Share-Ownership Distribution and Extraction Rate of Petrolium in Oil Fields[1]

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Abstract. We investigate the role of ownership distribution in determining the extraction rates of oil fields. We formulate an empirical equation where the percentage stake of the largest licensee and the percentage share held by the largest shareholder in the dominant company enter as dependent variables. Our sample consists of 44 oil fields in UK Continental Shelf over the period 1997-2001. We use both fixed-effects and random-effects panel data models. The main results show that the share ownership of the largest licensee and the largest shareholder of its multinational company both have a positive and significant effect on the extraction rate. Moreover, we confirm the role of typical control variables: pay thickness has a negative impact on the extraction rate, while remaining reserves are positively correlated with extraction rate. The sensitivity analysis shows that our results are robust to alterative sample selections and model specifications.

Key words: Non-renewable natural resources, share-holder distribution, oil field.

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1. Introduction

In a competitive economy, share-ownership distribution should not affect the production decision of the firm. The reason is that all shareholders, regarding their characteristics, would agree on the objective function of the firm: profit maximisation. When a firm is not a price-taker, any changes to the production decision would alter the prices, and in particular affecting he households' budget constraints. Those effects will have redistributive consequences among the shareholders (unless they hold identical shares) causing them to disagree on the production plan (in this case there is no profit maximisation rule on which shareholders can agree). A common way of reconciling shareholder disagreement is through shareholder voting (DeMarzo, 1993; Renström and Yalçin, 2003),[2] where in equilibrium the decision taken is the one preferred by the decisive voter (typically the median in the

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[2] Shareholder disagreement can also occur if there are incomplete markets or if externalities are present. For shareholder voting in this context see Kelsey and Milne (1996) and (2006).

voting distribution). In this way the ownership distribution will play an important role (in particular the share owned by the decisive shareholder). Renström and Yalçin (2003) demonstrated that shareholder voting may imply overproduction as well as underproduction, relative to the efficient level, depending on the underlying distribution of shares.

In the context of non-renewable resources, when the resource firm realizes it can affect its price by changing the extraction rate, shareholders will generally disagree on the extraction rate. The reason is that an individual with a share ownership different from the average wishes to manipulate relative prices of inputs. Thus, the link between shareholders' interests and extraction decisions for non-renewable resources is of central importance in the literature on natural resources and has been little explored before. The only paper we are aware of exploring this link is Liu, Marsiliani and Renström (2016) that formulate a simple open-economy non-renewable resource extraction model in which individuals differ in the share ownership of a resource firm. The extraction decision is assumed to be taken by a decisive individual (the median voter in voting distribution). Given that the distribution of voting rights is naturally right-skewed, the median-voter share increases as the share ownership of the largest shareholder increases, keeping the same distribution.[3] They take the share of the largest shareholder as a proxy for the share of the median in the vote distribution. They show both theoretically and empirically that if the substitution elasticity between the natural resource and labour is low, then the extraction rate is smaller if the largest shareholder holds a larger share. Nevertheless, Liu, Marsiliani and Renström (2016) focus on firms' resource extraction when each field is owned by a distinct single firm, ignoring multiple ownership or multiple licensees of the resource.

Within the empirical literature, most of the existing econometric models of natural resource extraction are also concerned with aggregate extraction (e.g. Favero, 1992; Mabro et al., 1986; Pesaran, 1990), which may undermine the efficiency of the parameter estimates (Pesaran, 1990). The few attempts at disaggregating production focus on oil fields and mainly analyse extraction cost functions. To our knowledge, Livernois (1987) and Livernois and Uhler (1987) have been the first to

[3] The reason is that the number of shares owned by an individual gives the number of voting rights (rather than one vote per person). Thus, the median in the vote distribution will lie to the right of the median in the distribution of the population.

