

Extractive Industries Reporting:

A Review of Accounting Challenges and the Research Literature

Sidney J. Gray¹, Niclas Hellman², and Mariya N. Ivanova³

¹ Business School, University of Sydney, NSW 2006, Australia
e-mail: sid.gray@sydney.edu.au

² Department of Accounting, Stockholm School of Economics, P.O. Box 6501,
113 83 Stockholm, Sweden
e-mail: Niclas.Hellman@hhs.se

³ Department of Accounting, Stockholm School of Economics, P.O. Box 6501,
113 83 Stockholm, Sweden
e-mail: Mariya.Ivanova@hhs.se

Extractive Industries Reporting: A Review of Accounting Challenges and the Research Literature

Abstract

While the extractive industries (EI) are of major significance economically the reporting of their activities has been the subject of contentious debate posing dilemmas for regulators and standard setters over many decades. In order to ensure alignment with the IASB research project on EI, we first identify some important economic characteristics of EI and associated accounting challenges together with an overview of how current accounting standards deal with these challenges using IFRS as the focus. Second, we conduct a review of extant research on EI reporting analyzed around the key areas of (a) international diversity of accounting practices and the challenges facing information users; (b) standard-setting processes and lobbying behavior, that deals with why the IASB (and other standard setters) have not succeeded in developing rigorous standards for extractive activities; (c) the reporting of oil, gas and mineral reserves, given that large proportions of the assets of EI firms (the reserves) are off-balance sheet; (d) environmental, social and governance (ESG) reporting dealing with how EI firms have increased their reporting of ESG information in response to regulatory demands and pressure for voluntary disclosures; and (e) other EI related topics such as earnings management and voluntary disclosure behavior. Finally, we present some conclusions together with suggestions relating to key areas for future research on EI reporting.

Key words: Environmental, social and governance reporting; Extractive industries and activities; Full cost versus successful efforts methods; IFRS; Lobbying and standard setting; Reserve recognition accounting

Introduction

Oil, gas and minerals firms represent enormous values on stock exchanges around the world, including some of the largest global companies but also many small exploration companies who rely on equity financing. At the same time, financial reporting in the extractive industries (EI) has been criticized for many years for being of low quality and difficult to compare across entities. For example, in November 2000, the International Accounting Standards Committee (IASC) Steering Committee on Extractive Industries wrote (IASC, 2000, p. 4):

There is currently great diversity in accounting and disclosure practices by extractive industries enterprises. Also, in many countries, extractive industry accounting practices differ significantly from accounting practices used by enterprises in other industries. These factors make it difficult for users to compare financial statements issued by mining and petroleum enterprises in different countries, or by such enterprises and other enterprises in the same country.

There have been many attempts to develop financial reporting standards based on principles that would reduce flexibility in the choices of accounting methods and guide the application of professional judgement. Historically, there have been national attempts to, for example, agree on principles regarding how to treat costs for exploration and evaluation and what to disclose with regard to reserves discovered. However, accounting diversity has to varying degrees persisted at the national level. For example, US GAAP still allows oil and gas companies to choose between the Full Cost (FC) Method and the Successful Efforts (SE) Method for exploration and evaluation (E&E) cost.¹ With regard to international accounting standards, there is limited guidance for EI firms. The only International Financial Reporting Standard (IFRS) dealing with extractive activities is IFRS 6 (Exploration for and Evaluation of Mineral Resources) which has a limited scope (only the E&E phases and only mineral resources) and permits national practices to continue. IFRS 6 was issued in 2005. In recent years, the International Accounting Standards Board (IASB) first launched a research project on ‘Extractive Activities/Intangible Assets/R&D’, which was later delimited to ‘Extractive Activities’. In July 2016, the Board classified this project a ‘Pipeline

¹ Under the full cost method, all costs associated with exploration of properties are capitalized within the appropriate geographic cost center (generally a country). Under the successful efforts method, the costs of drilling exploratory and exploratory-type stratigraphic test wells are capitalized, pending determination of whether the well can produce proved reserves. If it is later determined that the well will not produce proved reserves, then the capitalized costs are expensed (KPMG, 2017, p. 406).

Project’, i.e. a project that will initially be inactive but for which work is likely to start or restart during the forecast period 2017–2021 (IASB, 2016). The IASB research project is stated as setting out to ‘...assess whether the Board should introduce accounting requirements for exploration, evaluation, development and production of minerals, and oil and gas’ (IASB, 2016, p. 13).

It is startling that IFRS Standards are to a great extent missing for extractive activities. For example, it would seem that the general asset and liability definitions used under IFRS Standards are not always applied with regard to extractive activities (IASB, 2010). In the absence of IFRS Standards, national standard setters have attempted to fill the gaps. For example, PwC (2012, p. 21) notes that with regard to mining companies applying IFRS: ‘...the most common approach is to allocate costs between areas of interest’, i.e. normally a single mine or deposit where economic viability has been established. The concept of ‘area of interest’ was introduced in the Australian national standard AAS 7 (Accounting for the Extractive Industries), issued in 1989. In turn, this influence of national practices in an EI area may possibly affect the way IFRS Standards are applied more generally by EI firms.

This paper aims to contribute to the IASB Research Forum 2018 with the objective of reviewing the current literature on oil, gas and mineral firms and their reporting of extractive activities. Our review consists of two parts, a review of EI reporting issues and a research review. In the first part, in order to ensure alignment with the IASB research project on extractive activities, we identify some important economic characteristics of the extractive industries and associated accounting challenges. We then provide an overview of how current accounting standards deal with these challenges, using IFRS as the focus. In the second part, we conduct a review of extant research which begins with the methodology used to review the research literature. This is followed by reviews of the relevant literature analyzed according to the key areas of EI reporting. We focus on the international diversity of accounting practices and the challenges facing information users; standard-setting processes and lobbying behavior, that deals with the challenges of standard setting by the IASB and other standard setters in respect of extractive activities; the reporting of oil, gas and mineral reserves, given that large proportions of the assets of EI firms (the reserves) are off-balance sheet; environmental, social and governance (ESG) reporting relating to how EI firms have increased their reporting of ESG information in response to regulatory demands and pressure for

voluntary disclosures; and other EI related topics such as earnings management and voluntary disclosure behavior.

As indicated in the IASC (2000) quotation above, the high degree of diversity in accounting and disclosure practices by EI firms creates real problems for users. Market participants can be expected to wish to appraise the fair value of mineral and petroleum reserves and the future costs of extracting these reserves. At the same time, uncertainties are very high regarding both the output (exploration results, economically viable production, commodity prices) and the need and cost of input of resources, including clean-up and rehabilitation. This would appear difficult enough even without the lack of common definitions of key concepts, the lack of principles-based accounting standards where the relevant EI activities are scoped in, and the lack of harmonized accounting practices. There is a need for both analytical and empirical research that can point at how financial reporting information would best serve the primary users in the EI industries. It will be important to avoid a piecemeal approach where each issue, or phase in the extractive cycle, is addressed separately and hence we advocate a comprehensive perspective that originates from the needs of the primary users.

