved) reserves,[134] whereas North Sea oil activity amounted to about a 3.4% reduction in the total discovered (proved) reserves.[135] If production continues at current rates oil resources will be completely depleted in the Gulf of Mexico within seven years,[136] while the North Sea has only approximately five years of productive life remaining at current extraction rates.[137] This projection, of course, does not account for unproven and undiscovered reservoirs of oil, but this variable is present in both the North Sea and the Gulf of Mexico; new oil field discoveries do not impact the analysis of historic depletion rates. Exactly how long the productive life of each region remains cannot be predicted, but for both regions, sustaining the current rates as fields mature will prove difficult.[138] What is so surprising is that the overall reduction of original reserves is so similar in the two regions, especially given the longevity

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percentage of total estimated original reserves (14.38 billion barrels, *see supra* note 125).

131. As calculated by author, based on cumulative production (20.50 billion barrels, *see supra* note 128) as a percentage of total estimated original reserves (24.85 billion barrels, *see supra* note 126). *See also* Alex Kemp, *UK: New Incentives to Boost Recovery*, WORLD OIL (Nov. 2001), *available at* http://www.findarticles.com/cf_dls/m3159/11_222/80326152/p1/article.jhtml?term= (discussing how much oil is left in the North Sea and how much oil has been drawn down: "With respect to oil, around 80% of proven reserves have been produced to date (leaving 4.7 billion bbl).") These numbers are slightly different than the numbers used in this note, but are from a different year, which largely explains any differences.

132. *See* UKCS Oil Reserves, *supra* note 127 (3390 million tones = 24.85 billion barrels, based on 1 million tonnes = 7.33 million barrels of oil).

133. Crawford et al., *supra* note 126.

134. As calculated by the author, based on number of barrels of production in 2000 (427 million barrels, *see supra* note 91) as a percentage of the total estimated original reserves in the Gulf (14.38 billion barrels, *see id.* at p.v & 6).

135. As calculated by the author, based on number of barrels of production in 2000 (841 million barrels, *see* Mutiga, *supra* note 92) as a percentage of the total estimated original reserves in the North Sea (24.85 billion barrels, *see* UKCS Oil Reserves, *supra* note 127).

136. As calculated by author, based on 2000 production rate (427 million barrels, *see* MMS Website, *supra* note 89) divided into the estimated remaining reserves (2.98 billion barrels, calculated by subtracting cumulative production of 11.40 billion barrels from estimated original reserves of 14.38 billion).

137. As calculated by author, based on 2000 production rate (841 million barrels, *see supra* note 92) divided into the estimated remaining reserves (4.35 billion barrels, calculated by subtracting cumulative production of 20.50 billion barrels from estimated original reserves of 24.85 billion). These figures are used only as a comparison of how fast each region is depleting their proven reserves given current rates. With new discoveries and slowing rates of recovery out of already discovered but maturing fields, oil production in the North Sea and Gulf may continue for decades, but the peak rates experienced in the two regions are not sustainable. *See generally Offshore UKCS: Growing Old Gracefully*, PETROLEUM ECONOMIST (April 22, 2003), at 8. *See also* Roger Reed, *North Sea Evolution to Track Gulf of Mexico Model*, OIL & GAS JOURNAL (Aug. 26, 2002), at 40 (discussing decline rates in North Sea and predicting that commercial activity in the North Sea will increasingly rely on the kind of smaller, independent producers common in the Gulf of Mexico).

138. *See Offshore UKCS, supra* note 137, at 8.

of the oil industry in the Gulf of Mexico. Overall, the system-wide annual depletion rates demonstrate that resources are being depleted at roughly the same rate in both regimes over time, even if the North Sea is currently out producing the Gulf on a percentage basis.

V. SUMMARY & CONCLUSION

Offshore oil leasing regimes in operation in the North Sea in the United Kingdom and in the Gulf of Mexico of the United States. The primary differences between the regimes include the size of leasing tracts, bureaucratic requirements, and general government policy towards offshore oil operations. This note has predicted that the differences in the American leasing regime in place in the Gulf of Mexico will result in (1) higher administrative costs, inefficient capital investment and increased antagonism among neighboring leaseholders; and (2) higher depletion rates for oil fields, owing to the smaller field size and larger number of producers operating in the Gulf.

