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**Risk disclosure behaviour:
Evidence from the UK extractive industry**

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Abstract:

Purpose: This paper contributes to risk management research with reference to disclosure of risk specific information within the oil and gas industry. This paper provides empirical evidence regarding voluntary and mandatory disclosure behaviour from both a quantitative and qualitative perspective.

Design/methodology/approach: A longitudinal empirical study examines probabilistic reserve quantum reporting of UK companies, over a time-period spanning voluntary and mandatory disclosure. The researchers analyse disclosure behaviour under voluntary and mandatory time spans using a logistical regression approach to measure determinants of risk reporting. Form of regulation is considered as the fundamental driver for disclosure whilst controlling for other relevant variables. Implications for developing international regulation are presented with suggestions for further research.

Findings: Mandatory reporting is not seen as a significant influence to disclosure. Degree of risk, quality of audit firms, level of stock exchange and organisational visibility each impact on disclosure. The findings indicate that a mandatory disclosure approach is ineffective, partially explained by mimetic and normative forces and a balancing of agency related costs and benefits. There is an inverse relationship between level of risk and risk reporting.

Originality/value: The paper provides original insight into the area of risk management with particular focus on risk specificity and quantitative metrics for risk profiling re probabilistic estimations not previously tested. The paper introduces risk profiling as a variable in risk disclosure. The paper seeks to inform the IASB's on-going consideration of risk reporting.

Keywords:

Voluntary disclosure, Extractive Industry, Risk, Reserve quantum

1. Introduction

Corporate risk reporting provides stakeholders' with valuable information regarding operational sustainability (Elzahar and Hussainey, 2012), calibrating current and future risks regarding expected risk-return criteria (Cabedo and Tirado, 2004) and cash flows (Campbell *et al.*, 2014). Regulatory bodies (e.g. SEC, 2016) recognise the need for risk¹ disclosure as a valuable dataset for stakeholders. Reporting of risk should be expansive where it is of value to stakeholders (Abdullah *et al.*, 2015) and quantitative and qualitative in content (Miihkinen, 2012; Cabedo and Tirado, 2004). Recent risk disclosure research has also recognised the value of risk specific information (Heinle and Smith, 2015; Hope *et al.*, 2016).

The mandatory versus voluntary disclosure debate within risk disclosure provides this paper's first motivation, meeting prior literature's call for research into voluntary and mandatory disclosure in general (Healy and Palepu, 2001) and risk reporting in particular (e.g. Kravet and Muslu, 2013). Elshandidy *et al.* (2018) advocate the need for developing a theory of risk disclosure to understand incentivisation and behaviour. Two distinct streams of risk disclosure literature consider mandatory and voluntary reporting (Elshandidy *et al.*, 2013), one focusing on the impact of mandatory risk disclosure requirements (e.g. Jorgensen and Kirschenheiter, 2012) the other on the determinants of voluntary risk disclosure (e.g. Abraham and Cox, 2007).

This study considers information specific risk data (reserve quantum within the UK oil and gas sector²) to gauge reporting behaviour by analysing changes in reporting between periods of voluntary and mandatory reporting. The debate continues regarding voluntary and mandatory risk reporting as mirrored within the extractive industries where in the US reserve recognition accounting for proved reserves is specified by FASB ASC 932 whilst in the UK, industry bodies (e.g., UK Oil Industry Accounting Committee) provide recommended best practice (Gray *et al.*, 2019). The debate's importance is clearly illustrated within this sector in

¹ Risk, by definition, is a set of outcomes that can be assigned probabilities whereas 'uncertainty' arises where no probabilities have been assigned (Watson and Head, 1998). The application of the statistical evaluation of risk was developed over time through such bodies as the insurance industry (Linsley and Shives, 2006).

² Reserves as applied to this paper refer to the mineral reserves owned by a corporation as distinct to the equity reserves of that corporation.

the work of Cannizzaro and Weiner (2015) who document that multinationals strategically manage their disclosures.

The period under consideration in the paper (financial years 2006-2010) spans a period where the voluntary Operating and Financial Review (OFR) was followed by mandatory disclosure via the Business Review (Companies Act, 2006). To the best of our knowledge no paper considers risk information across periods of voluntary and mandatory reporting within the one geographical and industrial sector. The paper permits consideration of disclosure behaviour questions that cannot be fully considered by looking at only one of these modes of delivery in isolation, allowing consideration of how voluntary disclosure contrasts with politically determined regulatory disclosure. From a policy perspective there is a need to understand the likely reaction to moving to mandatory reporting from voluntary reporting for risk information. This not only informs the ongoing debate regarding risk information disclosure e.g. the Dynamic Risk Management (DRM) research project but also the extractive industry disclosure debate of the IASB.

The second motivation is to further the work on risk specificity. The SEC has commented on the need for specificity³ in risk disclosure rather than generic discourse (SEC, 2010). This paper links this need with prior risk literature's call for future research to assess the quality of specific risk disclosure in different fields (Heinle and Smith, 2015; Hope et al, 2016) and thus the paper will consider the level and determinants of risk specific information disclosure.

Risk disclosure requirements have been criticised with managers disclosing “all possible risks and uncertainties regardless of their likelihood” (Campbell *et al.*, 2014, 397) with no requirement to disclose the likelihoods of the realisation of those risks leading to vague disclosures being boilerplate in nature (Reuters, 2005). Research into risk reporting has predominantly focused on generic risk reporting (e.g. Dobler *et al.*, 2011) with the majority of work relating to influences of narrative disclosure (e.g. Elzahar and Hussainey, 2012), mandatory and voluntary reporting (Elshandidy *et al.*, 2015) and the information content disclosed (Campbell *et al.*, 2014). This paper provides insight into reporting behaviour

³ Hope et al (2016) define “specificity” as a higher level of detail being provided conditional on the firm deciding to disclose a particular risk

regarding specific risk management information where risks are recognised, defined by regulatory bodies using probabilistic methodologies and calculated.

The paper is structured as follows. Section 2 discusses the regulatory background of reserve disclosure practice in the UK context. Section 3 reviews relevant literature and section 4 develops the research hypotheses. Section 5 describes our research design. Section 6 reports the empirical analysis for the determinants of the voluntary disclosure of oil and gas reserves. Drawing on these findings, implications for the future regulation of reserves disclosures are discussed in Section 7. Section 8 concludes and offers suggestions for future research.

2. Sector background

A significant proportion of energy firms' value is derived from oil and gas reserve quantities not necessarily recorded in their annual report, yet such reserve information provides stakeholders with key risk signals regarding future value generation (e.g. Patatoukas *et al.*, 2015; Moses *et al.* 2018). These reserves are subject to a range of indigenous risks pertaining to unique operational, production and financial uncertainties including exploration, geological, production and logistical problems, and non-extractive uncertainties relating to commercial, political and financing factors (Wise and Spear, 2002).

This paper considers UK practice with the accounting profession's industry advisory group (Oil Industry Accounting Committee (OIAC)) providing detailed recommendations (OIAC, 2001) through Statements of Recommended Practice (SORPs). This was followed by the Accounting Standards Board's (ASB, 2005) Operating and Financial Review (OFR) containing specific requirements for the extractive industry. The SORP is still relevant when determining good industry practice regarding reserve disclosures (Gray *et al.*, 2019). Probabilistic estimation methodologies are advocated to create a range of estimates and their related probabilities from known geological, engineering and economic data using combinations of procedures such as volumetric studies, reservoir modelling and seismic estimation with the level of detail and analysis of data narrowing the range of uncertainty (Mitchell, 2004). The paper focuses only on the oil and gas industry within the extractive industry sector due to the SORP's petroleum constituency.