model costs of oil fields and Livernois (1987) the first to identify explicitly the role of geological characteristics as a determinant of costs of extractions for oil fields. Livernois and Uhler (1987) use a cross-sectional random sample of 166 oil pools in Alberta and find that extraction rate and number of oil wells have a positive effect on extraction cost. Remaining reserves is correlated with extraction cost negatively. Moreover, using a sample of 80 oil reservoirs in the province of Alberta in 1973, Livernois (1987) analyses how geological characteristics affect extraction cost in oil pools. Marginal costs including the marginal user cost of reservoir pressure are independent of the rate of oil extraction. The geographical factors of production are found to have a significant impact on marginal costs. Livernois (1987) finds that differences in the natural factors of production result in significantly different production possibilities among deposits under simultaneous exploitation.

Finally, when analyzing oil fields, one also needs to capture unobservable specific characteristics which potentially influence the extraction rate of each oil field. To our knowledge Kellogg (2011) is the only attempt in the literature on oil fields. Within a learning-by-doing approach, he specifies these unobservable characteristics as the 'relationship-specific learning' through accumulative working experience of the producer and the driller. When the latter accumulate experience working together, relationship-specific intellectual capital is created that cannot be appropriated to pairings with other firms. Using a dataset from the U.S. onshore oil and gas drilling industry with a sample of 1354 fields and 704 producers and 1339 rigs over 1991-2005, Kellogg (2011) demonstrates that productivity of an oil production company and its drilling contractor increases in their joint experience. He shows that a drilling rig that accumulates experience with one producer improves its productivity more than twice as quickly as a rig that frequently changes contracting partners. As a consequence, producers and rigs have a strong incentive to maintain their relationships, and the data demonstrate that producers are more likely to work with rigs with which they have substantial prior experience than those with which they have worked relatively little.

This paper aims at empirically analysing the effect of the size of the share held by the largest shareholder on the extraction rate in oil fields in the UK Continental Shelf. It combines relevant factors from the work of Kellogg (2011), Liu, Marsiliani, and Renström (2016), Livernois (1987) and

Livernois and Uhler (1987). Similar to Liu, Marsiliani and Renström (2016) we assess the impact of share-ownership distribution captured by the largest shareholder's share, and the largest licensee's share of the oil field, on extraction rate. Following Livernois (1987) and Livernois and Uhler (1987), we control for the effects of typical factors influencing non-renewable resources extraction rate, i.e. remaining reserves and geological characteristics such as pay thickness. Furthermore, as in Kellogg (2011), the heterogeneity across oil fields is captured by incorporating variables which account for both the geological features of each field and individual operator characteristics (i.e. the relationship-specific learning through accumulative working experience of the producer and the driller) in panel data models.

The contribution of this paper is twofold. First in focusing on oil field we solve the parameter inefficiency problem first underlined by Pesaran (1990) in connection to aggregate production estimations. Furthermore, we provide insight into the production decision making process of oil fields when, in addition to typical influencing factors, share ownership is also taken onto consideration. This has not been studied before. Using annual observations from 44 oil fields in the U.K. Continental Shelf for period 1997-2001 we find strong evidence that share ownership has significant and positive effect on the extraction rate of oil fields. The results suggest that the more share ownership the largest licensee (or the largest shareholder) holds, the higher is the extraction rate of the oil field.

The rest of the paper is organized as follows. Section 2 presents the empirical model and describes data and summary statistics. Section 3 includes the estimation and related diagnostics tests. Section 4 presents the empirical results and discussions. Sensitivity analysis is given in section 5 and section 6 concludes.