This note investigates several variables to determine the impact of the transaction costs on commercial oil activity and to test the predictions forwarded. The results, however, were somewhat mixed. The research yielded data that generally supports the predictions regarding overinvestment, overhead redundancies, and high compliance costs in the Gulf of Mexico regime. Each lease and each leaseholder produced significantly less oil than did companies operating on licenses in the North Sea. More importantly, competitive situations occurred with much more frequency in the Gulf than in the North Sea, a condition that should exacerbate inefficiencies as neighboring leaseholders race to capture the resources. The data for depletion rates, however, does not support the theoretical proposition predicted. Oil was depleted at a faster rate among the selected North Sea fields studied as compared with depletion rates for comparable Gulf of Mexico reservoirs investigated. System-wide, oil reserves in the Gulf are being depleted at a slightly slower pace than the resources of the North Sea, but both systems have extracted roughly the same percentage of their total original estimated reserves. This unexpected result hints that operators in the Gulf were able to overcome transaction costs and operate efficiently, at least in terms of extraction rates, despite the fact that oil fields quite often lay beneath more than one lease and are controlled by multiple owners.

Commercial oil activity seems to be more capital intensive and economically inefficient in the Gulf of Mexico, and the regime probably suffers from higher transaction costs. The data analyzed, although only a rough proxy, strongly supports the contention that the nature of the leasing regime in the U.S. encourages duplicative overinvestment and perhaps a less than optimal allocation of resources, and clearly competition remains more likely in the Gulf. The probability of having oil fields lying underneath multiple leases and multiple leaseholders is much greater in the U.S. system, increasing the risk of inefficient competitive behavior in both the capital investment and the extraction context. This fact in itself is significant: it means oil producers in the Gulf must contract for unitization or otherwise enter into joint operating agreements to protect their interest in the resource and prevent a race to capture the oil. These voluntary, private agreements entail their own transaction and enforcement costs, making extraction in the Gulf less efficient than in the North Sea where these agreements are usually unnecessary. Administrative costs in the Gulf should also be considered. Producers in the Gulf must compete in an auction with many other bidders on leases that may cover only a small sliver of an oil field. Similarly, the diffusion of producers in the Gulf likely entails redundancies in overhead and other business costs. The much higher number of producers and operators in the Gulf, combined with the extremely scattered nature of their leaseholdings, manifestly results in significantly less production per unit and per producer or operator, indicating that companies are duplicating operation and overhead costs in order to extract less oil than their peers extract in the North Sea.

Competition, however, does not seem to impact the decline rates of reservoirs, and the deleterious effects predicted are not apparent in the data collected on depletion either specifically (in the particular fields selected and studied) or systematically. Oil field depletion rates in the fields studied do not demonstrate a higher extractive rate in the Gulf, and system-wide the British are actually depleting their remaining reserves at a slightly faster rate. Several difficult to control variables may impact the depletion rates of oil fields in the areas studied, including but not limited to technology, history of development, geology, regulations, and the longevity of fields. One major factor to consider is that the Gulf has been producing oil for a much longer period of time.[139] The margin of difference at the system-wide level, however, remains small, and the truly curious discovery is that overall, both nations have largely similar patterns of depletion, and both regions are nearing the end of their large scale productive lives. Another possibility is that a quicker rate of depletion may be the mark not of extractive competition, but of efficient resource management.[140] Perhaps producers in the

139. I controlled for this fact when analyzing the annual depletion rates specific fields, but the longevity of the Gulf remains relevant to the system-wide data, especially how many years of production remaining at current rates.

140. A detailed analysis of petroleum management practices lies beyond the scope of this note, but it is sufficient to note that other considerations may drive depletion rates higher.

North Sea, in the absence of competition from aggressive neighbors seeking to assert dominion over the resource under a rule of capture regime, intentionally extract resources at a higher rate for commercial reasons.