Extractive Industries Reporting Challenges

Key Economic Characteristics and Accounting Challenges

Extractive activities refer to exploring for and finding minerals, oil and natural gas deposits, developing those deposits and extracting the minerals, oil and natural gas (IASB, 2010, p. 15). Thus, the extractive activities involve a number of phases where the mineral, oil or gas resource is discovered, evaluated and extracted. Such ‘upstream’ industry activities, leading to extracted metals and produced crude oil and gas, are followed by ‘downstream’ industry activities of refinery and development of value-added products. For example, the growing demand for electrical cars that require powerful batteries has increased the demand for minerals such as lithium, cobalt and rare-earth elements. Mineral, oil and natural gas are all non-regenerative natural resources, i.e. they cannot be replaced in the original state after extraction (IASB, 2010). The extractive industries have some economic characteristics in common that create accounting challenges.

Separate projects with finite lives

Extractive activities are performed within separate projects targeting particular minerals, oil or gas. In order to illustrate the implications of this, an expected net cash flow pattern of a (successful) mining project is shown in Figure 1. The figure illustrates how significant investments are needed in the early phases (exploration, evaluation, development), but also in connection with production (stripping to reach the ore, cost of machinery and installations) and step-wise extensions to reach new parts of the ore body, and finally, in connection with closure and restoration.²

{Insert Figure 1 about here}

Each project has a finite life; extensions can take place but the ore body, the oil well or the gas field will at some point have been fully extracted. Separate projects with finite lives pose an accounting challenge with regard to the use of the going concern assumption. Luther (1998) describes how South African gold mine corporations were historically formed as single, finite projects, and the resulting accounting was characterized by violations of the matching principle (as assets were considered sunk costs and were therefore not depreciated) and disregard of the need for capital maintenance before recognizing profit (the capital was not expected to be maintained). From an entity perspective, the problem posed by each project having a finite life may be solved by forming a larger entity with a balanced portfolio of projects, i.e. a portfolio with projects in each phase of the cycle. Thereby, the entity becomes a going concern even though each extractive project is finite. There are a number of very large EI-corporations with portfolios of projects in different phases. The strategy to create balanced portfolios is observed also in other industries with large finite-life projects, for example, in large pharmaceutical companies.

The creation of a large entity with a balanced portfolio of projects is one way to deal with the finite-life nature of mines and petroleum deposits. However, there are also many listed entities that have

² PwC (2012) describes the phases of mining operations as follows (p. 13): exploration (search for resources suitable for commercial exploitation), evaluation (determining the technical feasibility and commercial viability of a mineral resource), development (establishing access to and commissioning facilities to extract, treat and transport production from the mineral reserve, and other preparations for commercial production), production (day-to-day activities of obtaining a saleable product from the mineral reserve on a commercial scale. It includes extraction and any processing before sale); closure occurs after mining operations have ceased and includes restoration and rehabilitation of the site.

been formed around one, or just a few, specific projects. The creation of diversified portfolios may then take place at the level of the capital providers (e.g., mining finance companies).

High levels of uncertainty

Luther (1996) points to the high level of uncertainty that characterizes extractive industries (p. 70):

Returns from extractive industries are particularly risky; selling prices are uncontrollable and volatile and a high proportion of costs are fixed. This is aggravated by uncertainty of land access and environmental approval processes, of finding economic mineral reserves, of the technical feasibility of extraction, and of taxation and other government policies.

These uncertainties lead to high variation in possible outcomes which, in turn, makes predictive information more valuable. This reflects a situation where agency costs are high and where owners, theoretically, would request high levels of disclosure in financial reports. Other accounting challenges concern what recognition and measurement criteria to apply under such high levels of uncertainty. A comparison can be made with research and development (R&D) in the pharmaceutical industry, where the probabilities of succeeding are very low in the early phases and remains relatively low also in the later R&D phases (side effects may appear even after regulatory approval and product launch). As a consequence, both research and development costs tend to be expensed as incurred in pharmaceutical companies. However, if the pharmaceutical project is successful (e.g. the new pharmaceutical represents a significant improvement over previous treatments), the uncertainties are lower and prospects are good for the period up to patent expiration. As pointed out in the quotation by Luther (1996), the uncertainties are very high in the early phases in the EI industries, similar to R&D in pharmaceutical industries. However, if the EI-project is successful (economic reserves are found), much uncertainty still remains. Figure 2 shows the development of iron ore prices during a period of 110 years, and illustrates the high variation in prices of extracted commodities. Price levels and price variation will influence what is viewed to be economic reserves during the exploration, evaluation and development phases, but in contrast to, for example, the pharmaceutical industry, commodity price variations will continue to cause significant uncertainty with regard to profitability also during the production phase.

{Insert Figure 2 about here}

What happens then if the costs of extraction have to a great extent been capitalized throughout the cycle (exploration, evaluation, development, production) and commodity market prices decrease? For the corresponding capitalized development costs under IAS 38 (Intangible Assets), an impairment loss would most likely be recognized if the expected future economic benefits decline (i.e. if the recoverable amount is lower than the carrying amount; IAS 36 *Impairment of Assets*). In EI firms, the use of commodity prices in connection with impairment tests represents an accounting challenge. How should current commodity prices be used when determining inputs for value in use calculations and fair value measures? The issue will be further commented on below.

During production, there are also considerable risks related to the reliability of machinery and installations and the safety of workers. Events such as the BP Deepwater oil leak disaster in the Mexican Gulf in 2010 and the Samarco (Brazil) disaster in 2015, when two dams collapsed, have shown how such events can lead to considerable damages to be paid by the responsible EI firms. As a consequence, it is not uncommon even for large EI firms to organize EI projects as joint arrangements, as associated companies or as subsidiaries with significant non-controlling interests. For example, the Samarco project was a joint venture between Brazilian Vale and British-Australian BHP Billiton. The design of such risk-sharing arrangements will often have significant effects on how the financial consequences are described, i.e. whether the arrangement results in using the equity method (associated companies and joint ventures), the proportionate consolidation method (joint operations) or full consolidation with non-controlling interests (partly owned subsidiaries).

Historical cost and capital intensity

As referred to earlier (Figure 1), extractive projects are capital-intense and involve big cash outflows for many years before cash inflows are generated. How should these investments be accounted for? The accounting methods used tend to be based on historical cost. With regard to IFRS EI-firms, PwC (2012, p. 19) write:

An entity may have...a practice of deferring all exploration and evaluation expenditure as an asset even if the outcome is highly uncertain...Other entities may have...a practice of expensing all exploration and evaluation expenditure until the technical feasibility and commercial viability of

extracting a mineral resource has been established....There are a variety of policies that can be adopted between these two extremes.

The two ‘extremes’ referred to in the quotation represent less and more conservative treatments of E&E expenditure, respectively. A higher level of capitalization (the less conservative treatment) will lead to higher reported fixed costs (depreciation) in the future and normally lower reported returns due to also having more capital on the balance sheet. Theoretically, a single project with an expected cash flow pattern that is realized has a present value accounting solution (e.g., the effective interest method). The present value changes each period due to cash flows realized in the current period and future cash flows coming one period closer. The realized cash flows minus the change in present value (“depreciation”) will generate a constant periodic return that equals the internal rate of return. Figure 3 describes the development of the carrying amount of the investments made in the Figure 1 project example, according to (1) present value accounting, (2) historical cost accounting with capitalization and amortization and (3) historical cost accounting with immediate expensing of investments.

