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COMPARING THE SAFETY AND ENVIRONMENTAL RECORDS OF FIRMS OPERATING OFFSHORE PLATFORMS IN THE GULF OF MEXICO

Allan Pulsipher, Omowumi Iledare, David Dismukes, Dimitry Mesyanzhinov, Robert Baumann, William Daniel IV, Center for Energy Studies, Louisiana State University, Baton Rouge, LA 70803, 504/388-4550

ABSTRACT

At the 1994 Offshore and Arctic Operations Symposium we reported on findings from preliminary research indicating little if any difference in the environmental and safety records of the "majors" and those of the smaller "independents," operating on the OCS in the Gulf of Mexico (Pulsipher, 1995a). This paper continues the reporting on that research with updated data, better methods of measuring the safety and environmental records of individual firms, more complete specification of the factors that may affect them, and more precise methods of measuring the relationships between safety records and associated factors. Our findings confirm and strengthen our previous conclusions. Safety records of independents are marginally but significantly better than those of the majors. [keywords: offshore accidents, safety records]

1. BACKGROUND

The motivation for this research was widespread concern that as major oil and gas companies reallocated their investments in exploration and production (E&P) from the U.S. to foreign countries that, (1) U.S. reserves would be less aggressively and efficiently developed and (2) safety and environmental risks inherent in the development of those reserves would also grow. These concerns have been widespread in both government and industry circles and have contributed to the movement toward stricter regulations such as those epitomized by the Oil Pollution Act of 1990.

The "theory" underlying these concerns was that as majors shifted their E&P investments abroad more domestic E&P would fall to smaller independent companies, at least in a relative sense; who had neither the major's technical, scientific or regulatory experience nor their financial resources. Thus in the future domestic oil and gas reserves would be developed both less efficiently and less safely. We have found little empirical evidence to support these concerns in the historical data available for the federal OCS.

An analysis of the economic component of the argument suggests that the investment strategies of independents have mirrored the majors' shift toward foreign prospects, with the rate of substitution of domestic for foreign E&P investment about the same for majors and large independents (Pulsipher, 1995b). Moreover we also have found that independents were both more aggressive and more successful than the majors in developing domestic oil and gas reserves (Iledare, 1995).

The research we report on here indicates the independents have, at least marginally, a better safety record than the majors. We have not been able to measure and compare the environmental records (i.e., environmental damages resulting from accidents on offshore platforms) since reported environmental consequences from accidents are so rare and so limited that they do not constitute an adequate basis for meaningful measurement or comparison. However since the potential for environmental damage exists anytime an offshore accident occurs, it may be legitimate to make some inferences about potential environmental risk from the operator's safety record--the poorer the safety record the greater the potential environmental risk.