More importantly, the effects of voluntary unitization on reservoir depletion may explain the surprising results. The data collected hints that unitization, which should be difficult to accomplish among private parties,[141] may be taking place on otherwise competitive shared fields in the Gulf of Mexico. Unitization may prevent common pool problems predicted in the Gulf.[142] Such regulations may have resulted in more efficient production and a slower depletion rate for the selected fields in the Gulf, even though some commentators have argued that voluntary unitization is difficult to achieve.[143] Unitization may also be a story in the North Sea, but the need for it is not as apparent as in the Gulf given the nature of the property rights. The industry in Britain has voluntarily accomplished unitization where needed, and generally speaking the large size of tracts, the smaller number of producers, and the ability to tailor some licenses to fit the geographic boundaries of fields create far fewer instances where cooperative unitization among disparate license holders would be needed.[144] The Secretary of the DTI in the United Kingdom may require unitization at his discretion, but to date no such coercive authority has been exercised.[145] The similar rates of depletion seen at the system-wide level may be due to private unitization agreements or to other negotiated solutions to common pool extraction problems, such as joint operating agreements. The fact that the same major companies operate in both regions may encourage cooperation between companies and the use of joint operating agreements that minimize competition. Also, the national government of Britain has at times attempted to directly regulate the amount of oil being depleted from offshore fields.[146] These factors, difficult to account for in any systematic way, may impact the depletion rates, bringing them closer to alignment than expected.

Property regimes do seem to have some impact on natural resource management, and some reform is needed. The U.S. system in the Gulf of Mexico seems to result in less efficient capital investment, redundant overhead, and higher administrative compliance costs. The property arrangements in the Gulf also dramatically increase the likelihood of antagonism developing between multiple owners operating on separate leases who have an interest in a common field. But, surprisingly, competition among neighboring

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141. *See* Weaver, *supra* note 71, at 7-8.

142. *See* MMS Website, Unitization, *at* http://www.gomr.mms.gov/homepg/pd/unitization.html (last visited July 27, 2004). *See also infra* at 111 & n. 71, discussing voluntary unitization in the Gulf of Mexico.

143. *See infra* at 112.

144. Email from Michael Hawkins (DTI) (April 17, 2003) (on file with author).

145. *Id.*

146. Nelsen, *supra* note 41, at 113.

leaseholders does not appear to engender quicker depletion rates as was predicted, although this may be due to negotiated voluntary unitization agreements,[147] the creation and enforcement of which have their own transaction costs. Nevertheless, the data does support the prediction that the Gulf of Mexico regime engenders higher transaction costs, which need to be addressed by the MMS and the United States Congress. The dimensions of leases in the Gulf of Mexico should be increased to match more closely the measurement of license blocks in the North Sea, where oil fields rarely lie underneath more than one license block. The changes suggested would decrease overall transaction costs as competitive fields become less frequent. Such reforms would also reduce the number of operators and dramatically cut the bureaucratic costs associated with administering and complying the more than 7000 leases. Given the fact that the research did not uncover higher depletion rates in the Gulf of Mexico, a revision of the U.S. policy toward offshore leasing is not urgently needed to correct wasteful overproduction. Still, efficiency would likely be improved on several fronts if the U.S. were to adopt a regime in closer alignment with the British experience.

As energy needs increase in both the United States and the United Kingdom, the importance of domestic sources of oil and natural gas will only grow, and efficient extraction of these diminishing resources will become increasingly important; as argued in this note, the legal regimes governing offshore leasing can and seemingly do influence commercial production. Proper governmental stewardship of the resources demands an appropriate property rights regime that reduces transaction costs, administrative compliance costs, and competitive behavior while maximizing the efficient exploitation and conservation of natural resources. The lessons support making the suitable adjustments to the Gulf of Mexico oil leasing regime.

This note must emphasize, however, that offshore oil production remains incredibly complicated financially, bureaucratically, economically, commercially, technologically, scientifically, and administratively. As such, this note's investigation into capital costs and depletion rates does not perfectly capture all effects of the regimes studied on commercial oil activity. Nevertheless, and despite some methodological shortcomings, this note effectively evaluates how differences in property rights regimes impact the activities carried out under the systems in question, and the predictions, methodology, results, and analysis used in this note provide a strong foundation for future application of more technical expertise and generate more rigorous economic analysis to the subject.

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147. *See infra* at 112 & n. 71 (discussing voluntary unitization in the Gulf of Mexico under 30 C.F.R. pt. 250).