{Insert Figure 3 about here}

Figure 3 shows that full capitalization with subsequent depreciation is a better approximation of present value accounting than the method where early extractive activities are expensed immediately as the costs are incurred. As present value accounting is based solely on the cash flow pattern, this is a theoretical argument as to why these costs should be capitalized. A proponent of matching would argue that capitalization according to present value accounting improves matching between revenues and expenses. However, the present value accounting solution presumes that the expected cash flows are realized and this only applies to successful projects whereas most projects are unsuccessful. Accordingly, the current IFRS solution for pharmaceutical projects, referred to earlier, is to require immediate expensing of research costs and also with regard to development costs associated with high levels of uncertainty (IAS 38). Development costs that are capitalized may also be subject to impairment tests where the present value of future cash flows is calculated for the project. As the uncertainty associated with extractive activities is, arguably, of the same

magnitude as for internally generated intangible assets, it would perhaps be expected that IFRS Standards would adopt similar asset recognition principles for extractive activities as for R&D. This is not the case. In the Basis for Conclusions of IFRS 6 (Exploration for and Evaluation of Mineral Resources), the IASB states:

BC 17. A variety of accounting practices are followed by entities engaged in the exploration for and evaluation of mineral resources. These practices range from deferring on the balance sheet nearly all exploration and evaluation expenditure to recognising all such expenditure in profit or loss as incurred. The IFRS permits these various accounting practices to continue.

As illustrated by the quotation, the accounting treatment of costs incurred during the early phases of an EI project constitutes an accounting challenge that has not been solved. More generally, it is a problem of asset definition and asset recognition. Perhaps primary users would prefer E&E expenditure to be accounted for in the same way as internally generated intangible assets? Historical cost has conventionally been used as the basis for measuring the efforts performed in the early phases of the cycle. However, there is no strong causality between inputs and outputs in these early phases. In the words of the DP (IASB, 2010, p. 48), ‘...incurring a cost does not, in itself, determine whether an entity has something of positive economic value.’ An alternative would be to recognize mineral and petroleum reserves as assets to be measured at an entity-specific current value, or fair value. Arguably, primary users put more weight on expected value and present value calculations with regard to the reserves reported by EI firms in order to estimate asset values, compared to the costs incurred.

What is the unit of account?

The unit of account is the right or the group of rights to which asset recognition criteria (and measurement concepts) are applied (IASB Conceptual Framework 2018, p. 4.48). Consider a mineral exploration property that has the potential to produce economic benefits, but where the probability of an inflow of economic benefits is low. If the entity owns many properties in the same geographical area, it might be more relevant to users to view the geographical area as a single unit of account. In turn, the aggregation may lead to recognition of the property as an asset as the aggregation increases the probability of future inflows. Alternatively, a disaggregation would provide more relevant information, if say, the mineral deposit contains economically viable amounts of a number of different minerals with different expected cash flow patterns i.e. users

would benefit from the treatment of each mineral as a separate unit of account. Existing methods such as the FC method, the SE method and the area of interest method adopt different perspectives on the unit of account issue. The FC method uses a highly aggregated unit of account (generally a country), whereas the SE method has a narrower scope on separate wells. The area of interest method focuses on the geological area and the unit of account will normally comprise a single mine or deposit when economic viability is established (PwC, 2012, p. 21).

In terms of economic characteristics, the unit of account aspect relates to the earlier discussion on extractive projects having finite useful lives and the choice of some entities to create balanced portfolios of projects. Having a balanced portfolio of projects has positive economic effects for the entity in terms of being a more viable going concern. However, there is some logic to evaluating each project on its own merits. In this context, the IASB Conceptual Framework 2018, p. 4.51, points to the need of having separate units of account when, for example, the units are likely to expire at different points in time or when they have different expected cash flow patterns.

The unit of account issue is also closely related to the use of historical cost. The idea that costs ‘attach’ to things (e.g., products) was one of the main components in the Paton and Littleton (1940) framework for the transaction-based, historical cost accounting model. This somewhat abstract idea is still fundamental in accounting (e.g., adding up direct costs and overheads when valuing inventory at cost) and particularly strong with regard to extractive activities, where costs are often capitalized. The method of determining the unit of account (e.g., the FC, SE or area of interest methods) will determine the costs that can be attached, i.e. capitalized. The wider the definition of the unit, the more costs can be capitalized.

The connection between unit of account and the ‘cost attach’ concept is a strong one in the DP (IASB, 2010) proposal, which suggests the use of the area of interest method for determining the unit of account and suggested an asset recognition model based on acquired legal rights of exploration. Subsequent costs of E&E and development would be capitalized as ‘enhancements of the legal rights’ as they do not represent separate assets but are necessary to obtain future economic benefits (IASB, 2010, p. 53). A ‘costs attach’ logic appears to be part of this reasoning.

Economic value creation in different phases of a cycle

Extractive activities are generally described as taking place in a number of sequential phases that constitute a cycle. The different phases refer to various forms of activities and inputs to the process

ultimately leading to a saleable mineral or petroleum product. However, although these inputs are costly they do not directly correspond to the economic value created in each phase. Therefore, there will be accounting challenges in regard to the separation of extractive activities into predetermined phases (exploration, evaluation, development and so on). First, if the accounting standard starts out from the incurred costs in a specific period defined by the standard (i.e., exploration, evaluation, development), there will be a need to determine how these costs relate to the potential of producing future economic benefits (cf. the distinction between ‘research’ and ‘development’ phases in IAS 38). Second, the precise activities undertaken in each phase can vary across the minerals and oil and gas industries (IASB, 2010, p. 48). Therefore, linking asset recognition to specific phases is problematic, and part of the reason why the DP proposal (IASB, 2010) opted for a model based on the acquisition of legal rights.

Who do the resources belong to – the companies or the state?

One further characteristic of EI activities is the tension between whether the natural resources belong to the community as a whole or can be privately held proprietary rights. Even in countries with strong legal protection of private ownership, the state tends to be more involved in natural resources compared to most other business activities. This leads to far-reaching but sometimes unclear responsibilities for companies in relation to governments and potential conflicts between, for example, EI firms from rich countries and governments of developing countries. It may also create situations where EI firms and governments join forces in a way that gives them considerable lobbying power, including lobbying with regard to accounting standards.

Accounting Standards and Accounting Challenges

More than two decades ago, Luther (1996) concluded that there was significant diversity in accounting by EI companies in the five countries he evaluated (Australia, the United States, South Africa, Canada and the United Kingdom). Luther also described how there had been calls for regulation of accounting in the oil, gas and mineral industries during a period of over 100 years, but that these had been very unsuccessful due to lobbying and vested company and government interests. The IASC initiated a research project in 1998 (run by an all-volunteer extractive industry steering committee), which led to a 412-page Issues Paper published in November 2000 (IASB, 2000). The aim was to address the divergence of views with regard to (i) the extent to which the costs of finding, acquiring and developing minerals or oil and gas reserves and resources should be

capitalized; (ii) the methods of depreciating (or amortizing) capitalized costs; (iii) the degree to which quantities and values of minerals or oil and gas reserves and resources, rather than costs, should affect recognition, measurement and disclosure; and (iv) the definition and measurement of minerals and oil and gas reserves and resources (IASB, 2010, p 12). These issues are either directly or indirectly related to the economic characteristics and accounting challenges referred to above. However, agreement could not be reached on any of the issues – a large number of comment letters were submitted and the standard issued by the IASB, IFRS 6, only became an interim standard with limited scope, *essentially allowing all prior national practices to continue*. The Basis for Conclusions (BC) of IFRS 6 describes the Board’s reasoning behind the decision to allow current practices to continue for the E&E phases. It is argued in BC2-BC3 that in case the Board had not limited the need for entities to change their accounting policies for exploration and evaluation assets, they would have had to follow the hierarchy in IAS 8 (Accounting Policies, Changes in Accounting Estimates and Errors) which must be followed when no IFRS applies specifically to an item. The Board states (BC2):

Establishing what could be acceptable could have been costly and some entities might even had made changes in 2005 followed by further significant changes once the Board completes its comprehensive review of accounting for extractive activities.