The SORP allows companies to show one of the following risk categorisations:

- Proven and probable oil and gas reserves or

- Proven developed and undeveloped oil and gas reserves

For probable “there should be a 50 per cent statistical probability that the actual quantity of recoverable reserves will be more than the amount estimated as proven and probable and a 50 per cent statistical probability that it will be less. The equivalent statistical probabilities for the proven component of proven and probable reserves are 90 per cent and 10 percent respectively”. Within the definition of “Proved developed and undeveloped” the estimated quantities must demonstrate with reasonable certainty (90%) to be recoverable in future years from known reservoirs (OIAC 2001, SORP2.12.a and b).

Disclosure guidelines also include qualitative details complementing the probabilistic data. Seven such recommended qualitative disclosures are applied to this study in order to assess level of disclosure quality:

- Balances by **geographic region** (SORP, s246)
- **Source of the estimates** (SORP, s247)
- Name and qualification of an **independent expert** who reviewed the internal data (OFR, p77)
- **Basis** for arriving at the net quantities (SORP, s247)
- Application of an **accepted practice for defining reserve** quantum (e.g. SORP rules, s12, OFR p77)
- **Movement** in the net quantities of reserves (SORP, s249)
- Relevant **KPIs** (OFR, p77)

The voluntary OFR became mandatory by Statutory Instrument in April 2005 with implementation guidance provided by Reporting Standard 1: Operating and financial Review (ASB, 2005). However, the Statutory Instrument was withdrawn by the Chancellor of the Exchequer in January 2006. The OFR therefore has persuasive rather than mandatory force for the period considered in the study. Subsequently, section 417 of the UK’s Companies Act 2006 set out enhanced mandatory business review reporting requirements⁴ to be included as part of their directors’ report for financial years from 1 October 2007. Unlike the OFR’s specific guidance for the extractive industry, the business review is more generic with regard

⁴ This had implications for the ASB's Reporting Standard (RS) 1 'The Operating and Financial Review', which was formally withdrawn. As a result, the ASB converted RS 1 into a Reporting Statement of Best Practice based on the OFR, which has persuasive rather than mandatory force.

to principal risks and uncertainties facing a company with disclosure required to be consistent with the size and complexity of the business. This period allows a comparison between those periods of voluntary and those of mandatory reporting.

The IASB continues to have an on-going interest in the reporting of risk. In regards to risk disclosure the Board is currently considering risk management under the mantle of the DRM research project exploring whether it can develop an accounting model that will provide users of financial statements with better risk information and plan to publish a Discussion Paper. The IASB are also focusing on industries where risk information is of value to stakeholders. IFRS 6 *Exploration for and Evaluation of Mineral Resources* (IASB, 2004) was issued as an interim standard but merely codified existing industry practice allowing companies to continue reporting in their preferred manner (Cortese *et al.*, 2010). Thereafter, a working group issued a discussion paper released in April 2010 (IASB, 2010) to consider such factors as voluntary/mandatory requirements and reporting of risk. The Board continues to review the discussion paper having met in March 2019 to discuss feedback from national standard-setters.

3. Literature

Risk disclosure by its nature reflects unfavourable information of uncertainty, and without regulation, may lead to both an avoidance of disclosure or boilerplate generalities (Spindler, 2006). Mandatory frameworks enforce management's fiduciary duties and reduce agency problems, such as information asymmetry, and increase the credibility of the information (Elshandidy *et al.*, 2018; Brammer and Pavelin, 2006). Failure to disclose is particularly pertinent when incentives to voluntarily disclose appear to be low whilst the information is highly desired by stakeholders (both factors relevant to risk reporting) suggesting that regulation can be more effective in certain contexts and industries ((Marshall and Weetman, 2007; Elshandidy, 2018).

Within risk reporting structures differ between countries, some countries favouring mandatory (e.g. Germany), others voluntary (e.g. the UK) and others a compromise of the two (Elshandidy *et al.*, 2015). There is evidence that voluntary and mandatory risk disclosure may complement each other (e.g. Elshandidy *et al.*, 2015) but some argue that it has a substitutionary effect (e.g. Butler *et al.*, 2007) raising the question of the need for mandatory. Attempting to regulate risk reporting is fraught with complexities and controversy

(Elshandidy *et al.*, 2018) with guidelines having been criticised for their lack of clarity and uniformity (Abdullah *et al.*, 2015).

Specificity or risk information has been the subject of only a limited number of studies. In regards to its value to stakeholders, Heinle and Smith, (2015) argue that more precise signals of uncertainty receive greater weight with the market reacting to the precise risk disclosure. This is supported by Hope *et al.* (2016) whose empirical findings suggest that the level of specificity in risk disclosures affects investors' and analysts' evaluations and thus risk specificity is beneficial. They also find that within risk specificity investors seem to appreciate quantitative disclosures more than qualitative ones. Risk specific information also has incremental power to explain the future stock-return sensitivities (Thornton and Welker 2004; Linsmeier *et al.* 2002). Other risk specific studies are focused on the means of identifying risk specific information (e.g. Campbell *et al.*, 2014; Kravet and Muslu, 2013).

Studies focused on specificity of risk in regard to degree and determinants of disclosure, to the best of our knowledge, is covered only in regard to foreign exchange disclosure where only tacit disclosure requirements are provided and guidance being so general as to be effectively voluntary (Marshall and Weetman, 2007). Whilst governing bodies seek risk specificity there is little research into reporting behaviour within sectors where such specificity is evident. The oil and gas extraction context provides a unique insight into risk reporting where there is quantitative enumeration of risk and clear specificity of information including qualitative data.

4. Hypotheses development

Managers develop sophisticated systems to measure, communicate and evaluate business risk (Khalif and Hussainey, 2016). However, stakeholders may know little about this risk information and thus an information gap exists (Linsley and Shrivs, 2006). Agency theory suggests that publishing risk information may reduce such information asymmetry between insiders and outsiders (Elshandidy *et al.* 2013). Whilst discretionary disclosure persists there will be a balancing of agency costs and benefits (Cabedo and Tirado, 2004) impacting on disclosure and information asymmetry. Agency costs may motivate managers to reduce disclosure where seen as non-trivial in regard to the expense of verification and validation of the data by experts, and also proprietary and litigation costs. For example, within the risk

disclosure literature there is evidence of high political and proprietary costs impairing disclosure (Cannizzaro and Weiner, 2015; Akamah et al., 2018).

Mandating the disclosure should remove this discretionary appraisal which constrains disclosure and, by doing so, reduce information asymmetry. Companies would also be motivated to adhere to the mandated requirements as it would provide agency related benefits. The reduction of information asymmetry would reduce an organisation's cost of capital by allaying stakeholders uncertainty regarding risk (Craswell and Taylor, 1992), reduce moral hazard and adverse selection problems and reduce agency-related costs such as manager monitoring and incentivisation. There is also a confirmatory role creating principal and agent trust in regard to managers' ability to identify and manage risks effectively. It should be noted there is expected to be negligible marginal cost in providing the information externally as it already exists internally. We would contend that by ending the discretionary nature of risk disclosure with its focus on agency costs and resultant reduced disclosure and by recognising the agency benefits of the increased disclosure that managers will be motivated to increase risk reporting. It may even be that some managers may still balance agency costs and benefits and provide additional information beyond that mandated (Elshandidy et al., 2013).