TABLE I.
SYSTEM-WIDE COMPARISON OF U.S. AND U.K. LEASING REGIMES

	U.S.: Gulf of Mexico	U.K.: North Sea
1. Type of Lease[148]	Grid System; unified lease for both production and exploration	Grid system, but leases often later shaped to fit petroleum fields
2. Size of Lease[149]	Generally 5000 or 5760 acres	Several thousand square kilometers
3. Duration of Lease[150]	5, 8, or 10 years, depending on depth of drilling	Production leases cover entire duration of field if certain conditions are met; Exploration leases cover 3 years
4. Current Recognized Active Fields[151]	880 Total Active; 1003 proven & probable	224 Named Active Fields
5. Current Active Leases/Licenses[152]	7483	428
6. Producers Holding Leases[153]	391 active owners; 30 with 100+ leases	184, including all subsidiaries & affiliates (only 75 registered license title holders)
7. Total Production (2000)[154]	426,908,351 bbl (427 million)	841,703,900 bbl (841 million)
8. Est. Original Reserves[155]	14.38 billion bbl	24.85 billion barrels
9. Cumulative Production[156]	11.40 billion bbl	20.50 billion bbl
10. Current Est. Remaining Reserves[157]	2.98 billion bbl	4.35 billion bbl
11. Production (2000) as % of total original reserves (annual depletion of original reserves at 2000 rates)[158]	Approximately 3% (2.97%)	Approximately 3.4% (3.38%)

148. MMS, *Oil and Gas Leasing Procedures Guidelines*, OCS Report MMS 2001-076 (October 2001), *at* http://www.gomr.mms.gov/homepg/whatsnew/techann/2001-076.pdf (last visited July 27, 2004); DTI Website, *supra* note 56.

149. OCS Report, *supra* note 148 at 31-34.; DTI Website *at* http://www.og.dti.gov.uk/upstream/licensing/lictype.htm (last visited July 27, 2004).

150. OCS Report, *supra* note 148; DTI Website, *supra* note 56.

151. Crawford, et. al., *supra* note 126; Brown Book, *supra* note 2, at app.1.

152. MMS Website at http://www.gomr.mms.gov/homepg/fastfacts/WaterDepth/WaterDepth.html; Email from UK Gov't official at DTI (July 28, 2004) (on file with author).

153. OCSBBS website at http://www.ocsbbs.com/ocsbbs/private/gulfwide_activity_lists.asp; DTI website *at* http://www.og.dti.gov.uk/dti-lift/lift6.htm.

154. Crawford et al., *supra* note 126 at at p. v & 6; Brown Book, *supra* note 2, at App. 9 (841,703,900 barrels in 2000 calculated as 114,830,000 tonnes from offshore fields converted into barrels at 1 metric tonne oil = approximately 7.33 barrels oil).

155. OCS Report, *Estimated Oil and Gas Reserves, Gulf of Mexico, at* http://www.gomr.mms.gov/homepg/whatsnew/techann/2002-007.pdf at p. v & p. 6 (last visited July 27, 2004); Brown Book, *supra* note 2, at Updates, UKCS OIL Reserves 2003.

156. *Id.*

157. *Id.*

158. US: As calculated by the author, based on number of barrels of production in 2000 (427 million barrels) as a percentage of the total estimated original reserves in the Gulf (14.38 billion barrels); UK: As calculated by the author, based on number of barrels of production in 2000 (841 million barrels) as a percentage of the total estimated original reserves in the North Sea (24.85 billion barrels).

TABLE I. CONTINUED

	U.S.: Gulf of Mexico	U.K.: North Sea
12. Production (2000) as % of remaining reserves (annual depletion of remaining reserves at 2000 rates)[159]	14.32% years to deplete at 2000 prod. rate = approximately 7 years	19.33% years to deplete at 2000 prod. rate = approximately 5 years
13. Cumulative Production as % of total original reserves[160]	Approximately 80% (79.2%)	82.5%
14. Million barrels annual production per lease (2000)[161]	427m bbl/7,483 = .057m bbl per lease = 57,000 bbl per lease	841m bbl/428 = 1.96m bbl per lease = 1,964,953 barrels per lease
15. Production per producer (2000)[162]	1,092,000 bbl per lease owner	4,679,000 bbl per lease owner
16. Number of leasing blocks or license areas underlying major fields[163]	278 leases covering 30 fields	42 licensed areas covering 24 fields
17. How often are fields controlled by[164] multiple lease/license holders	26 of the 30 fields covered by more than one leaseholder	only 5 of 24 fields controlled by different companies holding the licenses

159. US: As calculated by the author, based on 2000 production rate (427 million barrels) divided into the estimated remaining reserves (2.98 billion barrels); UK: As calculated by author, based on 2000 production rate (841 million barrels) divided into the estimated remaining reserves (4.35 billion barrels, calculated by subtracting cumulative production of 20.50 billion barrels from estimated original reserves of 24.85 billion).