In contrast, the Board argued against extending IFRS 6 to comprise also earlier and later stages of the mining cycle (BC 7):

The Board decided not to do this for two reasons. First, it did not want to prejudge the comprehensive review of the accounting for such activities. Second, the Board concluded that an appropriate accounting policy for pre-exploration activities could be developed from an application of existing IFRSs, from the Framework’s definitions of assets and expenses, and by applying the general principles of asset recognition in IAS 16 Property, Plant and Equipment and IAS 38 Intangible Assets. The Board also decided not to expand the scope of IFRS 6 beyond that proposed in ED6 because to do so would require additional due process, possibly including another exposure draft.

The two quotes from the Basis for Conclusions show that the arguments are not consistent, in that the costs and problems that could follow from applying IAS 8 for the E&E phases were not considered a problem with regard to earlier and later phases. The key problem appears to have been

lack of time, as many companies had to adopt IFRS in 2005 and an interim solution was urgently needed.

In order to develop a rigorous standard, the IASB formed a research group in 2004, involving a team of national standard setters from Australia, Canada, Norway and South Africa, who developed a 179-page IASB Discussion Paper (DP) released in April 2010.

The DP developed and proposed one consistent method for accounting for minerals and oil and gas activities, based on the ‘area of interest’ approach currently used in Australia. The economic characteristics and accounting challenges described above were addressed by the DP. The supply of both historical cost information and current value information (as disclosures) would appear to address the problem of high uncertainties and information asymmetry between management and capital providers. The proposed model had some similarities with the cost model in IAS 40 (Investment Property), where assets are valued on the basis of historical cost with supplementary fair value disclosures.

A key proposal in the DP (IASB, 2010) was that legal rights (exploration rights, extraction rights etc.) should form the basis of an asset referred to as ‘minerals or oil and gas property’. The property is recognized when legal rights are acquired and subsequent exploration, evaluation and development are treated as enhancements of the legal rights. The emphasis on rights would appear to be in line with the definition of economic resources and assets in the IASB Conceptual Framework 2018 and makes it possible to avoid the problem of relying on definitions of phases. However, the proposal also shows signs of why it is so hard to develop a standard in this area given the challenges. The ‘enhancements of the legal right’ is expected to lead to E&E activities being capitalized despite the uncertain nature and economic substance of the resource. In the comparable standard dealing with R&D activities and internally generated intangible assets, IAS 38, similar uncertainty levels lead to immediate expensing. Admittedly, an important difference is that a legal right is required for the E&E asset to be recognized whereas a corresponding legal right would often appear at later stages for R&D activities (patents etc.). However, with regard to R&D activities, asset recognition (capitalization) is based on a more comprehensive evaluation where both economic substance and legal rights are considered. At the same time, low uncertainty has become less critical for asset recognition under the IASB Conceptual Framework 2018, which implies that IAS 38 might have been designed differently if the new framework had been applied.

Still, the legal rights with subsequent capitalized costs (enhancements) approach will comprise high levels of uncertainty. This is illustrated by the DP proposal that IAS 36 should not (cannot) be applied for the test of impairment because no recoverable amount can be determined. The suggested treatment of E&E costs seems to rely on the ‘cost attach’ logic as described above.

Extractive Industries Reporting: A Research Review

In this part, we review the research literature on the reporting practices of firms operating in the extractive industries and the determinants and consequences of their accounting choices. To systematically identify relevant studies, we utilized the academic databases Science Direct and Business Source Premier and searched for keywords such as ‘extractive industry’, ‘oil and gas’, ‘mining’, ‘minerals’, and ‘natural resources’. We limited our search to peer-reviewed accounting journals included in the Association of Business Schools (ABS) journal rankings with a rating of 2 or above,³ including but not limited to the following: *Abacus, Accounting and Business Research, Accounting and Finance, Accounting in Europe, Accounting Forum, Accounting Research Journal, Accounting, Organizations, and Society, Advances in Accounting, Advances in International Accounting, Australian Accounting Review, British Accounting Review, Critical Perspectives in Accounting, European Accounting Review, Contemporary Accounting Research, Journal of Accounting and Economics, Journal of Accounting Auditing and Finance, Journal of Accounting Research, Journal of Accounting and Public Policy, Journal of Business Finance and Accounting, Review of Accounting Studies, and The Accounting Review*. In a second step, we extended our coverage to include also high impact peer-reviewed international business journals such as *Journal of International Business Studies* and *Management International Review*, in a search for articles related to financial reporting and disclosure choices of firms in the extractive industries.

The resulting list of 3379 articles⁴ was carefully screened to identify those most closely related to EI reporting issues associated with: the financial reporting practices of EI entities; standard-setting processes and lobbying behavior; reporting of oil, gas, and mineral reserves; environmental, social, and governance (ESG) reporting including corporate social responsibility reporting; and other

³ The Association of Business Schools evaluates peer-reviewed journals based on criteria such as article citations impact and input from subject specialists. The ratings range from 1 to 4* with 1 being given to peer-reviewed journals with low or no citation impact factor and 4* being given to journals of distinction. For more information about the ranking see <https://charteredabs.org/academic-journal-guide-2018/> (Last accessed: 6 September 2018).

⁴ A large number of articles were included in the search output of both databases.

topics related to the financial reporting practices of EI firms including earnings management, disclosure, bankruptcy prediction and managerial compensation. To reduce concerns that relevant articles were omitted in this search, we also screened Google Scholar for additional articles related to the aforementioned topics that were omitted in the original search. Finally, we also considered studies published in *Resources Policy*, an international journal specializing in issues related to natural resources, *Petroleum Accounting and Financial Management Journal*, which is specialized in contemporary issues related to the oil and gas industry and publishes articles by academics and practitioners, and *Journal of Accountancy*, a practitioners' journal published by the American Institute of Certified Public Accountants (AICPA). The final outcome of the screening process was a short list of 146 articles published between 1970 and 2018. We now discuss this research on EI analyzed according to their primary focus in respect of (a) international diversity of reporting practices and user information needs; (b) standard-setting processes and lobbying behavior; (c) reporting of oil, gas and mineral reserves; (d) environmental, social and governance (ESG) reporting; and (e) selected EI related topics (owing to space limitations) including earnings management and voluntary disclosure behavior.