2. METHODS

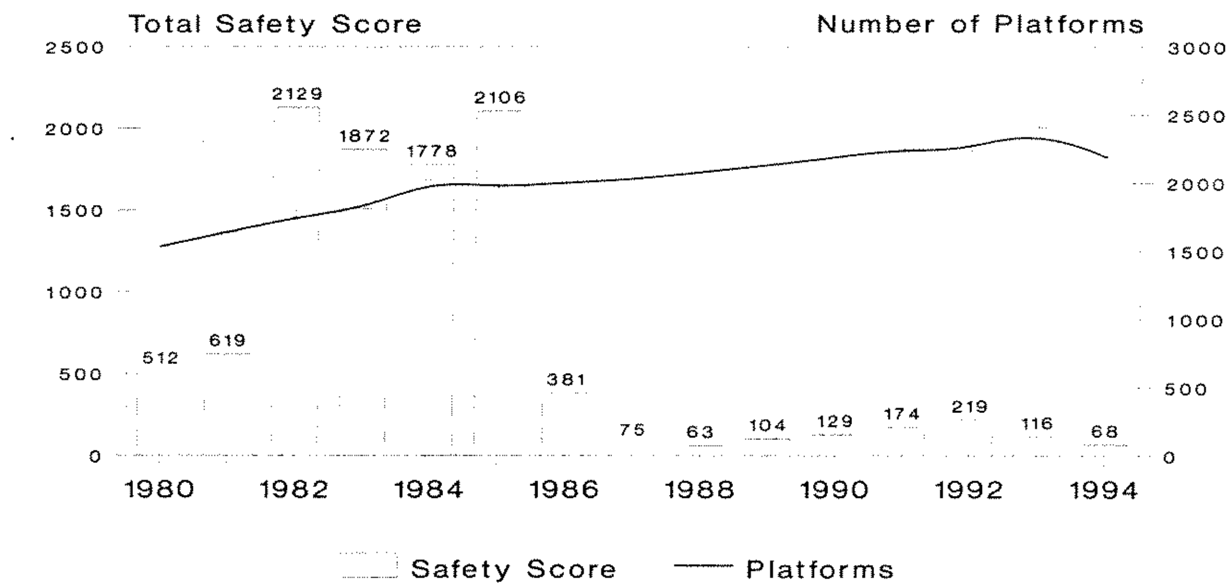
Our earlier report measured and compared the shares of fires and explosions on the OCS attributable to individual firms during the 1983 to 1990 period, expressed relative to the firm's share of OCS production. We found no statistically significant differences among the majors, large or smaller independents, considered as groups, and very few "outliers" or "bad actors" measured either relative to their own group's average or to the average of all offshore operators considered collectively.

2.1 Data - For this report we assembled a consistent data base from published and unpublished MMS data for each OCS operator and cross checked it with data from Offshore Data Services. However the data are organized on a platform rather than an operator or a production basis and have been extended to cover the 1980 to 1994 period.

2.1.1 Accidents and Safety Scores - Since accidents vary greatly in their seriousness or consequences, we differentiated among them with the following crude weighting scheme. Accidents in which no injuries or fatalities were reported were assigned a weight of one, accidents with injuries but no fatalities were weighted as five, and accidents resulting in fatalities were counted as twenty-five. Admittedly this (1-5-25) scheme is as subjective as it is simple but experimentation with other schemes suggests to us that the results are not very sensitive to the particular weights chosen. Accidents occurring on a platform either prior to its acquisition or after any sale accrue to the responsible operator at that time, not the current operator in that year. An individual operator's safety score is simply the sum of these weighted values for each year.

There has been rather extreme variation in the cumulative safety score for all operators over the study period as illustrated in Figure 1. At the crest of the domestic oil boom in the early 1980s when in expectation of $50/barrel-oil-forever, 200 or more new platforms were being installed annually on the OCS (with inexperienced workers on rush schedules) accidents soared. The cumulative safety score as we have defined it jumped from about 500 in 1980 to around 2000 between 1982 to 1985. When the world oil price dropped, so did OCS activity and so did OCS accidents--with the industry's annual safety score falling from 2100 in 1985 to less than 400 in 1986. Less dramatic but perhaps more significant is the fact that the offshore industry's safety score remained at very low levels after OCS activity revived in the later 1980s and 1990s. As can be seen in Figure 1 there is about an order of magnitude difference

Figure 1 - Total Safety Score Compared with Total Number of Operating Drilling and Production Platforms, 1980 to 1994



Note: Total safety score per text, non-drilling or production platforms and platforms w/o data are excluded.

between accident-scarred early 1980s and the post-price-collapse period--despite, as measured on the left axis, a steadily growing number of operating platforms.

2.1.2 Explanatory Variables - The individual operator's safety score would be expected to vary with a number of factors such as the number, type and age of the platforms operated. In order to account for, or "hold constant", such factors, we have used multiple regression analysis. This allows us to: 1) estimate the association between accidents and several hypothesized explanatory variables, as well as; 2) predict a safety score for an individual operator, or group of operators, which reflects their own unique circumstances, and then compare such predicted values to the measured value to statistically identify "better" or "worse" safety records. The variables we have included in the regression equation are, the dependent variable (I) which is the safety score for each operator and the following independent or explanatory variables:

- LPLTY - Platform years, the summation of the number of platforms operated in each year by the operator over the study period--the hypothesis being that more platform years provide more opportunity for accidents.