160. As calculated by author, based on cumulative production (11.40 billion barrels) as a percentage of total estimated original reserves (14.38 billion barrels); as calculated by the author, based on cumulative production (20.50 billion barrels) as a percentage of total estimated original reserves (24.85 billion barrels).

161. US: As calculated by author, based on 427 million barrels divided by 7483 active leases. *See* MMS annual summary of production; *see also* MMS, *Annual Summary for Entire Region 1997-2000* (June 16, 2001), *at* http://www.gomr.mms.gov/homepg/pubinfo/repcat/product/pdf/Region%20Production%20by%20Year%201997-2000.pdf (last visited June 10, 2004) (approximately 427 million barrels in 2000); UK: as calculated by author, based on 841 million barrels production in 2000 divided by 428 active leases. *Id.*

162. As calculated by author, based on number of producers divided by total production.

163. OCBBS Website, *at* http://www.ocsbbs.com/ocsbbs/private/gulfwide_activity_lists.asp; http://www.og.dti.gov.uk/information/index.htm

164. As determined by author from maps published by the MMS and from maps detailing the oil field contours in the North Sea. *See* DTI, Maps, *supra* note 7.

TABLES II & III: OIL LEASE PRODUCTION, RESERVES AND DEPLETION FOR MAJOR FIELDS

TABLE II.
UNITED STATES: GULF OF MEXICO

Field[165] (20 Fields)	Total Cumulative Production Millions of bbl[166]	# of Years Since Discovery Through 1999	Average Annual Production Millions of bbl[167]	Proved Reserves in Millions of bbl	Average % Annual Decrease in Reserves[168] (Depletion)
EC271	63	28	2.25	68	3.31%
EC321	76	28	2.71	67	4.05%
EI330	381	28	13.61	414	3.29%
EI361	55	26	2.12	76	2.78%
GB426	134	12	11.66	224	5.25%
GC019	78	19	4.11	96	4.28%
GC065	98	16	6.13	109	5.62%
HI573A	98	26	2.62	104	2.51%
MC109	40	15	2.67	49	5.44%
MC194	165	25	6.60	183	3.61%
MC281	55	23	2.39	58	4.12%
MC807	132	10	13.20	456	2.89%
MP073	42	24	1.75	51	3.43%
MP311	84	22	3.82	101	3.78%
SM128	113	25	4.52	121	3.73%
SM130	174	26	6.69	180	3.71%
SM269	49	26	1.88	52	3.62%
SP049	74	25	2.96	81	3.65%
SP078	60	27	2.22	74	3.00%
WD109	66	24	2.75	74	3.72%
TOTALS:	2037 mill. bbl	Avg. Age 22.75 yrs	96.66 mill bbl	2638 mill bbl	3.66%
Median %					3.65%

165. Table represents every Gulf of Mexico lease block with a cumulative production total over 100 million barrels of oil, up to 1999. U.S. field production data taken from Minerals Management Service, Reserve History for Proved Fields Gulf of Mexico Outer Continental Shelf, *available at* http://www.gomr.mms.gov/homepg/offshore/fldresv/99-HIST.PDF (last visited April 5, 2003). A field covers several smaller leases and approximates the U.K. field-lease designations.

166. Rounded to nearest million.

167. Rounded and as calculated by the author.

168. As calculated by the author.

TABLE III.
UNITED KINGDOM: NORTH SEA

Field (19 Fields)	Total Cumulative Production in Million Tonnes[169]	# of Years in Production	Average Annual Production	Proved Reserves[170]	Average % Annual Decrease in Reserves (Depletion)
Auk	16.804	25	6.72	19	3.53%
Piper	131.757	24	5.49	145	3.79%
Forties	326.714	25	13.07	347	3.77%
Thistle	53.034	22	2.41	55	4.39%
Ninian	148.328	22	6.74	159	4.24%
Heather	15.111	22	.69	18	3.81%
Claymore	67.963	23	2.95	86	3.44%
Brent	250.053	24	10.42	263	3.97%
Buchan	15.664	19	.82	20	4.12%
South Brae	31.933	17	1.88	40	4.71%
Fulmar	71.130	18	3.95	73	5.41%
N.W. Hutton	16.566	17	.97	17	5.73%
Dunlin	48.755	22	2.22	51	4.34%
Tartan	13.496	19	.71	14	5.01%
Hutton	26.189	16	1.63	26	6.25%
N & S Cormorant	73.114	21	3.48	85	4.10%
Arbroath	14.772	10	1.48	23	6.42%
Magnus	95.608	17	5.62	121	4.65%
Beryl	99.079	20	4.95	128	3.87%
TOTALS:	1457 mill. tonnes	Avg. Age 20 years	76.20 mill. tonnes	1690 mill. tonnes	4.51%
[Conversion][171]	10,926 mill. bbl		571.5 mill. bbl	12,675 mill. bbl	
Median %					4.24%