International Accounting Diversity and User Information Needs

Accounting practices vary around the world with regard to EI-specific issues, as discussed by, for example, Luther (1996) with regard to Australia, the United States, South Africa, Canada and the United Kingdom. One area of diversity concerns the extent to which costs in the early phases of extractive activities should be capitalized. One international comparative study in this area is Abdo (2016) who compares the accounting treatment of E&E costs in 118 oil & gas companies listed on six stock exchanges around the world (FTSE 350, Hang Sen, Toronto TSX, Fortune, ISEQ, and AIM). On the basis of content analysis of annual reports for these companies, he reports that 47% of firms state they use the SE method, 28% the FC method, 9% the areas of interest method, and 16% do not specify a particular method. Abdo also evaluates compliance with IFRS 6 requirements regarding E&E assets (measurement, presentation, impairment, disclosure) and identifies seven types of firm which differ in their compliance with IFRS 6. A somewhat related study is Power *et al.* (2017) who investigate the impact of E&E cost recognition method on value relevance in the oil and gas industry and for mining firms. Using a sample of UK firms, they find that the policies

range from the relatively conservative SE method to the most aggressive FC method. The authors come to the conclusion that the flexibility in choice of accounting method is necessary to facilitate disclosure of value-relevant accounting information. There are similar earlier studies within the US and within Australia showing high degrees of diversity with regard to E&E accounting (Gerhardy, 1999; Bryant, 2003). Furthermore, there are some international comparative studies in the areas of accounting and disclosure of reserves (Nichols, 2007; Odo et al., 2016) and ESG reporting (Hardy and Frost, 2001; De Villiers and Alexander, 2014; De Barkemeyer et al, 2015; Schneider et al., 2017) which will be reviewed in separate sections below.

While the DP (IASB, 2010) proposes ways to deal with accounting differences currently not rigorously addressed by international accounting standards, such as E&E costs and reserves, there are issues that are important to EI firms that *are* covered by existing IFRS Standards. For example, depreciation of mining or oil and gas assets, impairment of such assets, recognition and measurement of environmental liabilities, and joint arrangements. Although there are existing IFRS Standards for these issues, the EI-specific applications of the Standards may involve accounting choices and differences in practice. There are many prior studies investigating international accounting differences in general, but they tend to focus on country differences, using industry as a control variable. This occasionally leads to observations pertaining to the extractive industries, for example, Meek et al. (1995) report, on the basis of a comparison of US, UK and Continental European annual report disclosures, that (p. 566): ‘Companies in the oil, chemicals and mining industry seem particularly inclined to provide non-financial information, such as those related to the environment...’ An international comparative study focusing specifically on the role of industry is Jaafar and Mcleay (2007). They find that country effects dominate industry effects with regard to the choice of depreciation method, *except for* the resources sector where firms tend to make an industry-specific choice of either straight-line or units-of-production or a combination of these methods. Jaafar and McLeay also find that the resources sector has the highest odds of employing more than one inventory method (FIFO, LIFO, weighted average) and the highest probability of selecting the longest amortization period for goodwill, i.e. a less conservative judgment compared to other industries.. Further, Nobes (2013), in a study of 45 large Canadian companies adopting IFRS in 2011, finds that extractive firms make different accounting choices compared to firms from other industries in the same country. In a related study of IFRS policy choices, Nobes and Stadler (2012) included sector as an independent variable (financial companies excluded though)

and find that it has little explanatory power except for the IFRS policies used by extractive companies. In a study by Hellman *et al.* (2015), ‘Basic Materials’ is one of few industries where IFRS adoption in 2005 caused a decrease in the valuation of shareholders’ equity compared to prior national GAAP, indicating that prior national practices may have been less conservative. In the context of international accounting classifications, Nobes and Stadler (2013) state (p. 581): ‘Apart from the financial sector, which is excluded from many studies on policy choice, a sector which might make idiosyncratic choices is extractives, given the degree to which US practices dominate.’

While the literature on comparative international accounting standards and practices is wide-ranging, it focuses primarily on differences that may be linked to countries such as equity financing system, legal system, or culture (e.g. Hellman *et al.*, 2015). Industry has not been identified as a factor explaining accounting diversity but would seem to warrant closer attention in future research with special reference to EI.

The international accounting diversity reported in the literature raises the question of how users deal with a situation where financial statements are not comparable across EI firms. There is a vast literature on how analysts and investors generally make use of accounting information for their processes of screening investment alternatives, making forecasts and investment recommendations, communicating with clients, etc. (e.g., Barker, 2000; Bradshaw, 2004; Brown *et al.* 2016). A robust result in the literature is that clients particularly appreciate sell-side analysts’ industry knowledge. For example, Brown *et al.* (2015, p. 3) find that ‘...industry knowledge is the single most useful input to analysts’ earnings forecasts and stock recommendations.’ However, although there are archival studies investigating the significance of analysts’ industry expertise (e.g., Kadan *et al.*, 2012), the extractive industries have not received much specific attention in recent years. One exception is Chen *et al.* (2018), who investigate the forecasts of earnings of firms involved in E&E activities for an Australian sample 1993–2013. They find that, for these firms, analysts develop more private information which allows them to issue more accurate forecasts. Another relevant study is Quirin *et al.* (2000) who first identify nine fundamental variables (growth of reserves, reserve replacement ratio etc.) used by US oil & gas financial analysts, based on 30 analysts responding to a mailed survey, and then examine the relationship between these variables and stock market variables. Their results suggest that these fundamentals provide incremental information beyond earnings and book value of equity when explaining equity values and stock returns (p. 816).

In an earlier study, Ghicas and Pastena (1989) find that when analyst information is more current than competing information, analysts' appraisals provide a significant incremental contribution (beyond selected financial statement variables) for predicting acquisition values of oil and gas firms.

In addition to archival research, there is a comprehensive literature on analyst behavior based on experiments and field studies. In general, this literature suggests that professional users build up task-specific knowledge (Bouwman *et al.*, 1987) and use accounting data in context-specific ways (e.g., Imam and Spence, 2016). For example, in connection with investment screening, a rejection based on accounting data does not tend to be offset by other positive (non-financial) information (e.g., Barker & Imam, 2008). At the same time, some experimental research suggests that analysts may be fixated on accounting numbers as they are reported by firms, disregarding differences in accounting methods (e.g., Hellman *et al.*, 2016). To the best of our knowledge, there are no experimental or field research studies specifically targeting users of financial information in EI. However, as part of the work on the DP (IASB, 2010), the responsible team made detailed interviews with 34 professional users around the world. According to the DP (pp. 21–22), their data suggest that the historical cost-based information on minerals, oil and gas properties in the statement of financial position does not generate useful information, whereas the amount spent on finding costs per unit of oil reserves is useful. That is, the users prefer the original expenditure data over cost-based amounts that have been subject to depreciation and/or impairment. In general, the users were not in favor of measuring minerals or oil and gas properties at fair value, because of the substantial subjectivity involved. They are, however, dependent on finding information useful for estimating the value of reserves and resources, for example, quantities of reserves, development and production, and how those reserve estimates and costs change over time. Although most interviewees said they would not rely on a fair value provided by the entity unless there was extensive disclosure of the assumptions used, some of them said they might use fair value information to check their own estimate. In line with this, some of the users found the SEC standardized measure on proved reserves useful as it made possible an analysis of the components of the measure and the changes over time.