- LAVAGE - Average age of operator's platforms -- the hypothesis being that older platforms are less safe.

- LWELLS - Number of wells drilled -- the hypothesized relationship being that drilling provides more opportunity for accidents than production.

- LGPLT - Percent of platforms producing gas, the hypothesis is that gas production is more accident prone than oil production.

- LINCS - Cumulative number of INCs (instances of noncompliance recorded against the operator during the MMS inspection process) -- the hypothesis being the larger the number of INCs the more likely accidents are to occur.

To test directly for differences among the safety records of majors and independents considered as groups, we also classified each operator either as a major (18 firms as usually identified), large independent (35 firms with total assets world-wide in excess of $500 million) or smaller independent (90 firms including all other operators active on the OCS during the study period). Groups were assigned "dummy variables" to measure the association between group membership and safety scores. Large independents were designated in the regression equations as LARGEI and smaller independents as SMALLI.

2.2 Procedure - Because of the extreme variation in the safety scores and associated independent variables observed in the pre- and post-price-collapse periods, and because MMS did not institute its inspection program until 1987, two periods were used to estimate the regression equations, 1980-1986 and 1987-1994.

Symbolically, the form of the equations estimated for the two periods was:

$$[Eq.\ 1]\quad (I_i|_{80-86}) = \beta_0 + \beta_1 LARGEI_i + \beta_2 SMALLI_i + \beta_3 LPLTY86_i + \beta_4 LGPLT86_i + \beta_5 LWELLS86_i + \beta_6 LAVAGE86_i + \eta_i$$

$$[Eq.\ 2]\quad (I_i|_{87-94}) = \beta_0 + \beta_1 LARGEI_i + \beta_2 SMALLI_i + \beta_3 LPLTY94_i + \beta_4 LGPLT94_i + \beta_5 LWELLS94_i + \beta_6 LAVAGE94_i + \beta_7 LINCS94_i + \epsilon_i$$

As indicated by the notation above, Eq. 1 covers the period from 1980 to 1986 while Eq. 2 covers the period from 1987 to 1994. Logarithmic transformations of all of the continuous variables, including the dependent variable, have been taken in each of the models. These transformations help minimize potential heteroskedasticity problems as well as yield parameter estimates which can be interpreted as elasticities. Other than the time periods analyzed, the two equations differ in one other respect: incidents of non-compliance (LINCS94) have only been included in Eq. 2 since the inspection data are not available for the earlier period.

The careful reader will note, however, that no dummy variable for majors is included in the equations. It was necessary to exclude the classification variable for major operators in order to give the regression a reference point and to prevent a possible econometric specification error. The parameter values for LARGEI and SMALLI are interpreted as values relative to the excluded base: in this instance, relative to major operators. Thus, if the parameter value of LARGEI is negative, it means that large independents tend to have fewer accidents relative to major operators.

3. RESULTS

Analysis of the data, indicated the presence of heteroskedasticity in the residuals. Specifically, the errors tended to grow with increases in the number of operator platform years. Thus, weighted least squares (WLS) was applied to both sets of regressions with the variance of platform years (LPLTY86 or LPLTY94) being used as weights in order to correct for this problem and yield more reliable estimates.

The empirical results for [Eq. 1], which span the period 1980-1986, are presented in Table 1. The summary statistics for the model are good. The R^2 and adjusted R^2 are both reasonably high and indicate that the hypothesized model captures some 70 to 71 percent of the variation in the safety scores.

Three of the six variables were significantly different from zero at the 99 percent level as evidence by t-ratios which exceed an absolute value of 2. The three variables which proved to be statistically significant included: the indicator for large independent operators (LARGEI); the indicator variable for small independent operators (SMALLI) and the number of platform years (LPLTY86). In addition to the statistical significance, we found that all of the signs resulting from the parameter estimates were of the anticipated direction.