2. Empirical Model, Data and Descriptive Statistics

Following the argument underlined by the relevant existing literature (namely Kellogg, 2011; Liu, Marsiliani and Renström, 2016; Livernois, 1987; Livernois and Uhler, 1987) the following equation is used to estimate the effect of share ownership distribution on extraction rate of oil fields:

$$ER_{it} = \beta_0 + \beta_1 SH_{it} + \beta_2 MSH_{it} + \beta_3 RR_{it} + \beta_4 \lg Z_{it} + e_{it} \quad (1)$$

$$e_{it} = u_i + v_{it}, \; i = 1,..., N, \; t = 1,..., T$$

where ER_{it} is the extraction rate of oil field i in year t. β_0 is the intercept. SH_{it} is the percentage of shareholdings owned by the largest shareholder in the field. MSH_{it} is the percentage of shareholdings owned by the largest shareholder of the responsive multinational company for variable SH_{it}. RR_{it} is the ratio of remaining reserves over total initial oil in place. $\lg Z_{it}$ indicates the logarithm of pay thickness for oil reservoir as measurement of field size and therefore geological characteristics as in Livernois (1987) , e_{it} is the error term for firm i at time t and consist of the unobservable time-invariant field-specific effect u_i and an ordinary white noise term v_{it}. As suggested by Kellogg (2011), the specific factor u_i is considered as the relationship-specific learning through accumulative working experience of the producer and the driller as firm characteristics that influence the oil extraction rate for each oil field.

To examine the effect of share ownership distribution on the extraction rate of UK Continental Shelf oil fields, we gather data from various databases. Table 1 below reports the included variables and data sources.

Table 1. Definitions and sources of the variables

Variable name	Definition
Extraction Rate (**ER**)	the ratio of annual oil production over recoverable reserves of oil field
share ownership distribution of licensees (**SH**)	the percentage of share ownership the largest licensee holds
share ownership distribution of the multinational company (**MSH**)	the percentage of share ownership controlled by the largest shareholder of the multinational company in which the largest licensee is belonged to
Remaining Reserves	the ratio(initial deposit - cumulative production)/initial deposit
Thickness of oil fields	net pay thickness in feet
	Sources
ER, SH	DECC historical statistics and Brown book https://www.og.decc.gov.uk/pprs/pprsindex.htm https://www.og.decc.gov.uk/information/index.htm
MSH	Thomson ONE Banker
RR, Z	United Kingdom Oil and Gas fields Commemorative and Millennium and 25years commemorative volume edited by Gluyas and Hichens (2003) and United Kingdom Oil and Gas fields: 25 years commemorative volume edited by Abbotts (1991).

From the historical statistics and Brown books provided by Department of Energy and Climate Change (DECC) of the UK government, we obtain the annual production and reserves for 121 offshore oil and gas fields over the period 1997-2001[4]. We restrict our focus to oil fields. Hence those fields producing gas are removed from our sample. Moreover, data on share ownership the largest licensee holds is collected from Brown books. From the Thomson One Banker database, we also draw data on share ownership owned by the largest shareholder of the multinational company to which the largest licensee belongs. Accounting for geological factors, the reserves of initial oil in place and thickness of the oil field are mainly collected from United Kingdom Oil and Gas fields Commemorative and Millennium: volume No.20 (Gluyas and Hichens, 2003) and supplemented by United Kingdom Oil and Gas fields: 25 years commemorative volume (Abbotts, 1991).

[4] On the one hand, year 2001 is the last year which is easily accessible; on the other hand, the oil price is calm and low before year 2003.

For each field and variable, we go as far back in time as the data permit. We then drop the oil fields that do not have complete records on three key variables used in our regressions, namely the extraction rate, share ownership of largest licensee and share ownership of the largest shareholders of the multinational companies. This leaves us with a sample of 216 annual observations on 44 oil fields for 1997-2001. The sample has an unbalanced structure, with the number of years of observations on each firm varying between 3 and 5.

The dependent variable in our estimation is the annual extraction rate of oil fields, denoted as **ER**. It is measured by dividing annual production over recoverable reserves for each oil field. The recoverable reserve is defined as the oil that can be recovered from the oil reservoir, which is calculated by multiplying the amount of oil initially in place by the recovery factor.