The above discussion on users has some implications for standard setters and future research. The extractive industries have exceptionally high levels of uncertainty and this is combined with

accounting standards that are not sufficiently rigorous. In line with this, the results of the few studies available (e.g., Quirin et al., 2000; Chen et al., 2018) indicate that financial analysts following EI firms develop private information and fundamental industry-specific value drivers that significantly adds to the available accounting information. Chen et al. (2018) notes that investors will benefit from analysts' expertise in this situation of high information asymmetry. From an accounting standard-setter point of view, however, these results may be interpreted as an urgent need for improving the quality of financial reporting standards. From the point of view of future research, the combination of, on the one hand, deficient accounting standards and high levels of business uncertainty, and, on the other hand, studies pointing at financial analysts adding much value for investors through private information, would seem to represent a unique setting, suitable for empirical research designs involving archival, experimental or field study approaches. In particular, given the somewhat extreme characteristics of the setting, some of the field experiment approaches suggested by Floyd and List (2016) would seem likely feasible (e.g., a framed field experiment or a natural field experiment). A future change in accounting standards leading to more rigorous standards and regulation would also represent an important research opportunity.

Standard Setting Processes and Lobbying Behavior

Relating to our discussion of EI reporting issues, this has been a contentious area of debate among regulators and standard setters for decades as observed by Luther (1996) in respect of the pre-IASB period up to the mid-1990s and more recently by Cortese *et al.* (2009) who provide a historical analysis that includes also the post-IASB period from 2000 and the growing development of IFRSs.

The review by Luther (1996) of the development of accounting regulation in the pre-IASB period shows such regulations to be limited in scope and inconsistent in prescription. Luther (1996) suggests that the resultant diversity of practices is an outcome of the accidental nexus of powerful vested interests of large politically sensitive companies, fierce political lobbying by smaller exploration-type companies, technical accounting complications, and a perception that, given the limitations of historical cost accounting, the cost of regulation and standardization would not be justified. Cortese *et al.* (2009) demonstrate that not much has changed in the post-IASB period. It would seem that concerns that focus in particular around the economic consequences of adopting successful efforts rather than full cost accounting have been used to perpetuate accounting

flexibility in order that companies may continue to present the results of operations in the most favorable light. Cortese *et al.* (2009) suggest that the apparent unwillingness of regulators and standard setters, including the IASB, to set some limits on this flexibility may well be because of the economic significance and associated political influence of the companies involved.

Illustrative of the regulatory challenges is the experience of the FASB in the US in the late 1970s when the SEC withdrew its support for the FASB's proposed Statement No.19 *Financial Accounting and Reporting by Oil and Gas Producing Companies* which would have mandated successful efforts accounting (Cortese *et al.*, 2009). The economic consequences of the proposed standard, especially for small and medium sized oil and gas companies, was clearly of major concern with a number of studies documenting the negative stock market reactions to the proposed standardization of accounting methods (Dyckman and Smith, 1979; Lev, 1979; Collins and Dent, 1979; Collins *et al.*, 1981; Jain, 1983) though not all studies found significant differences between full cost and successful efforts firms (Kross, 1982). Positive stock market reactions were recorded, on the other hand, following the SEC's rejection of FASB's Statement No.19 by Collins *et al.* (1982) and Benjamin and McEnroe (1982) though Smith (1981) found no extreme information effects arising from the retention of full cost accounting. The significance of debt covenants in terms of their potential impact on the stock prices of full cost firms when accounting changes are proposed was also highlighted in a number of studies around this time (Lys, 1984; Frost and Bernard, 1989; Mohrman, 1993).

The extractive industries debate was reignited at the international level when in 1998 the IASC decided to add an extractive industries project to its agenda which led to a 412-page Issues Paper published in November 2000, as discussed above, and in response to which a large number of comment letters were submitted. The standard finally issued by the International Accounting Standards Board (IASB), IFRS 6 *Exploration for and Evaluation of Mineral Resources* was effectively an interim standard with limited scope as according to Cortese, Irvine and Kaidonis, 2009 (p.34) it 'merely codifies established, disparate, and largely unregulated industry practice'.

It seems that the economic significance of extractive industries firms and associated lobbying were sufficient to ensure flexibility and the continuation of both full cost and successful efforts accounting in practice. As documented by Cortese, Irvine and Kaidonis (2010) in their critical investigative study of comment letters, applying critical discourse analysis and regulatory capture

theory (Mitnick, 1980; Walker, 1987), it was evident that there were hidden coalitions between powerful players. The standard setting process thus has the potential to be captured by those being regulated leading in this case to the codification of existing practice under IFRS 6. While viewed as an interim standard to be further developed by the IASB, this currently remains an inactive project. While the IASB had formed a research team to progress matters, involving national standard setters from Australia, Canada, Norway and South Africa, which led to a 179-page IASB Discussion Paper being released in April 2010, the IASB later decided not to add this project to its active agenda.

A number of studies provide additional support for the significant role played by lobbying in the context of extractive industries standard setting. In the US during the pre-IASB period, Deakin (1989) provided evidence suggesting that lobbying behavior was positively associated with the variables capturing management incentives i.e. whether management compensation is likely to decrease due to the switch to successful efforts accounting, firm leverage, and exploration and evaluation expenditures. Further, Gorton (1991) conducted interviews with the SEC Chairman, SEC Active Chief Accountant and other actors which revealed that while there was a strong lobbying effort to keep the status quo of allowing both full cost and successful efforts accounting, another reason to do so appeared to be the deficiency of the proposed alternatives.

In the post-IASB period, Noel *et al.* (2010) determine whether the procedures at work in international accounting standard setting are compatible with the requirements of a democratic society. With the focus on IFRS 6, they find that neither the IASB's way of working nor its composition fulfils the criteria of discourse ethics as the international standard setting process depends largely on interest relationships between the dominant economic actors and grants experts too much importance. Asekomeh *et al.* (2006, 2008) find that a majority of extractive industry respondents appear to have used comment letters leading to IFRS 6 to lobby for the retention of practices that maintain the current discretionary aspects of accounting for the exploitation of mineral resources. Moreover, firms with high lobbying intensity have high debt/equity ratios and changes in ownership which, the authors claim, provide incentives to report smooth earnings i.e. lobbying behavior was driven by the motivation to maintain the status quo and ensure the opportunity to maintain smooth earnings also in the future.

Given the significance of lobbying revealed by prior research there would seem to be scope for further research that closely monitors lobbying behavior and its consequences in respect of ‘regulatory capture’ of future standard setting developments involving the extractive industries.

Reporting of Oil, Gas, and Mineral Reserves

Reserves can be broadly defined as discovered quantities of minerals or oil and gas that are recoverable and can be economically extracted. Currently, IFRS does not require companies to disclose reserve information. Yet, in the context of the extractive industries, reserves are generally one of the most valuable assets (and often *the* most valuable asset). Some national GAAPs mandate supplemental disclosure of reserves, e.g., in Australia mining companies are required to disclose publicly the value of their reserves in accordance with the Joint Ore Reserve Committee (JORC) Code and in the US reserve recognition accounting is specified by FASB ASC 932, while in other countries such as the UK, industry bodies (e.g. UK Oil Industry Accounting Committee) provide recommendations regarding best practice (Statement of Recommended Practice, or SORP). In the US, only proved reserves are subject to mandatory disclosure in the financial statements.⁵ In the UK, under the statements of recommended practices (SORPs), companies could use one of two identification strategies: proved versus probable (probabilistic methodology) or proved developed versus undeveloped (deterministic methodology), the latter being similar to the US requirement (Nichols, 2007).^{6,7}

Generally, the US reserve recognition guidance is considered to represent ‘best practice’ (PwC, 2017) and most empirical research on the value-relevance of reserve disclosures is conducted in the US setting. Consequently, the majority of studies on reserve recognition and disclosure

⁵ SEC Rule 4-10a that came in effect on 1 January 2010 defines proved oil and gas reserves as ‘those quantities of oil and gas, which, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be economically producible—from a given date forward, from known reservoirs, and under existing economic conditions, operating methods, and government regulations—prior to the time at which contracts providing the right to operate expire, unless evidence indicates that renewal is reasonably certain, regardless of whether deterministic or probabilistic methods are used for the estimation.’ This definition is consistent with the definition used by the Petroleum Resource Management System (PRMS). Since 1 January 2010, under The Final Rule, companies may provide optional disclosure of unproved reserves.