Table 1: Empirical Results -- Index of Operator Accidents (1980-1986)

Variable	Parameter Estimate	Standard Error	T-Ratio
INTERCEPT	1.804269	0.89109841	2.025
LARGEI	-2.312938	0.46252361	-5.001
SMALLI	-3.288777	0.53819132	-6.111
LPLTY86	0.482109	0.17346319	2.779
LGPLT86	-0.084118	0.11660727	-0.721
LWELLS86	0.161634	0.12554486	1.287
LAVAGE86	0.145651	0.22146305	0.658
R^2	0.7144		
Adjusted R^2	0.6981		
n =	115		

The regression indicates that during the period 1980 to 1986, both large and small independents tended to have better safety records than the majors. Some algebraic manipulation of the results[1] also tells us that, holding other things constant, a shift of operator classification from a major to a small independent would result in 0.96 percent reduction in the operator's expected safety score. A shift from major classification to large independent would result in a 0.90 percent reduction.

We also conducted an analysis of the model's outliers. Outliers are those observations which differ significantly from their predicted values. These were identified via the calculation of studentized residuals as prescribed by Belsley (1980). These studentized residuals are distributed closely to the t-distribution. Thus, studentized residuals of absolute values greater than two are said to be significant outliers. In our analysis of the outliers, we found three "good actors": two of which were majors, while one was a large independent operator. We also found six "bad actors": one of which was a major, three of which were large independents; and two were small independents.

The analogous empirical determinants of accidents during the 1987-1994 time period are shown in Table 2. The summary statistics (R^2 and adjusted R^2) are both relatively high explaining some 70 to 72 percent of the variation in operator safety scores. The parameter estimates presented in Model 2 are generally consistent with the results found in the 1980-1986 model. In this model, however, we found five of the seven explanatory variables to be statistically significant at the 95 percent level. These variables included: operator classification (LARGEI, SMALLI), platform years (LPLTY94), number of wells (LWELLS94), and average age of platform (LAVAGE94). The estimates for the two classifications of independents are similar to those of the 1980-1986 period, as is the estimate of the platform-years variable.

We also conducted a outlier analysis for the 1987-1994 period. Using the same criteria outlined above, we found nine significant outliers: seven "bad actors" and two "good actors." Two majors, three small independents, and two large independents met the bad-actor- test, while two majors satisfied our criteria for good actors.

Table 2: Empirical Results -- Index of Operator Accidents (1987-1994)

Variable	Parameter Estimate	Standard Error	T-Ratio
INTERCEPT	0.515357	0.49028377	1.051
LARGEI	-1.447334	0.24113063	-6.002
SMALLI	-1.362809	0.26875779	-5.071
LPLTY94	0.204935	0.09598936	2.135
LGPLT94	-0.084200	0.06165584	-1.366
LWELLS94	0.246714	0.08053146	3.064
LAVAGE94	0.219109	0.10983526	1.995
LINCS94	0.038510	0.07515702	0.512
R^2	0.7233		
Adjusted R^2	0.7079		
n =	136		

4. CONCLUSIONS

The statistical evidence we have discussed shows that independents had a marginally better safety record than the majors during the two periods we analyzed--when intervening variables such as the number of platform years, the number of wells drilled, and the age of platforms operated were held constant. The independents' superiority is modest but consistent and statistically significant. This result is contrary to the conventional thinking in both industry and regulatory circles.

We also found only a very small number of "outliers," i.e., operators with either much better or much worse records than one would expect given the number, age etc. of the

[1]Elasticities -- or the percentage change in accidents resulting from a change in operator classification can be generated using the following formula:

$$\xi = e^{\beta} - 1$$

platforms they operated, with no predominance by either independents or majors. Such comparisons of majors and independents admittedly are tentative, but they certainly do not suggest that history provides much of an argument for tighter OCS regulations if more work offshore were to fall to independent operators.

When comparing independents and majors, it is important not to lose sight of the remarkable decline in the offshore industry's accident rate depicted in Figure 1. Others have shown that workers on offshore platforms today face risks comparable to such occupations as flight attendants or roofers--an equivalence that many would find most surprising (Arnold, 1990).

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