$$\frac{\text{Total Cumulative Production}}{\text{\# of Years Since Discovery}} = \text{Average Annual Production}$$

$$\frac{\text{Average Annual Production}}{\text{Proved Reserves}} = \text{Average Annual Decrease in Reserve (Depletion)}$$

169. Total from start of production (but not before 1975) to 2000 in millions tonnes oil. *See* Brown Book, *supra* note 2, at App. 9.

170. Total in millions of tonnes of oil, rounded to nearest million. *Id.* at App. 9.

171. Approximate conversion rate of 1 million tonnes of crude oil = 7.5 million barrels. For conversion information, *see* Main Conversions, *supra* note 92 ; Amos Mutiga, *Energy Data Conversions*, *available at* http://www.afrepren.org/datahandbook/pdfs/conver.pdf at Table 3.6, p. 5.

TABLE IV.
LEASES AND LEASEHOLDERS PER FIELD, U.S. GULF OF MEXICO

Field Lease Block: EIA Field Code	Total Cum. Production	# of Lease Grid Blocks	# of Leaseholders (Name(s) of Leaseholder)
BM002: 803002	502	16	2 (Chevron USA Inc.; Energy Partners Ltd.)
EI126: 829126	127	4	1 (Ocean Energy Inc.)
EI175: 829175	101	7	4 (Apache Corp.; Shell Offshore Inc.; BP America Production; Newfield Exploration)
EI276: 831276	105	8	5 (Nexen Petrol. USA; TotalFinaElf E&P USA; SOCO Offshore Inc.; Forest Oil Corp.)
EI330: 831330	381	11	7 (ExxonMobil; Devon Energy; Shell Offshore Inc.; Chevron USA Inc.; Hunt Petrol.; Newfield Exploration; BP Exploration)
GB426: 840426	134	4	1 (Shell Offshore)
GI016: 842016	290	7	2 (ExxonMobil; Freeport McMoran)
GI043: 842043	347	15	5 (BP America Production; ExxonMobil; Energy Partners LTD; J. M. Huber Corp.; Offshore Energy)
GI047: 842047	132	11	3 (BP America Production; Conoco; Vastar Resources)
MC807: 874807	132	4	2 (Shell Offshore; BP Exploration)
MC194: 874194	165	4	1 (Shell Offshore)
MP041: 866041	232	25	3 (Chevron USA Inc.; Amerada Hess Corp.; Walter Oil & Gas Co.)
MP144: 866144	117	9	6 (Chevron USA; Conoco; GOM Shelf LLC; Shell Offshore; Oxy USA; Vastar Resources)
MP299: 870299	126	6	3 (Chevron USA; Walter Oil & Gas Co.; Freeport McMoran)
SM128: 901128	113	7	4 (Devon Energy Production; PennzEnergy Co.; Newfield Exploration; Kerr-McGee Oil & Gas)
SM130: 901130	174	3	2 (Energy Resources, Walter Oil & Gas)
SP027: 909027	146	9	5 (Energy Partners LTD; Texaco Inc.; Hunt Oil Co; Tenneco Oil Co.; Stone Energy Partners)
SP061: 909061	240	11	3 (BP American Production; Ocean Energy; Chevron USA)
SP062: 909062	146	4	2 (Apache Corp.; Chevron USA Inc.)
SP065: 909065	122	4	1 (Ocean Energy)
SP089: 913089	170	8	3 (ExxonMobil; Marathon Oil Corp.; Chevron USA Inc.)
SS113: 894113	110	12	3 (Comstock Offshore; Odeco Oil & Gas; Murphy Exploration)
SS169: 894169	132	15	6 (Conoco Inc.; Apache Corp.; Newfield Exploration; Chevron USA Inc.; W&T Offshore Inc.; Andarko E&P Co.)
SS208: 894208	202	10	5 (Union Oil; Kerr-McGee Oil & Gas; Shell Offshore, Inc.; Anadarko E&P Co.; LLOG Exploration)
SS230: 894230	116	14	11 (Forest Oil Corp.; Taylor Energy Co.; Kerr-McGee Corp.; Shell Offshore Inc.; Anadarko E&P Co.; Norcen Explorer Inc.; Union Oil Co.; El Paso Production; Walter Oil & Gas; Energy Resource; Kerr-McGee Oil & Gas.)