During a licensing round companies generally working together in consortia invest for the field on offer. According to the Department of Energy and Climate Change in the U.K., one of the consortium companies (generally the company with the largest interest in a field) takes responsibility for operating the field under the control of a joint operating committee of all the licensees. To examine the impact of share ownership (**SH**) to extraction, we use the share ownership that the largest licensee holds. Meanwhile, we also consider the role of the multinational company to which the largest licensee belongs (**MSH**). For instance, for one oil field named Andrew, its largest licensee is BP Exploration Operating Company Limited. In addition, to explore the effect of the largest licensee on extraction, we would identify if its parent firm, BP plc, affects the extraction decision of the oil field. The relating multinational companies list for each oil field is available from the authors on request.

. The variable of remaining reserves is treated as a controllable factor of production and denoted by **RR**. Following Livernois and Uhler (1987), it is calculated as $RR_{it} = (S_i - Y_{it}) / S_i$, where S_i is the initial reserves in place and Y_t is cumulative extraction before year t. It accounts for the factors of initial deposit and age of the oil field. Pickering (2008) uses panel data and finds a positive and highly significant relationship between extraction rates and remaining reserves wherein differences in costs and pricing behaviour are all contained within the intercept term. Therefore, we expect that the fraction of remaining reserves is positively correlated with extraction rate.

Moreover, the differences in exogenous physical characteristics would determine the extraction rate for oil fields. According to Livernois (1987), the production is increasing in the thickness of the pay zone of the reservoir into which the well is drilled. This physical factor is measured with net pay thickness in feet, **Z**, which is defined as the thickness of rock that can deliver hydrocarbons to the well bore at a profitable rate. It is computed by oil column multiplied by net/gross thickness ratio. The effect of pay thickness on extraction rate is expected to be positive in our estimations.

The statistics summary of our sample is presented in Table 2. Below. Data are available from the authors on request. Our sample consists of 44 oil fields over 1997-2001. We have a total of 305 observations for the dependent variable, i.e. annual extraction rate for North Sea oil fields. The average rate of extraction is 6%, and the range goes from 0 to 56%. The largest licensee holds 58% of share ownership on average. There are five oil fields owned by the licensee with 100% of shareholdings, namely Andrew, Cyrus, Highlander, Miller and Tartan. The lowest maximum for shareholdings is 20%. The share ownership distribution is apparently concentrated, while the relating multinational company's share ownership distribution is dispersed with the average share ownership 7% as well as a range from 0.0014 to 0.26. The statistics show that 70% of initial reserves are remaining in oil fields on average. The minimum level of remaining reserve is 29% and the maximum proportion of remaining reserve is 100%. Net pay thickness as the geological factor which impacts the oil reserve and production has skewed data. The average thickness of rock is 537 feet and the sample value ranges from 75 feet to 2135 feet. Thereby it is transformed into a logarithm with base 10 to achieve the data normality. Moreover, Table 2 also shows the paired correlation for variables estimated in our regressions. The multinational company is correlated with extraction rate of oil field positively and significantly. The physical characteristics factors, remaining reserves and net pay thickness, are related to oil extraction strongly significantly ($p<0.01$).

Table 2. Descriptive Statistics

Variable	Mean	SD	Minimum	Maximum	Median
ER	0.061704	0.066767	0	0.556317	0.034822
SH	0.575081	0.224240	0.2	1	0.5
MSH	0.078709	0.071028	0.0014	0.2576	0.0527
RR	0.697046	0.185114	0.290815	1	0.697502
Z	537.7958	475.6533	75.9	2135.182	337.5

Correlation Matrix:

	Variable			
Variable	ER	SH	MSH	RR
SH	0.0785			
MSH	0.1261**	-0.1865**		
RR	0.3171***	0.0162	-0.1337**	
Z	-0.3413***	-0.2528***	0.0107	-0.0632

*p<0.1, **p<0.05, ***p<0.01; Significance levels are based on two-tailed tests.

3. Estimation

Estimation is performed using panel data techniques. On the one hand, it can address the panel structure of the collected data on extraction rate of oil fields. On the other hand, the panel data models can capture both the heterogeneity across oil fields and the heterogeneity across time periods.