⁶ SEC Rule 4-10a describes the method of estimating reserves as deterministic ‘...when a single value for each parameter (from the geoscience, engineering, or economic data) in the reserves calculation is used in the reserves estimation procedure’. In contrast, the method is called probabilistic ‘...when the full range of values that could reasonably occur for each unknown parameter (from the geoscience and engineering data) is used to generate a full range of possible outcomes and their associated probabilities of occurrence.’

⁷ Following the adoption of the new UK standards FRS 100–102 (in force since 2015), OAIC has effectively stood down as a SORP-setting body.

included in this review pertain to the US context and focus almost exclusively on oil and gas firms. Nonetheless, we believe that these studies provide important insights into the reserve disclosure practices of EI firms as well as the value-relevance of such disclosures and will uncover fruitful areas for future research.

In 1978, the SEC issued Accounting Series Release (ASR) No. 253, which required firms operating in the oil and gas industry to adopt reserve recognition accounting (RRA), i.e. to estimate and report the fair value of their proved reserves, RRA earnings and RRA cash flows that were adjusted for additions to proved reserves and revisions of previously recognized proved reserves. The main purpose of RRA was to address the inadequacy of the historical cost approach by providing a fair representation of companies' reserves (Dharan, 1984). The new regulation required the estimation of proved reserve quantities, timing of future production, future revenues of proved reserves by using current prices, and costs of production. The expected net revenues were then discounted at an arbitrary 10% discount rate.⁸ Given the radical departure from historical cost accounting, RRA was initially adopted on a three-year experimental basis. Practitioners strongly criticized RRA mostly due to the subjectivity involved in every step of the estimation process, which arguably led to imprecise reserve estimates (Connor, 1979).⁹ Indeed, a study conducted by Price Waterhouse & Co. and presented in Connor (1979) concluded that the estimates presented under RRA were unreliable and misleading and should not be included in the primary financial statements. While practitioners generally agreed on the imprecise nature of RRA disclosures, the empirical evidence on the information content of reserve recognition suggested that it could be beneficial to investors. In a study on the stock market reactions in response to the initial RRA disclosures, Bell (1983) reported a positive market reaction at the disclosure date providing evidence that investors consider RRA disclosures to be value relevant. In addition, Boone (1998) documented a reduction in the bid-ask spread of the disclosing firms suggesting that RRA disclosures reduced the information asymmetries between the market participants.

Notwithstanding the empirical findings on the benefits of RRA, in response to heavy criticism by the accounting profession, in 1982 the FASB issued SFAS No. 69, which required supplementary

⁸ The 10% discount rate was selected arbitrarily to increase the uniformity in the reporting practices of oil and gas firms without any consideration being given to firm-specific factors that would influence the appropriate discount rate.

⁹ The main criticisms were related to the subjectivity of estimating the quantity of proved reserves and the assumptions related to production and financial factors.

disclosure of the quantity of reserves and a standardized measure of discounted future net cash flows relating to proved reserves, but not of RRA earnings.^{10,11} Subsequent studies examining the informational content of reserve disclosures report conflicting results on the informational value of these disclosures to users of financial statements. While, Doran *et al.* (1988) and Kennedy and Hyon (1992) document that reserve disclosures provide value-relevant information after controlling for historical cost earnings, Dharan (1984), Magliolo (1986), Harris and Ohlson (1987), and Clinch and Magliolo (1992) find limited evidence of incremental information content of the aggregate reserve disclosures. For example, Dharan (1984) observes that about 94% of the reported variation in reserve estimates could be explained by publicly available information implying limited incremental informational value of RRA disclosures. Magliolo (1986) complements this finding by pointing out that only the newly discovered reserves, which are generally anticipated by the market, are strongly associated with market value. A potential explanation for the conflicting evidence on the information content of reserve disclosures is that estimates of reserve quantities are imprecise since the ability of a company to successfully develop its reserves depends on a number of economic factors such as the country where the reserves are located and the expected timing of the extraction (Spear, 1994). Indeed, Clinch and Magliolo (1992) document that the disclosure of proved reserve quantity is informative for a subset of companies that have previously provided relatively accurate information (measured as the magnitude of revisions to prior quantity estimates). In contrast, reserve quantity disclosures of companies with a history of large revisions are not informative to investors. Additionally, while the aggregate disclosure of change in the quantity of the reserves might not be incrementally informative, the components of the reported change, i.e. changes due to discoveries, production, net purchases, and revisions of prior quantity estimates, provide differential signals that might offset each other (Alciatore, 1993; Spear 1994, 1996). Generally, the empirical evidence suggests that investors react positively to discoveries and upward revisions (Costabile *et al.*, 2012) and negatively to downward revisions (Spear 1994, 1996). Consistent with this evidence, Raman and Tripathy (1993) document reduced bid-ask spreads in response to disclosure of reserve discoveries for a sample of OTC oil and gas firms, indicating

¹⁰ The original RRA under ASR No. 253 required disclosure of reserve value and RRA earnings and cash flows in the primary financial statements, whereas SFAS No. 69 required reporting of reserve estimates only as a supplementary disclosure or in the footnotes.

¹¹ Specifically, SFAS No. 69 required the disclosure of the quantity of proved reserves, a standardized measure of discounted future cash flows related to proved reserves, the annual change in proved reserves, and the components of the annual change, i.e. discoveries, production, net purchases, and revisions to prior quantity estimates.

reduced information asymmetry. An interesting observation is that the market reaction to reserve additions depends on the accounting method, i.e. whether companies employ the FC or the SE method. In particular, Spear (1996) documents that while market participants react positively to disclosures by FC firms, there is no significant impact on the market prices of SE firms. He suggests that this result is due to the fact the historical-cost information provided under the SE method could be deemed sufficient, which is consistent with the findings on the relative informativeness of earnings of SE firms versus that of FC firms (Bandyopadhyay, 1994; Sunder, 1976).

Subsequent research examines additional explanations for the weak evidence on the information content of reserve disclosures in the US setting. To reconcile the conflicting findings of prior research and identify the reasons behind the weak value relevance of reserve disclosures documented by earlier studies, Boone (2002) reexamines the value relevance of reserve disclosures for stock prices and documents that reserve disclosures based on the fair value of reserves have higher explanatory power than book values when an unrestricted fixed-effects balance-sheet valuation model is applied. He concludes that the previously reported weak evidence on the value relevance of reserve disclosures was due to model misspecifications in prior studies rather than measurement error or low value relevance of proved reserves disclosures. Further, Patatoukas *et al.* (2015) build on the approach proposed by Boone (2002) and provide robust evidence for the value-relevance of discounted cash flow estimates of proved reserves under ASC 932 on a sample of oil and gas royalty trusts.¹² Berry and Wright (2001) suggest an alternative explanation for the weak value relevance of reserve disclosures. They propose and provide evidence that market participants consider a firm's effort (proxied by exploration costs) and ability to locate new reserves (proxied by new additions to proved reserves due to discoveries divided by exploration costs) to evaluate the information content of reserve disclosures. Consistent with the evidence provided by Spear (1996), the value relevance of both effort and ability in their sample is higher for firms using the FC method than for the firms using the SE method.