TABLE IV. CONTINUED

Field Lease Block: EIA Field Code	Total Cum. Production	# of Lease Grid Blocks	# of Leaseholders (Name(s) of Leaseholder)
ST021: 919021	236	7	3 (J. M. Huber Co.; Walter Oil & Gas; Tenneco Oil Co.)
ST135: 919135	242	7	2 (Chevron USA Inc.; North Central Oil)
WD073: 942073	245	10	7 (ExxonMobil; Offshore Energy; BP Exploration; AGIP Petroleum; El Paso Production; ATP Oil & Gas Corp.; Apache Corp.)
WD079: 942079	158	8	2 (Amerada Hess Corp.; Samedan Oil Corp.)
WD030	531	18	9 (ExxonMobil; Nexen Petroleum; Shell Offshore; Maritech Resources; Humble Oil; Chevron USA; Gulf Oil Corp.; Samedan Oil Corp.; Seneca Resources Co.)

TABLE V.
LEASES & LEASEHOLDERS PER FIELD, NORTH SEA

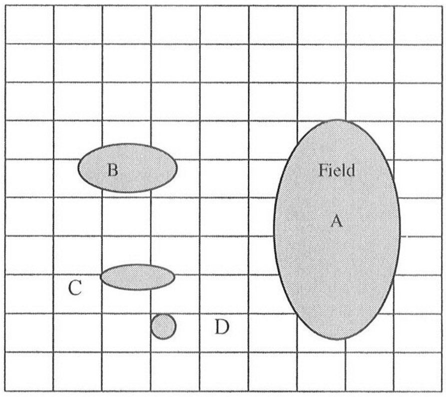
Field/Lease	Total Cum. Production	Does Field Extend to Other Leases?	Licensees Holding More than 5% (Name(s))
Auk	16.804	No	Shell U.K. (50%); Esso Exploration & Prod. (50%)
Piper	131.757	No	Talisman Energy (20%); Talisman North Sea Ltd. (16.5%); Transworld Petroleum (23.5%); LASMO Ltd. (20%); Intrepid Energy (20%)
Forties	326.714	Yes, but BP is a partial or full owner of other blocks	BP Exploration
Thistle	53.034	Yes, but identical companies as licensees	Britoil plc (82%); Conoco UK Theta Ltd. (18%)
Ninian	148.328	Yes	Kerr-McGee U.K. Ltd. (63%); Murphy Petroleum Ltd. (20%); Ranger Oil UK Ltd. (12%); Lundin North Sea Ltd. (6%)
Heather	15.111	No	DNO Heather Ltd. (32.25%); GB Great Britain Ltd. (32.25%); Texaco Explorer Ltd. (32.25%); DNO Heather Oilfield Ltd. (6.25%)
Claymore	67.963	No	Talisman Energy UK Ltd. (13%); Talisman North Sea Ltd. (17%); Transworld Petroleum UK Ltd. (18%); LASMO Ltd. (20%); Intrepid Energy CNS Ltd. (14%); Dana Petroleum E&P Ltd. (8%)
Brent	250.053	Yes, but identical companies as licensees	Shell UK (50%); Esso Exploration & Prod. (50%)
Buchan	15.664	Yes (other field 100% Talisman)	Talisman Energy UK Ltd. (71%); Transworld Petroleum Ltd. (13%); EDC Europe Ltd. (13%)
South Brae	31.933	Yes, but identical companies as licensees	Marathon Oil North Sea Ltd. (38%); BP Exploration Operating Co. (20%); Talisman Energy UK Ltd. (14%); Kerr-McGee Oil UK plc (8%); BG International Ltd. (8%); Burlington Resources UK Inc. (6%)
Fulmar	71.130	Yes	Shell UK Ltd. (45.25%); Esso E&P UK Ltd. (45.25%); Amoco UK Petroleum Ltd. (9.5%)
N.W. Hutton	16.566	No	Petrobras UK Ltd. (28%); Amoco UK Petroleum Ltd. (26%); Cieco E&P UK Ltd. (26%); Mobil North Sea Ltd. (20%)
Dunlin	48.755	Yes	Shell UK (50%); Esso Exploration & Prod. (50%)
Tartan	13.496	No	Talisman Oil Trading Ltd.
Clyde	16.191	Unclear	Talisman Energy UK Ltd. (81.5%); Esso Exploration & Prod. UK Ltd. (18.5%)