Institutional theory espouses organisations seeking legitimacy through forms of isomorphism⁵ (DiMaggio and Powell, 1983; Scott, 1995) creating mandatory pressures (coercive) and voluntary pressures (mimetic and normative, the former based on competitors and the latter on professional norms). Institutional theory has been used within voluntary accounting reporting literature (e.g. Cho et al., 2012; Guerreiro, Rodrigues, & Craig, 2012) but has had limited exposure to risk reporting (Cannizzaro et al., 2015). Regulative or coercive pressure, from countries' legal and political systems (DiMaggio & Powell, 1983) is likely to affect firms' decisions to reveal risk information (Elshandidy et al., 2015). To maintain legitimacy firms would wish to adhere to regulations. There is also a mimetic force as firms will be motivated to be consistent with similar firms that respond to higher levels of risk disclosure as mandated. Responses to such pressures should shape decisions on

⁵ The congruence between organizational arrangements and institutions in society is explained through the process of isomorphism (DiMaggio and Powell, 1983) in that "coercive isomorphism stems from political influence and the problem of legitimacy; mimetic isomorphism resulting from standard responses to uncertainty; and normative isomorphism, associated with professionalization" (p. 150).

disclosing more information with other pressures working alongside this (Judge *et al.*, 2008) such as agency benefits.

Oil and gas reserve quantum reporting is an appropriate field for testing institutional and agency related dynamics in regard to risk reporting. This is a high-risk industry particularly in regard to reserve quantum estimates. The paper will consider risk reporting as the dependent variable being presented by firstly the provision of reserve quantum information. Secondly the quality of narrative supporting reserves disclosures in UK annual reports will be considered, adding to the literature in the area of qualitative reserve risk reporting (e.g. Ferguson and Pündrich, 2015; Taylor *et al.*, 2012). The paper adopts a longitudinal approach considering disclosure behavior to different forms of regulation. We argue that mandated requirements will increase disclosure through the removal of discretion with its agency-cost focus, the pressure to maintain legitimacy through adherence, in addition to the agency benefits outlined. The quantitative and qualitative reporting aspects are tested separately to contrast whether regulation impacts on the two forms differently. We do not contend that the increases in quantitative and qualitative reporting will be similar. This leads to the following hypothesis based on the premise that mandatory reporting will increase both the quantitative and qualitative disclosures as follows:

H1: Disclosure of reserve quantum balances in the oil and gas industry increase in periods of mandatory disclosure requirements.

H2: The quality of disclosure of reserve quantum balances in the oil and gas industry increases in periods of mandatory disclosure requirements.

5. Research design

5.1 Sample

The annual report is used as part of the accountability discharge activities of an entity being seen as statutory, within the public domain, regularly produced and important to an entity's public image (Gray *et al.*, 1995). This paper selects a single industry context within the oil and gas sector to permit depth of analysis of a risk dominated industry with a focus on reserve quantum which is of significant importance to stakeholders carrying with it high levels of uncertainty.

The analysis is undertaken for the years 2006 to 2010 examining disclosures in a purely voluntary environment (2006-2007) in contrast to the mandatory requirements after this period. Oil and gas companies, including both producer and developer entities were selected from the London Stock Exchange (LSE, industry classification code 533) and the PLUS SX market in London. This resulted in a final sample of 86 companies: 18 listed on the main LSE, 65 companies listed on the LSE Alternative Investment Market (AIM) and 3 on the PLUS stock market. Of these 67 companies provided full information. Six companies were also included where information was only available for four years but equally bridging the voluntary/mandatory period. However, 13 companies were excluded from the study due to incomplete information. This provides a wide spread of entity irrespective of size, stage of production and profitability with 359 observations as summarised in Table 1. The dominating methodology is content analysis, a methodology commonly used regarding generic risk (e.g. Elshandidy et al., 2015). This study applies textual analysis but adopts a different approach from prior risk studies focusing on risk specificity rather than generic risk and uncertainty.

Insert Table 1 here

5.2 Basic regression model

Following prior disclosure literature, logistic regression analysis is used to measure the determinants of reserve quantum reporting. The study focuses both on the disclosure of reserve quantum but also the quality of that disclosure. The Lagrange Multiplier test was applied which suggested using pooled ordinary least squared (OLS) regression analysis to measure the determinants of such reporting. The following formula tests our research hypothesis for reserve quantum disclosure (QUANTDIS) and the quality of that disclosure (QUALDIS) in regard to voluntary and mandatory frameworks whilst controlling for other variables:

$$QUANTDIS = a + b_1REGULATION + b_2RISKPROF + b_3LOGTA + b_4EXCH + b_5USLIST + b_6LEV + b_7AUDIT + b_8LOGVIS + e$$

$$QUALDIS = a + b_1REGULATION + b_2RISKPROF + b_3LOGTA + b_4EXCH + b_5USLIST + b_6LEV + b_7AUDIT + b_8LOGVIS + e$$

The variables are detailed below. The intercept is denoted as a and e is the standard error of residual for firm i in year t .

In order to verify the relationship between the independent variable (REGULATION) and dependent variable of risk disclosure it was decided to include a lagged dependent variable in our model based on prior research (e.g. Li, 2010 and Hassanein and Hussainey, 2015) with the change in disclosure rather than disclosure levels mitigating the problem of endogeneity.

5.3 Validity and reliability

Weber (1990, p. 12) argues that ‘to make valid inferences from the text, it is important that the classification procedure be reliable in the sense of being consistent: different people code the same text in the same way’. Following Marshall and Weetman (2007) we controlled for consistency by having the principal researcher score all disclosures using an agreed questionnaire instrument, and controlled for judgement errors by having a second researcher carry out sample checking with differences noted and amendments made if necessary to the research instrument.

5.4 Disclosure Measures

Reserve quantity balances disclosure (QUANTDIS) is measured by whether or not reserves are recorded in the company annual report. Where companies have no reserves and state so this is regarded as a disclosure providing the status of the reserves (Crasswell and Taylor, 1992). QUANTDIS is measured using a dichotomous variable coded as one for firms disclosing reserves information and zero otherwise. Whilst QUANTDIS is a dichotomous variable the quality of reserve disclosure (QUALDIS) is measured by capturing whether any of the seven SORP/ OFR attributes⁶ above are found within the annual report as discussed in Section 2 the score ranging from 0 to 7. For measuring separately reserve disclosure in terms of quantity and quality we follow prior disclosure studies in measuring the quantity and quality of disclosure using an unweighted content analysis approach (e.g. Chakron and Hussainey, 2014; Elzahar et al, 2015; Alotaibi and Hussainey, 2016a; 2016b and Al Lawati et al, 2020).

5.5 Independent variables

⁶ Balances by geographic region, Source of the estimates, Name and qualification of an independent expert who reviewed the internal data, Basis for arriving at the net quantities, Application of an accepted practice for defining reserve quantum, Movement in the net quantities of reserves, Relevant KPIs

Regulatory influence (**REGULATION**) is measured in regard to voluntary versus mandatory disclosure requirements. Companies reporting in 2006 and up to September 2007 were subject to voluntary disclosure (and scored zero) whereas thereafter up to the end of 2010 the reporting was subject to mandatory requirements (and scored one). We follow (Abed *et al.*, 2014 and Al Lawati *et al.*, 2020) in measuring the regulation variable.