Our econometric analysis utilizes two specific standard panel data models: fixed-effects model and random-effects model (Hsiao, 1986). Each specific model stems from a more general model that captures differences across the various producers by incorporating an individual term for each oil field. If it is uncorrelated with the other regressors in, then a random-effects model is appropriate. The one-way random-effects model captures differences across the various producers by including a random disturbance term that remains constant over time and captures the effects of unobservable factors specific to each oil field. The two-way random effects model captures differences over time periods by additionally including a random disturbance term that is generic to all producers but captures the effects of excluded factors specific to each time period.

If the oil field-specific term is correlated with the other regressors, then a fixed effects model is appropriate. It removes any variable that does not vary within the groups. The one-way fixed effects model captures differences across oil fields by estimating a constant term for each oil field. The two-way fixed effects model captures differences over time periods by additionally estimating an individual constant term for each time period. Table 3. below shows a summary of diagnostics tests for regressions.

Diagnostics		
Breusch-Pagan test (*p value*)	chi2 (1)	52.88 (*0.000*)
variance inflation factor		1.1
Ramsey reset test(*p value*)	F(3, 208)	4.04 (*0.008*)
Wooldridge test for serial correlation(*p value*)	F(1, 43)	25.928 (*0.000*)

Breusch-Pagan test statistics with 52.88 strongly rejects the null hypothesis that the variance of the residuals is constant. It suggests that the residual has a heteroskedasticity problem. Moreover, as the degree of multicollinearity increases, the regression model estimates of the coefficients become unstable and the standard errors for the coefficients can get wildly inflated. To test the multicollinearity, variance inflation factor is measured. Generally, if a variable whose VIF values are greater than 10, the variable could be considered as a linear combination of other independent variables. In our regression model, the VIF equals 1.1 suggesting there is no multicollinearity problem. In addition, the specification error is found as Ramsey reset test with statistics 4.04 at significance level below 1%, which indicates that the estimation has omitted variables. Finally, we use Wooldridge test to check the autocorrelation in panel data. We reject the null hypothesis that there is no first-order autocorrelation in panel data.

In order to ensure valid statistical inference when some of the underlying regression model's assumptions are violated, we rely on panel models regressions and apply the fixed-effects model and random-effects model (Hsiao, 1986). Each specific model stems from a more general model that captures differences across the various producers by incorporating an individual term for each oil field. Thereby, to some extent, the specification error problem is mitigated. Finally, considering the above problems such as panel-specific AR1 autocorrelation and panel-level heteroskedastic error term, we correct them by clustering at the panel level. It will produce consistent estimates of the standard errors.

4. Estimation Results and Discussions

In this section, we report and interpret estimation results with alternative estimators shown in Table 4 below.

Due to the coefficients of time-specific factors showing insignificant in all estimations, only one-way fixed-effects estimator and one-way random-effects estimator are used. Model 1 shows that right-skewed share ownership distribution of licensees has a significant and positive effect on the oil extraction rate of oil fields. Moreover, the share ownership distribution of parent companies to which the largest licensee belongs also impacts the extraction rate positively at significance level of 1%. The greater the right-skewed share ownership distribution, the higher is the extraction rate for oil fields. Apart from the effect of share ownership distribution, oil extraction rate is determined by geological factors of individual fields proxied by remaining reserves and net pay thickness. The results show that the oil fields with more remaining reserves tend to extract more oil. Moreover, as we expected, higher extraction rate depends on smaller thickness of rock that can deliver hydrocarbons to the well bore.

Although the pooled OLS model generates solid results, it disregards the expected heterogeneity inherent in the panel data. To exploit the heterogeneity across individual oil fields, we turn to one-way panel data models. If appropriate, the one-way random effects model is preferred to the one-way fixed effects model as fixed effects model precludes estimation of one key time-invariant factor: net pay thickness of oil fields. Much of the subsequent analysis focuses on this factor when examining heterogeneity across oil fields.