TABLE V. CONTINUED

Field/Lease	Total Cum. Production	Does Field Extend to Other Leases?	Licensees Holding More than 5% (Name(s))
Hutton	26.189	Yes	Kerr-McGee North Sea UK Ltd. (88%); Ranger Oil UK Ltd. (12%)
N & S Cormorant	73.114	Yes, but identical companies as licensees	Shell UK (50%); Esso Exploration & Prod. (50%)
Eider	13.965	Yes, but identical companies as licensees	Shell UK (50%); Esso Exploration & Prod. (50%)
North Alwyn	29.997	Yes, but identical companies as licensees	TotalFinaElf Exploration UK plc (33%); Elf Exploration UK plc (67%)
Balmoral	13.799	Yes	AGIP UK Ltd. (75%); Kerr-McGee Resources UK Ltd. (15%); Pentex Oil UK Ltd. (10%)
Arbroath	14.772	Yes, but identical companies as licensees	Enterprise Oil plc (41%); Amoco UK Petroleum Ltd. (31%); Amerada Hess Ltd. (28%)
Scapa	13.964	Yes, but identical companies as licensees	Talisman Energy UK Ltd. (20%); Talisman North Sea Ltd. (17%); Transworld Petroleum (23.5%); LASMO Ltd. (20%); Intrepid (20%)
Magnus	95.608	Yes, but identical companies as licensees	BP Exploration Operating Co. Ltd. (85%); Nippon Oil E&P UK (5%); AGIP UK Ltd. (5%)
Beryl	99.079	Yes, but identical companies as licensees	Mobil North Sea Ltd. (45%); Amerada Hess Ltd. (20%); Enterprise Oil plc (20%); BG Int'l Ltd. (10%); OMV UK Ltd. (5%)

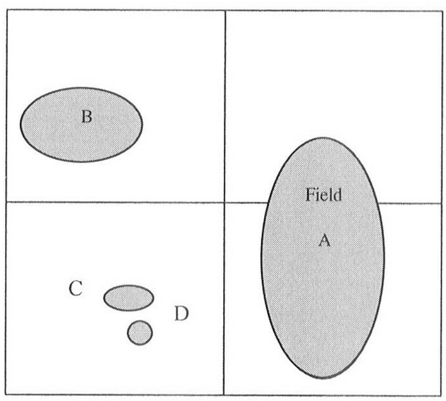
FIGURES 1 & 2: EXAMPLES OF OIL FIELDS AND LEASE BLOCKS

FIGURE 1: GULF OF MEXICO



FIELD A: COVERED BY 21 LEASE BLOCKS, WITH UP TO 21 DIFFERENT OWNERS
FIELD B: COVERED BY 9 LEASE BLOCKS, WITH UP TO 9 DIFFERENT OWNERS
FIELD C: COVERED BY 2 LEASE BLOCKS, WITH NO MORE THAN 2 DIFFERENT OWNERS
FIELD D: COVERED BY 1 LEASE BLOCK WITH A SINGLE OWNER

FIGURE 2: NORTH SEA



FIELD A: COVERED BY 2 LICENSE BLOCKS, WITH NO MORE THAN 2 DIFFERENT OWNERS (IN REALITY, THE BRITISH GOVERNMENT MAY CARVE OUT BLOCKS SO THAT THIS FIELD FALLS UNDER ONLY 1 LICENSE)
FIELD B: COVERED BY 1 LICENSE BLOCK WITH A SINGLE OWNER
FIELDS C & D: BOTH FIELDS CONTAINED IN 1 LICENSE BLOCK UNDER A SINGLE OWNER