5.6 Control variables

A number of control variables are selected based on prior voluntary/mandatory disclosure, In addition a further variable risk profile, used in prior reserve quantum research and considered pertinent for inclusion, is introduced to the risk management literature.

Log of total assets (LOGTA) is seen as a measure for firm size and is the logarithm of the total assets, in pounds (thousands), of the company, as used in recent literature (Allini *et al.*, 2016; Elberry and Hussainey, 2020). A positive association between firms' voluntary disclosure and their size is anticipated as large firms attract more interest from analysts and investors.

Stock exchange listing (EXCH) has been used as a proxy for the impact of visibility on companies' disclosure practice (e.g. Singhvi and Desai, 1971) with entities on major stock exchanges being more likely to disclose due to greater scrutiny and higher level reporting requirements. **EXCH** is recorded as a dichotomous categorical variable with a score of one for firms listed in LSE, two for the AIM and three for firms listed in PLUS⁷.

Differing international stock exchanges listings (USLIST) has been considered with the expectation that different listings will increase reporting requirements (e.g. Malone *et al.*, 1993). We consider listings on US stock exchanges and therefore subject to differing reporting requirements such as the Securities Exchange Commission. A dichotomous variable code is applied as either two for companies with a US listing otherwise one.

⁷ The AIM is a sub-market of the LSE designed to help smaller companies access capital but with much greater regulatory flexibility compared to the main market. PLUS Markets Group was a stock exchange based in London for small capitalised companies who aimed to ease compliance costs and was seen as a stepping stone for gaining entry into the AIM

Leverage (LEV) has been found to be inconsistent in direction and statistical significance in disclosure studies (e.g. Jensen and Meckling, (1976) and Alsaeed, (2006)). *LEV* is recorded as a company's debt to equity ratio.

The quality of external audit (AUDIT) considers audit firms' reputational loss by being associated with clients with poor reporting practices this being more prevalent amongst the higher quality audit firms (Deangelo, 1981). A dichotomous variable is coded as 1 where audited by one of the Big Four auditing firms and zero otherwise.

Corporate visibility (LOGVIS), we follow Allini *et al.* (2016) in measuring the visibility of firms (e.g. the number of times each firm appears on Google search). LOGVIS is measured by the logarithm of detailed Google visits to the corporations' site.

Risk profile (RISKPROF): We allow for consideration of differing levels of specific risk in regard to reserve quantum as risk is seen to diminish as we approach the construction and production phase of the value chain. We categorise and code as zero the companies into pre-production developer firms⁸ (exploration and development) as opposed to production companies (coded one) as with prior literature (Mirza and Zimmer, 2001, McChlery *et al.* 2015).

The descriptive characteristics of the dependent and independent variables are found in Table 2. In regard to the dependent variables it was noted that in 62% of the company observations the reserve quantum was disclosed, consistent with Mirza and Zimmer (2001) in their Australian study and in the UK by Odo *et al.* (2016). In regard to the quality of the disclosure the mean score was 2.7 (maximum disclosure score 7). Of particular note to the method of research adopted in regard to the new variable proxying for risk (producer v developer firms) is the fact that of the observations noted 60% were producer firms.

Insert table 2 here

6. Empirical analysis: Determinants of the extent and the quality of reserves disclosure

⁸ We classify firms as producers (have started production and earned revenue from the sale of the product) and developers (have neither started production nor derive revenue from the sale of the product). Developer companies would not be expected to have substantial reserves in contrast to production companies (Crasswell and Taylor, 1992).

6.1 Data reliability tests

A Kolmogorov-Smirnov test is conclusive regarding the distribution not being normally distributed, thus requiring non-parametric statistical tests. An initial univariate test is conducted examining the simple relationships between the dependent variables (disclosure) and the independent variables using Spearman's correlation coefficient to test for multicollinearity. Table 3 shows no collinearity $> .8$ and thus multicollinearity is not evident, although there are significant relationships relating to size (LOGTA) and UK exchange listing (EXCH) ($r = -0.717$, $p < .01$) which may affect multivariate tests.

Insert table 3 here

The authors also tested for multicollinearity using variance inflation factor (VIF) methodology with VIF values suggesting no multicollinearity issues in the data.

6.2 Regression analyses

6.2.1 Determinants of reserve balance disclosure

We use binary logistic regression because our initial dependent variable (reserve quantum disclosure) is dichotomous and the predictor variables are either continuous or categorical.

This methodology allows the researcher to establish the variable coefficients (β) which are influential in predicting the categorical outcome. This study, is not seeking to predict the probability *per se* of disclosure, but rather to understand the strength and significance of influence of the independent variables on disclosure.

Insert table 4 here

Table 4 considers the importance of voluntary versus mandatory reporting requirements for reserve quantum⁹. Regulation is not seen as a significant variable in changing reporting behaviour and therefore hypothesis 1 is rejected. Reserve balance disclosure is positively

⁹ To address the possibility of time effect bias on data the researchers let the intercept vary across years. With five years of data, we have used only four dummies to avoid falling into the dummy-variable trap. USLISTING is omitted due to the statistical difficulty of using more than one dummy variable as independent (QUANTDIS being set up as a dummy variable) the analysis automatically deleting the variable and removing 15 observations.

associated with RISKPROF ($p < .001$). This indicates that the extent of reserves disclosure for the lower risk producer firms is greater than the disclosure of the developer firms. This is consistent with prior extractive industry research (Mirza, 1999; Mirza and Zimmer, 2001). LOGTA is also statistically significant (at $p < .01$), and with the expected positive relationship and consistent with prior reserve quantum research (Mirza, 1999; Mirza and Zimmer, 2001; Taylor *et al.*, 2011). The positive and statistically significant relationship with quality of audit (AUDIT, $p < .05$) is also consistent with the prior mineral quantum research of Craswell and Taylor (1992) and Taylor *et al.* (2011). All other independent variables are not statistically significant.

6.2.2 *Determinants of the quality of reserve quantum disclosure*

Table 5 presents the regression results for the quality of reserve quantum disclosure¹⁰ showing again that regulation has had no effect on the quality of information provided. Therefore we reject hypothesis two. Quality of disclosure is positively influenced by RISKPROF ($p < .001$) indicating that the quality of reserves disclosure for lower risk producer firms is greater than the quality of disclosure for developer firms. We note that LOGTA is also statistically significant ($p < .001$). All other independent variables are not statistically significant.

Insert Table 5 here

6.2.3 *Separate consideration of producer and developer firms*

From the analysis above a significant variable for both dependent variables has been risk profile. This relatively untested variable in risk management literature requires further consideration. The data collected is therefore further analysed to consider two distinct groups within the sector. An alternative approach is therefore applied to consider segmental disparities within the sector to gauge whether companies differ in regard to the voluntary/mandatory impacts on disclosure of such distinct entities and thus reporting policies should differ.

¹⁰ USLIST was accepted within this analysis as QUALDIS is not a dummy variable (unlike QUANTDIS).