Table 4. Estimations of oil extraction rate: Fixed and Random effects models

Dependent Variable ER	**Pooled OLS Model 1**	**Fixed Effects Model 2**	**Random effects Model 3**
SH	0.047***	0.008	0.046**
	(2.64)	(0.36)	(2.00)
MSH	0.288***	0.340**	0.308***
	(4.96)	(2.71)	(3.90)
RR	0.135***	0.235	0.151***
	(6.76)	(1.43)	(4.47)
LGZ	-0.068***	*N/A*	-0.067***
	(-5.53)		(-4.00)
_cons	0.102**	-0.123	0.088
	(2.41)	(-1.18)	(1.49)
rho		0.538	0.348
R-squared : overall	0.327	0.173	0.102
within		0.109	0.492
between		0.2267	0.326
No. of observations	216	216	216

t values are shown in parentheses;***** for p<0.10, ****** for p<0.05, and ******* for p<0.01; N/A indicates that a particular regressor is not applicable to the noted model; Time dummies are not included as time-specific coefficients are insignificant. In case of OLS only the values of R-squared is reported. rho is the fraction of variance due to ui. Panel-specific AR1 autocorrelation and panel-level heteroskedastic in the idiosyncratic error term are corrected by clustering at the panel-level.

The one-way random effects model dominates the pooled OLS model according to Breusch-Pagan Lagrange multiplier (LM) test under the null hypothesis that variances of groups are zero. We find strong evidence of significant differences across oil fields as LM statistics equals 44.56 at significance level below 1%. Moreover, according to Hausman test for random effects, we could not reject the null hypothesis that the individual specific term is uncorrelated with the regressors as the test statistics equals 2.69 and P value is 0.442. Therefore, the random effects model domains the fixed effects model

Model 2 reports the estimation results from the one-way fixed effects model. There is a significant and positive relationship between extraction rate and the share ownership distribution of the parent company to which the largest licensee belongs. However, the share ownership of licensees and remaining reserves are found to be insignificant. Moreover, the appropriate F-test for joint significance of all the fixed effects – oil field-specific – confirms their importance at levels far below 1% (statistic equals 5.14). Thus, the one-way fixed-effects model dominates the comparable pooled OLS model.

As mentioned above, the one-way random effects model not only dominates the one-way fixed effects model but also the pooled OLS model. Therefore, we focus more on the random-effects model. Model 3 reports the estimation results from the one-way random effects model. The results for factors involving share ownership distributions of oil fields and the parent company of the largest licensee, the proportion of remaining reserves and the net pay thickness of oil fields are very similar to the pooled OLS results in sign and statistical significance. Inclusion of these oil field-specific factors increases the coefficient of the share ownership distribution controlled by parent company to which the largest licensee of oil field belongs, from 0.288 to 0.308. Moreover, the coefficient of remaining reserves also increases from 0.135 to 0.151.

Overall, we find evidence that share ownership owned by the operator (i.e. the largest shareholder of the oil field is the operator) has a positive effect on oil extraction rate at 5% significant level. The largest shareholder from the operator's multinational company shows a strong relationship with the extraction rate of the oil field at 0.1% significant level. In particular, when the multinational firm's largest shareholder increases 1 per cent of ownership, extraction rate would increase by 0.3%. In addition, geological factor, pay thickness and remaining reserves are found to be strongly correlated with extraction rate.

5. Sensitivity Analysis

Using OLS as the reference point, the robustness across these models has been evaluated in model 1 of Table 4. The results generated by OLS are consistent with our main results estimated by one-way random-effects model. This section thoroughly tests the robustness of the results across sample selection and model specification as well as different estimation methods. Firstly, we test whether the results are driven by outliers by excluding various groups of oil fields from the sample. Two methods are used to detect outliers and influential points: the plots of leverage against residual squared and the partial regression plots. We found that field no.41 was a point of major concern. Then, we performed random effects estimation with the outlier and without it separately. Deleting field no.41 made little change in the coefficients. For instance, the most change is of coefficient for MSH and simply dropped from 0.28 to 0.25. Therefore, oil field no.41 did not affect the regression. Thus, there is no influential point which has a large effect on regression results to remove.