Table 6 considers separately the impact of regulation on producer and developer companies in regard to reporting reserve quantum. RISKPROF is discarded as the types of company which make up this variable are considered independently. Regulation is not statistically significant for both producer and developer companies. Production companies are influenced by size ($p < .001$) but not developer companies ($p > .05$). Only developer firms are influenced by audit firm size ($p < .01$). All other variables are not statistically significant except for visibility for producer companies ($p < .05$).

Insert table 6 here

Table 7 considers regulation in regard to production and developer companies separately in regard to quality of information provided. Regulation is not statistically significant as a driver for disclosure for both segments. Size remains a statistically significant variable for both producer ($p < .001$) and developer ($p < .01$) entities. With the removal of RISKPROF stock exchange (EXCH) becomes statistically significant for both types of entity ($p < .05$) whilst US listing becomes significant for the producer companies ($p < .05$). For developer firms the level of gearing is statistically significant (at $p < .001$) as is the quality of audit (at $p < .01$). The remainder of the variables are not statistically significant.

Insert table 7 here

7. Discussion

7.1 Voluntary and mandatory reporting

The change from the voluntary OFR to the obligatory business review had no impact on reserve reporting both quantitatively and qualitatively and for producer and non-producer companies when considered separately. An argument may be made for the mimetic and normative pressures affecting the potency of the mandated requirements. The highly detailed specific requirements of the normative SORP may have become embedded in the “tradition” of reporting with entities hesitant to provide less information than their competitors and also affect stakeholders’ expectations. One might have expected entities already providing significant levels of information voluntarily to reduce their information provision to the lower generic requirement of the Business Review. For those companies with current poor voluntary disclosure they did not improve their disclosure practices perhaps in regard to the nebulous nature of the Business Review and the strength of its mandate.

Alternatively or concurrently the agency costs may outweigh the agency benefits in regard to altering reporting behaviour. It was noted within the risk literature that political and proprietary costs may impair disclosure (Cannizzaro and Weiner, 2015; Akamah et al., 2018) and these factors may be tipping the balance towards non-disclosure. The alteration in

perceived agency costs and benefits, including the costs of ignoring the mandate, is not regarded as significant enough by agents as to alter their reporting behaviour. An alternative explanation is that the adjustments to the agency costs and benefits counter-balance each other resulting in no significant change to the agency cost/benefit balance.

Consideration should also be given in regard to the regulations themselves in terms of their perceived value to stakeholders in contrast to the existing voluntary practice. There is a strong argument that the Business Review requirements provide scant risk information of value as compared to the original SORP. The OFR did make specific reference to extractive industry reserves whilst the Business Review is too generalised to provide specific value relevant information. The lack of a clear mandate regarding specific content continues to provide management discretion regarding disclosure. Firms are legitimised not by the lack of sanction but by the specificity of detail and thus continue with their practice of information asymmetry. This concurs with Bather and Tucker (2011) in that generic disclosure requirements provides management latitude of discretion with the content of the Business Review. This accords with Cortese *et al.*, (2010) in that corporations pursue maintaining considerable management discretion in their reporting.

The context under consideration is unique to the extractive industries but allows reflection on generic guidelines versus specific guidelines for differing sectors. The paper would suggest the need for specific requirements in industries where such detail would provide value rich data for stakeholders. This concurs with Marshall and Weetman (2007) and Elshandidy (2018) who recognise differential stakeholder needs calling for specific consideration to what is valued by each sector's stakeholders. It would be wrong to penalise stakeholders of those industries by reducing their reporting requirements, although entities at their discretion could continue to provide additional information voluntarily. The IASB's extractive industries discussion paper (IASB, 2010) provides requirements that are broadly similar to those contained in the SORP and this continuum would provide value rich risk data and clarity to providers. Business risk is clearly a key driver to disclosure and the researchers would support the IASB's stance per the discussion paper regarding extending the OFR qualitative data to including sensitivity analysis around different "confidence intervals", "market and political risks" and "main assumptions" (IASB, 2010, p104). A case could also be made in regard to mandating the qualitative aspects of the risk information provided. The quality of the information reported could be enhanced (a mean score of only 2.7 was recorded with a

maximum score 7) through more clarity and mandate of the qualitative aspects as at present the voluntary reporting is relatively ineffective yet the information provided is valued to stakeholders (Cabedo and Tirado, 2004).

7.2 Influences on reporting of specific risks

The paper contributes to the risk management literature in regard to risk specificity providing a perspective on the drivers for disclosure. In addition to the voluntary/mandatory discussion above, where no influence was shown regarding mandatory requirements, the paper permits a consideration of other influences on risk specific disclosure.

A number of agency related factors are seen to impact on the level of risk disclosure. Firstly, risk profile (RISKPROF) indicates a robust inverse relationship between disclosure (quantitative and qualitative) and level of risk i.e. low risk producer companies produce more information than high risk developer companies, the former being more confident in the reserve details. For the higher risk companies their behaviour could be explained by the potential agency benefits of reducing capital costs being outweighed by the risk of litigation and potential loss of reputation, particularly in the light of mineral reserve quantum overstatement scandals such as Shell (see DFSA, 2004 and SEC, 2004). This runs contrary to the needs of developer companies with their particular financing requirements as disclosure could reduce their cost of capital and make available greater funds through reducing stakeholder concerns. Our findings contradict the findings of Elshandidy et al. (2013) who in their generic risk-based study note that high risk firms are sensitive to underlying risk levels resulting in higher levels of disclosure. This could be explained for the Oil and Gas sector in that the level of transparency given by the clearly defined probabilistic based risk information differs from the more generic qualitative and tacitly defined uncertainties within other industries.

Secondly, the agency related costs of data collection may impact the level of disclosure. In considering firm size (LOGTA) there is a significant positive relationship to both specific quantitative and qualitative risk disclosure which aligns with previous risk studies (Linsley and Shrivs 2006; Khlif and Hussainey 2014), and also with prior extractive industry studies (e.g. Taylor *et al.*, (2011)). This can be explained regarding the costs of data collection relative

to an entity's size and resources (Singhvi and Desai, 1971). On separately considering production and developers entities all remain significant at $<.05$ except for developers in regard to quantum which may point to the materiality of their reserves in contrast to producer companies. Thirdly, gearing is seen to be a positive and significant influence for both quantity and quality of disclosure for developer companies. The findings concur with studies by Elshandidy et al. (2013), Hassan (2009), Marshall and Weetman (2007), and Taylor et al. (2010).

Other pressures may work alongside the pressures as identified in institutional theory (Judge et. al., 2008). Public scrutiny may be such a pressure with public transparency and analysis impacting disclosure. Visibility (LOGVIS) is seen as significant for reserve quantum of production companies suggesting that entities widely scrutinised by stakeholders, are subject to public accountability demands and influencing positively the level of disclosure. This concurs with Allini *et al.* (2015) in their study on generic risk disclosure. The level of stock exchange (EXCH) impacts producer and developer firms regarding quality of information, however, the signs are inconsistent. Producer companies increased their disclosure the higher the level of stock exchange whilst developer companies reduced their disclosure. This could be explained in regard to levels of uncertainty of the two types of firm. Producer companies are willing to provide fuller disclosure as their information is more certain due to their position on the sector's value chain and they are confident in having their disclosure scrutinised. Developer companies with higher levels of uncertainty have reverted to the more general narrative information requirement of the Business Review rather than the normative requirements of the industry as they are concerned re the higher levels of scrutiny of the higher exchanges. This producer firm behaviour in regard to scrutiny is further corroborated in regard to US listing (USLIST) which is a further influence on the quality of the reserve quantum reported. This aligns with prior literature with a positive association between disclosure and overseas cross-listing (Rajab and Handley-Schachler, 2009).

One further factor influencing disclosure merits comment in regard to risk specificity. The quality of external audit (AUDIT) as a positive influence on quantitative disclosure is consistent with Taylor *et al.* (2011) in regard to extractive industries and Hossain and Adams (1995) regarding voluntary disclosure. This may be explained by high quality audit firms encouraging comprehensive disclosure to preserve their reputation (Deangelo, 1981) and also because larger audit firms have greater expertise and resources to undertake such specialised

areas as the extractive industry (Mirza, 1999). Quality of external audit does not influence quality of disclosure suggesting a perceived difference in importance and relevance between quantum and the quality of reporting by the audit firms. Interestingly when production and developer firms are considered separately developer firms are influenced by external audit both quantitatively and qualitatively unlike producer firms. This may indicate developer companies being more reliant on the expertise on risk reporting and being persuaded by large audit firms in this matter. The complexity surrounding mineral extraction and geological risk creates a need for specialisation within audit firms or the use of “auditor’s experts” (International Auditing and Assurance Standards Board, ISA 620, 2010) possessing proficiency in a field other than accounting or auditing whose work assists the evidence base of the auditor. We believe that audit quality provides a significant influence through its specialisation and resources base (including auditor experts) with audit firm specialisation also likely to be influential in other sectors.

8. Conclusions

We find that there is no difference in reporting behaviour where regulation is imposed. The explanation behind these findings may show that where there exists strong mimetic and normative pressures with detailed guidelines of risk specificity then the tradition of voluntary reporting will continue even where the mandatory information is generalised (as with the Business Review). The normative guidelines whilst powerless due to its voluntary nature lead to disclosure through non-coercive forces. An example is provided in Appendix 1 of reserve disclosure of both quantitative and qualitative good practice.

The lack of impact of mandating the information would suggest encouraging rather than mandating reporting. Mandatory reporting will be ineffective without having specific and contextualised requirements to specific contexts where unique characteristics arise. Where normative forces are effective the regulatory bodies may rely on this to produce requisite reporting, however, where the normative forces are non-existent or weak in risk reporting then regulation could be considered. Any existing normative frameworks should not be seen as beyond critique, for example, within the research study qualitative aspects of disclosure are seen as weak and could be bolstered. A limitation to this study is that the business review reporting requirements do not refer specifically to oil and gas reserves which has an existing normative structure. Other sectors who do not have such a normative structure may behave

differently to a mandated framework. In this instance, the lack of a relationship with the mandated requirement could more reflect on the existence of existing good practice and does not preclude benefits of the business review's generality elsewhere. There is however an argument for leaving it to the industrial sectors to create and monitor their own risk specific frameworks aligned to their stakeholder needs, similar to the OICA's approach.

The issue of generic boiler plate requirements as opposed to risk specificity needs close consideration. Whilst there may be areas of generic risk across sectors and some sectors closely related to others there is a danger of creating generic frameworks where managers can use their discretion, similar to voluntary reporting, adding information of little use to stakeholders and also capable of diluting existing practice norms (although not in this case). We would concur with Abdullah *et al.* (2015) in criticism of general guidelines (such as the Business Review) for their lack of clarity, in this case in regard to risk information. Future studies should consider specific sectors as well as cross sectoral studies of differentiating practices. Even within industries a general categorisation for an industry may not be sufficient requiring segmental consideration (as shown by differences in results for producers and developers). This is critical when setting risk parameters within the one industrial context.

Quantitative data has taken precedence over qualitative complementary information. The reporting entities and governing bodies should take cognisance of this reporting gap and the value to stakeholders of qualitative information and prioritise the development of a complementary framework. It may be that the lack of clarity around such qualitative information requirements has led to this lack of priority to disclose.

The findings have implications for theory and practice. From an institutional theory perspective it would appear that coercion has not been effective as explained by the existing more robust normative reporting framework for the industry and a strong mimetic pressure between competitors. In addition, public scrutiny is seen as being an added pressure impacting on other institutional pressures. The anticipated reduction in information asymmetry provided by mandate by halting the discretionary conservatism focused on agency costs did not emanate. This has been explained by the fact that the mandated requirements were more generic and lacking the detail of the existing normative framework and that mimetic forces failed to alter behaviour towards the mandated requirements. The IASB

should be interested in the findings from the perspective of both DRM and the extractive industry reporting discussion paper. The paper also contributes to knowledge on the effectiveness of the extant UK financial reporting regime for intangible assets. In regard to the extractive industry discussion paper it could be argued that without an industry specific standard there is a danger of adopting a generic standard without contextualised reference which, whilst capturing effectively many sectors, may ignore the unique attributes of specific industries. The authors would argue that industry led normative processes should lead to sector specific frameworks which will be more value relevant to stakeholders. They are also likely to be more understandable and fairer to the sector and with the industry's involvement in its creation likely to lead to acceptance and mimetic behaviour. A mandated generic risk disclosure framework will fail to serve the stakeholder community and be more likely to be subject to management interpretation.

Managers of entities should also engage more with the risk disclosure process both within their own entities and with their industrial sector's leading body. Internally entities have a robust risk management system which is maintained and monitored continuously within its governance mechanisms. The agency cost of creating further information is likely to be negligible if the information is already in existence. Recognition of proprietary costs cannot be ignored but this should be balanced against the value relevance to stakeholders. The lesson from the oil and gas industry is that a normative framework led to mimetic behaviour by many in the industry in particular regarding quantitative data. Such frameworks, which need industry buy-in and intelligence, will lead to a workable model by sector which will not compromise the entities and gain traction without mandate. In addition managers must recognise the importance of the integrity of the data provided as well as the qualitative information to complement the metrics.

The reporting of risk to stakeholders is of great value (Elzahar and Hussainey, 2012), but is clouded by complexities and controversy (Elshandidy *et al.*, 2018). Further work is needed into the value to stakeholders of generic boiler plate risk information as contrasted with risk specificity. In regard to the voluntary and mandatory reporting a further avenue of research could consider changes in behaviour between those currently providing high levels of risk information with those providing low levels to gauge the impact of mandating the reporting. The relationship between level of risk and reporting also requires further study with consideration being given to the dimensions of the aspect considered at risk when developing

the dependent variable (e.g. in this study the quantity of reserve quantum). Further work should also be conducted into specific industry sectors to understand the needs for sector specific risk information.