It is interesting to test for non-linearities by augmenting the regressions of Table 4 with quadratic and cubic terms of the share ownership distribution. The relationship between inequality of share ownership distribution and extraction rate could depend on an oil field's stage of development. We test for this by experimenting with different functional forms, such as including a squared and/or cubed term for inequality. We do not find any evidence for a significant quadratic or cubic relationship between changes in share ownership inequality and changes in extraction rate.

As a further robustness check, we enquire whether the estimation method matters. Equation (1) is re-estimated using Feasible Generalized Least Squares estimator (FGLS) and OLS with Panel-Corrected standard errors (PCSE). Both panel-specific AR1 autocorrelation and panel-level heteroskedastic errors are controlled. We estimate a set of regressions where the dependent variable (pollution emission) is regressed on the core variable (share ownership distribution) and all possible combinations of other control variables. The results are presented in Table 5 below.

In comparison with PCSE estimations, results using FGLS appear overconfident. This problem is explored by Beck and Katz (1995) who attribute this overconfidence to time-series cross-section data where the error process has a large number of parameters as the FGLS assume the error process is known but not estimated. This oversight causes estimates of the standard errors of the estimated coefficients to understate their true variability.

Table 5. Sensitivity analysis: alternative estimator FGLS and PCSE

Dependent Variable **ER**	**FGLS AR1** (1)	**FGLS AR1** (2)	**FGLS AR1** (3)	**FGLS AR1** (4)	**PCSE AR1** (5)	**PCSE AR1** (6)	**PCSE AR1** (7)	**PCSE AR1** (8)
SH	0.024393***	0.039632***	0.020502**	0.041799***	0.03773	0.059652**	0.028873	0.056044**
	(0.00688)	(0.01096)	(0.00938)	(0.01132)	(0.02837)	(0.02346)	(0.02651)	(0.02551)
MSH	0.199431***	0.085001***	0.121079***	0.151949***	0.338382***	0.214831***	0.272279***	0.150215**
	(0.02837)	(0.02321)	(0.02761)	(0.00255)	(0.08585)	(0.08025)	(0.0895)	(0.07507)
RR	0.099261***	0.156953***			0.085605	0.113648***		
	(0.01321)	(0.01587)			(0.05573)	(0.04359)		
LGZ	-0.07576***		-0.09235***		-0.10038***		-0.10614***	
	(0.00813)		(0.00714)		(0.03276)		(0.02084)	
_cons	0.16696***	-0.06826***	0.29417***	0.040656***	0.231309**	-0.04443	0.322227***	0.051624***
	(0.02756)	(0.01193)	(0.02193)	(0.00674)	(0.1244)	(0.03569)	(0.05873)	(0.01755)
R-squared					0.4887	0.4237	0.4620	0.3602
N	216	271	216	276	216	271	216	276

Note: a) robust standard errors are in parenthesis. b) *, **, *** denotes significance at the 10% level, 5% level, and 1% level respectively. c) Both panel-specific AR1 autocorrelation and panel-level heteroskedastic errors are corrected.

Summing up, for most regressions, the coefficients of share ownership distribution variables indicate high significance with positive sign regardless of FGLS estimator and PCSE estimator. The results are again qualitatively similar to those reported in column (3) of Table 4.

6. Conclusions

This paper examines the influence of share ownership distribution on extraction rate differences between oil fields. Results based on data from an unbalanced panel set of 44 UKCS oil fields covering the period 1997-2001 show that there is positive relationship between the share ownership of the largest licensee and the largest shareholder of the largest licensee's multinational company and extraction rate. It suggests that an oil field with more right-skewed share ownership distribution tends to extract more oil after controlling for geological characteristics such as remaining reserves and pay thickness. In particular, when the multinational firm's largest shareholder increases 1 per cent of ownership, extraction rate increases by 0.3%.

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