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Tables

Table1 : Observations

	Number	Observations
Companies with incomplete information and therefore excluded	13	0
Companies with 4 years information bridging voluntary and mandatory periods	6	24
Companies with full 5 year information	67	335
Total companies considered	86	359

Table 2: Descriptive analysis

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
QUANTDIS	359	0.62117	1	0.48577	0	1
QUALDIS	359	2.69916	3	2.55854	0	7
RISKPROF	359	0.59610	1	0.49136	0	1
REGULATION	359	0.73228	1	0.44335	0	1
TA	359	5,000,594	47,566	25,918,089	218	203,282,503
EXCH	359	1.79666	2	0.45513	1	3
USLIST	359	1.04178	1	0.20037	1	2
LEV	359	0.21347	0.0605	0.45068	0.0001	1.88470
AUDIT	359	0.45682	0	0.49883	0	1
VIS	359	2,231,237	185,995	8,352,495	8,320	62,488,486

QUANTDIS = disclosure of quantity of reserves

QUALDIS = the quality of risk disclosure in regard to reserves

REGULATION = A dummy with 1 one for voluntary disclosure and 0 otherwise

TA = Total assets

EXCH = Level of stock exchange where company is listed and is recorded as a dichotomous categorical variable with one for firms listed in LSE, two for the AIM and three for firms listed in PLUS

USLIST = A dichotomous variable code is applied as either two for companies with a US listing otherwise one

LEV = debt to equity ratio

AUDIT = A dichotomous variable is coded as 1 where audited by one of the Big Four auditing firms and zero otherwise

VIS = Google visits to the corporations' site

RISKPROF = a dichotomous variable coded zero for developer firms or one for producer firms

Table 3: Correlation analyses

	QUANTDIS	QUALDIS	RISKPROF	LOGTA	EXCH	USLIST	LEV	AUDIT	LOGVIS
QUANTDIS	1								
QUALDIS	0.8250***	1							
RISKPROF	0.5976***	0.5541***	1						
LOGTA	0.4503***	0.6023***	0.3951***	1					
EXCH ¹¹	-0.3999***	-0.5132***	-0.4058***	0.7170***	1				
USLIST	0.1631**	0.3079***	0.1719***	0.6300***	0.3660***	1			
LEV	0.2261***	0.2695***	0.1132**	0.2579***	0.1863***	0.0300	1		
AUDIT	0.3704***	0.4188***	0.2421***	0.5870***	-0.4633	0.2277***	0.2081***	1	
LOGVIS	0.0616	0.1179**	0.0742	0.1877***	-0.1856	0.2581***	0.0924***	-0.0271	1

The table shows the correlation coefficients between the variables. *** refers to the significance at the 1% level, while ** refers to the significance at the 5% level.

QUANTDIS = disclosure of quantity of reserves

QUALDIS = the quality of risk disclosure in regard to reserves

REGULATION = A dummy with 1 one for voluntary disclosure and 0 otherwise.

LOGTA = Logarithm of total assets

EXCH = Level of stock exchange where company is listed and is recorded as a dichotomous categorical variable with one for firms listed in LSE, two for the AIM and three for firms listed in PLUS USLIST = A dichotomous variable code is applied as either two for companies with a US listing otherwise one

LEV = debt to equity ratio

AUDIT = A dichotomous variable is coded as 1 where audited by one of the Big Four auditing firms and zero otherwise

LOGVIS = logarithm of detailed Google visits to the corporations' site

RISKPROF = a dichotomous variable coded zero for developer firms or one for producer firms

¹¹ Note that the EXCH coefficients are negative as the categorical variables applied are in descending order.

TABLE 4: QUANTDIS (FORM OF REGULATION) = REGULATION: RISKPROF; LOGTA; EXCH; USLIST; LEV; AUDIT; LOGVIS

QUANTDIS	COEF.	STD. ERR.	Z	P>Z	95% CONF.	INTERVAL
REGULATION	0.42706	0.64829	0.66	0.51	-0.84356	1.69769
RISKPROF	2.47880	0.31688	7.82	0	1.85773	3.09986
LOGTA	0.88130	0.28857	3.05	0.002	0.31571	1.44688
EXCH	-0.65453	0.57589	-1.14	0.256	-1.78319	0.47413
USLIST	(OMITTED)					
LEV	0.75421	1.11128	0.68	0.497	-1.42386	2.93228
AUDIT	0.82724	0.38129	2.17	0.03	0.07993	1.57455
LOGVIS	0.08002	0.13763	0.58	0.561	-0.18973	0.34977
Y2006	0.52845	0.81846	0.65	0.518	-1.07570	2.13259
Y2007	0.38412	0.57597	0.67	0.505	-0.74476	1.51299
Y2008	0.35443	0.47540	0.75	0.456	-0.57734	1.28619
Y2009	0.08217	0.48441	0.17	0.865	-0.86726	1.03159
CONS	-5.05093	2.16545	-2.33	0.02	-9.29512	-0.80673
PSEUDO R ²	0.38420					
CHI ² (11)	92.26					
Number of observations	344					

QUANTDIS = disclosure of quantity of reserves

QUALDIS = the quality of risk disclosure in regard to reserves

REGULATION = A dummy with 1 one for voluntary disclosure and 0 otherwise.

LOGTA = Logarithm of total assets

EXCH = Level of stock exchange where company is listed and is recorded as a dichotomous categorical variable with one for firms listed in LSE, two for the AIM and three for firms listed in PLUS

USLIST = A dichotomous variable code is applied as either two for companies with a US listing otherwise one

LEV = debt to equity ratio

AUDIT = A dichotomous variable is coded as 1 where audited by one of the Big Four auditing firms and zero otherwise

LOGVIS = logarithm of detailed Google visits to the corporations' site

RISKPROF = a dichotomous variable coded zero for developer firms or one for producer firms

TABLE 5 QUALDIS [FORM OF REGULATION] = REGULATION; RISKPROF; LOGTA; EXCH; USLIST; LEV; AUDIT; LOGVIS

CHANGE IN QUALDIS	COEF.	ROBUST STD. ERR.	T	P>T	[95% CONF.	INTERVAL]
REGULATION	0.48241	0.42338	1.14	0.255	-0.35033	1.31514
RISKPROF	1.88093	0.23464	8.02	0	1.41942	2.34243
LOGTA	0.86638	0.18423	4.7	0	0.50404	1.22873
EXCH	-0.36110	0.30039	-1.2	0.23	-0.95189	0.22974
USLIST	-0.24990	0.50093	-0.5	0.618	-1.23519	0.73530
LEV	0.59530	0.49840	1.19	0.233	-0.38498	1.57556
AUDIT	0.40592	0.26610	1.53	0.128	-0.11746	0.92931
LOGVIS	0.03175	0.09983	0.32	0.751	-0.16460	0.22809
Y2006	0.38197	0.51135	0.75	0.456	-0.62378	1.38771
Y2007	0.27153	0.35747	0.76	0.448	-0.43156	0.97461
Y2008	0.26072	0.31683	0.82	0.411	-0.36244	0.88387
Y2009	0.01159	0.32410	0.04	0.972	-0.62588	0.64905
CONS	-2.73738	1.10106	-2.49	0.013	-4.90300	-0.57176
R ²	0.5052					
F	63.07					
Number of observations	359					

QUANTDIS = disclosure of quantity of reserves

QUALDIS = the quality of risk disclosure in regard to reserves

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LOGTA = Logarithm of total assets

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LEV = debt to equity ratio

AUDIT = A dichotomous variable is coded as 1 where audited by one of the Big Four auditing firms and zero otherwise

LOGVIS = logarithm of detailed Google visits to the corporations' site

RISKPROF = a dichotomous variable coded zero for developer firms or one for producer firms

TABLE 6: QUANTDIS (FORM OF REGULATION) FOR PRODUCTION AND DEVELOPMENT COMPANIES SEPARATELY = REGULATION; LOGTA; EXCH; USLIST; LEV; AUDIT; LOGVIS

	PANEL 1: PRODUCTION COMPANIES				PANEL 2: DEVELOPER COMPANIES			
QUANTDIS	COEF.	STD. ERR.	Z	P>Z	COEF.	STD. ERR.	Z	P>Z
REGULATION	-1.10719	0.96497	-1.15	0.251	1.34203	1.21750	1.1	0.27
LOGTA	2.04341	0.49718	4.11	0	0.94717	0.52914	1.79	0.073
EXCH	-1.16644	1.12967	-1.03	0.302	-0.31282	0.85538	-0.37	0.715
USLIST	(OMITTED)				(OMITTED)			
LEV	-0.44228	0.29216	-1.51	0.130	4.67144	1.31395	3.56	0
AUDIT	-1.04808	0.59668	-1.76	0.079	1.59191	0.51075	3.12	0.002
LOGVIS	0.54269	0.27534	1.97	0.049	-0.39639	0.29713	-1.33	0.182
Y2006	-1.17962	1.21893	-0.97	0.333	1.89562	1.48454	1.28	0.202
Y2007	-0.32657	0.71818	-0.45	0.649	0.65251	0.96714	0.67	0.5
Y2008	0.84789	0.77051	1.1	0.271	-0.19789	0.82504	-0.24	0.81
Y2009	0.72796	0.67010	1.09	0.277	-0.69494	0.82892	-0.84	0.402
CONS	-7.04160	4.48301	-1.57	0.116	-5.26034	3.51293	-1.5	0.134
PSEUDO R ²	0.2524				0.3536			
LR CHI ² (9)	42.59				59.7			
Number of observations	199				145			

QUANTDIS = disclosure of quantity of reserves

QUALDIS = the quality of risk disclosure in regard to reserves

REGULATION = A dummy with 1 one for voluntary disclosure and 0 otherwise.

LOGTA = Logarithm of total assets

EXCH = Level of stock exchange where company is listed and is recorded as a dichotomous categorical variable with one for firms listed in LSE, two for the AIM and three for firms listed in PLUS

USLIST = A dichotomous variable code is applied as either two for companies with a US listing otherwise one

LEV = debt to equity ratio

AUDIT = A dichotomous variable is coded as 1 where audited by one of the Big Four auditing firms and zero otherwise

LOGVIS = logarithm of detailed Google visits to the corporations' site

RISKPROF = a dichotomous variable coded zero for developer firms or one for producer firms

TABLE 7: QUALDIS [FORM OF REGULATION] FOR PRODUCTION AND DEVELOPMENT COMPANIES = REGULATION; LOGTA; EXCH; USLIST; LEV; AUDIT; LOGVIS

QUALDIS	PANEL 1: PRODUCTION COMPANIES				PANEL 2: DEVELOPMENT COMPANIES			
	COEF.	STD. ERR.	T	P>T	COEF.	STD. ERR.	T	P>T
REGULATION	-0.00120	0.63880	0	0.998	0.39163	0.52747	0.74	0.459
LOGTA	1.16805	0.23393	4.99	0	0.99834	0.29692	3.36	0.001
EXCH	-0.85971	0.36098	-2.38	0.018	0.60733	0.26382	2.3	0.023
USLIST	-1.27112	0.57221	-2.22	0.027	(OMITTED)			
LEV	-0.17465	0.26527	-0.66	0.511	2.90395	0.30930	9.39	0
AUDIT	-0.37399	0.36988	-1.01	0.313	0.85761	0.35433	2.42	0.017
LOGVIS	0.25154	0.15237	1.65	0.1	-0.14056	0.11923	-1.18	0.241
Y2006	-0.55140	0.77429	-0.71	0.477	1.09765	0.66242	1.66	0.1
Y2007	-0.08166	0.43787	-0.19	0.852	0.62068	0.53566	1.16	0.249
Y2008	0.25822	0.40501	0.64	0.524	0.22189	0.42239	0.53	0.6
Y2009	0.10402	0.40576	0.26	0.798	0.02668	0.41004	0.07	0.948
CONS	-0.49037	1.52017	-0.32	0.747	-5.29531	1.67174	-3.17	0.002
R ²	0.3302				0.4301			
F	10.54				11.87			
Number of observations	214				145			

QUANTDIS = disclosure of quantity of reserves

QUALDIS = the quality of risk disclosure in regard to reserves

REGULATION = A dummy with 1 one for voluntary disclosure and 0 otherwise.

LOGTA = Logarithm of total assets

Level of stock exchange where company is listed and is recorded as a dichotomous categorical variable with one for firms listed in LSE, two for the AIM and three for firms listed in PLUS

USLIST = A dichotomous variable code is applied as either two for companies with a US listing otherwise one

LEV = debt to equity ratio

AUDIT = A dichotomous variable is coded as 1 where audited by one of the Big Four auditing firms and zero otherwise

LOGVIS = logarithm of detailed Google visits to the corporations' site

RISKPROF = a dichotomous variable coded zero for developer firms or one for producer firms

Appendix 1: Example of good practice: Extracts from Tullow OIL PLC's oil and gas annual report 2019. The detail in the report would have scored 6 from a qualitative perspective based on the research instrument.

Commercial reserves and contingent resources summary (unaudited) working interest basis

	West Africa		East Africa		New Ventures		Total		
	Oil mmbbl	Gas bcf	Oil mmbbl	Gas bcf	Oil mmbbl	Gas bcf	Oil mmbbl	Gas bcf	Petroleum mmboe
Commercial reserves									
1 January 2019	236.2	259.9	-	-	-	-	236.2	259.9	279.5
Revisions	12.9	(110.6)	-	-	-	-	12.9	(110.6)	(5.5)
Production	(30.5)	(2.6)	-	-	-	-	(30.5)	(2.6)	(31.0)
31 December 2019	218.6	146.7	-	-	-	-	218.6	146.7	243.0
Contingent resources									
1 January 2019	137.3	436.0	656.7	42.7	-	-	794.0	478.7	873.6
Additions	-	-	-	-	47.4	-	47.4	-	47.4
Revisions	141.3	336.8	(18.8)	11.7	-	-	122.5	348.5	180.6
31 December 2019	278.6	772.8	637.9	54.4	47.4	-	963.9	827.2	1,101.6
Total									
31 December 2019	497.2	919.5	637.9	54.4	47.4	-	1,182.5	973.9	1,344.6

Notes:

1. Proven and Probable Commercial Reserves are as audited and reported by an independent engineer. Reserves estimates for each field are reviewed by the independent engineer based on significant new data or a material change with a review of each field undertaken at least every two years, with the exception of minor assets contributing less than 5 per cent of the Group's reserves.
2. Proven and Probable Contingent Resources are as audited and reported by an independent engineer. Resources estimates are reviewed by the independent engineer based on significant new data received following exploration or appraisal drilling.
3. The revision to reserves relates mainly to increases at the Jubilee Field and in some of the non-operated assets, offset by a reduction at the Enyenra Field.
4. The additional contingent resources relate to oil discoveries in Guyana.
5. The revision to the contingent resources relate mainly to increases at the TEN and Jubilee Fields.

The Group provides for depletion and amortisation of tangible fixed assets on a net entitlements basis, which reflects the terms of the Production Sharing Contracts related to each field. Total net entitlement reserves were 225.1 mmboe at 31 December 2019 (31 December 2018: 264.9 mmboe).

Contingent Resources relate to resources in respect of which development plans are in the course of preparation or further evaluation is under way with a view to future development.

Financial results summary	2019	2018
Working interest production volume (boepd) [†]	84,800	81,400
Sales volume (boepd)	74,000	74,200