While most of the studies discussed above investigate the implications of reserve disclosures mandated by SFAS No. 69 for equity market participants, Chung *et al.* (1993) examine the relevance of such disclosures to lenders. They focus on a sample of small oil and gas firms with

¹² ASC 932 superseded SFAS No. 69 and came in effect on 1 January 2010. According to ASC 932-235-50-30, in addition to the reserve estimate disclosure requirements, oil and gas producers are required to disclose a standardized measure of discounted future net cash flows related to proved reserves.

higher probability of default and document that the value of their reserves is positively associated with their borrowing base and total outstanding debt. Their examination of a sample of lending agreements unveiled that RRA is also frequently included within the body of the agreement providing further support for the relevance of RRA disclosures for lending decisions.

Overall, despite the early conflicting evidence on the value relevance of reserve disclosures mandated by ASR No. 253 and SFAS No. 69, subsequent empirical research in the context of US oil and gas companies provides evidence on the decision usefulness of such disclosures for lenders and equity investors. While an aggregate measure of reserve quantity is weakly associated with security prices or returns, the different components of the changes in reserve quantity such as discoveries are sources of value-relevant information (e.g. Alciatore, 1993; Spear, 1994). Further, the value relevance of reserve disclosures depends on the accounting method used by the firms. The information content appears to be higher for FC firms than for SE firms (Berry and Wright, 2001; Spear, 1996), a potential explanation being that historical cost information under the FC method is more informative than historical cost information under the SE method. Finally, Berry and Wright (2001) suggest that investors consider the effort and ability of firms to uncover new reserves in the assessment of the value relevance of reserve disclosures.

The studies discussed above are exclusively focused on US oil and gas firms. There is scant evidence on the reserve disclosures of companies operating in the extractive industries outside of the US setting with a few notable exceptions that will be discussed next.

Teall (1992) examines the information content of historical cost earnings and reserve disclosures on a sample of Canadian oil and gas firms in the period between 1983 and 1987. The results from a pooled regression analysis suggest that historic capitalized costs, reserve quantities, and discounted cash flows related to reserves contain value-relevant information. The author concludes that the three measures are complementary and should be jointly disclosed in the annual reports of oil and gas firms. In contrast to most findings in the US setting, Teall (1992) does not document any statistically significant differences due to the accounting method (FC or SE). Donker *et al.* (2006) examine the information content of probable reserves disclosures in addition to proved reserves on a sample of Canadian oil and gas firms between 2001 and 2004 and document that the percentage change in probable reserves is positively associated with abnormal returns after controlling for the percentage change in proved reserves. From these results, one might infer that

more extensive disclosure regarding both probable and proved reserves would be beneficial to investors. Indeed, Boone *et al.* (1998) find that disclosing unproved reserves (probable and possible) reduces the information asymmetry between the market participants. Specifically, they take advantage of differential rules regarding reserve disclosures for US firms versus foreign firms traded on a US exchange. In the US, under ASR No. 253 and SFAS No. 69, US oil and gas companies were allowed to disclose only proved reserves, while foreign firms e.g. Canadian firms were allowed to follow the disclosure criteria promulgated by their local GAAP. Boone *et al.* (1998) investigate the differential impact of unexpected trading activity on the midpoint of the bid-ask spread for a sample of US and Canadian firms traded on a US equity market and document that this impact is lower for Canadian firms suggesting that quantifying unproved reserves has a positive impact on the market microstructure.

In response to significant advances in the technology for the recovery and characterization of reserves and calls for increased disclosure, since 1 January 2010, under ASC 932, which superseded SFAS No. 69, US companies are also allowed to provide optional disclosures of unproved reserves, thus reducing the heterogeneity in the reporting practices of reserves between US companies and their foreign counterparts. Yet, we could not identify any published studies that examine to what extent US or Canadian companies choose to disclose unproved reserves and whether such disclosures are informative to equity investors, lenders, and financial analysts, which we consider to be fruitful areas for future research. In addition, there is no evidence on how analysts use reserve disclosures, which could be addressed in future studies.

In Australia, EI firms are required to disclose their resources and reserves under the Code developed by the Joint Ore Reserve Committee (hereafter JORC Code).¹³ Compliance with the JORC Code is mandatory for all public reports (annual and quarterly reports, press releases, information provided on company's websites, etc.) issued by companies listed on Australian Securities Exchange (ASX) and the New Zealand Stock Exchange (NZX). The disclosures provided under the JORC Code should be based on evidence prepared by a Competent Person (CP).¹⁴ The JORC Code sets the minimum requirements for disclosure of

¹³ JORC collaborates closely with the Committee for Mineral Reserves International Reporting Standards (CRIRSCO) in the development of reporting standards to ensure international consistency. More information on the activities of JORC is available at <http://www.jorc.org/> (Last accessed: 13 September 2018).

¹⁴ As stated in JORC Code (2012), Clause 11A: "Competent Person" is a minerals industry professional who is a Member or Fellow of The Australasian Institute of Mining and Metallurgy, or of the Australian Institute of

exploration results mineral resources or ore reserves and provides recommendations for additional disclosure. Nonetheless, there is considerable diversity in the disclosure practices of publicly traded firms in Australia (Craswell and Taylor, 1992; Taylor *et al.*, 2012). In a pre-JORC Code study (first edition of the Code issued in 1989) on the disclosure practices of 86 Australian oil and gas companies, Craswell and Taylor (1992) report that only 16 of the companies in their sample disclosed reserve information in 1984. The probability to disclose was positively associated with having a Big 8 auditor and negatively associated with cash flow risk, but did not depend on company's leverage, size, or dispersion of ownership. In a follow-up study, Mirza and Zimmer (2001) examine factors that affect the probability of reserve quantity disclosure and complement the earlier findings of Craswell and Taylor (1992) by documenting that firm size, stage of operations, financing at the project level, and bearing low measurement costs increased the probability of reserve quantity disclosure. Additional evidence on the reserve reporting practices of Australian companies in the 1990s is provided by Mirza and Zimmer (1999), who survey the reserve disclosure and recognition practices of 126 Australian minerals and oil and gas firms in 1994 to 1996 and report that while the majority (73%) of the firms in their sample disclose reserve quantities, only six firms recognize the net value of the reserves on their balance sheets. The authors qualitatively examine the reasons behind the reporting choices of the firms in their sample and conclude that even though the recognition of reserve value can be associated with lower cost of debt or serve as a takeover defense, it can increase the threat of litigation and the political costs for the recognizing firms. While most of the early studies on the determinants of reserve reporting in Canada measure disclosure as a binary variable, Taylor *et al.* (2012) develop an index that provides a more comprehensive measure of the extent of reserve disclosure by Australian listed resource companies. The index consists of 75 separate disclosure items and only a limited number of the items (reserve categorization, a competent person's statement about the calculation of reserves and a statement of compliance with the JORC Code) are mandatory. The results indicate that the

Geoscientists, or of a 'Recognised Professional Organisation' (RPO), as included in a list available on the JORC and ASX websites. These organizations have enforceable disciplinary processes including the powers to suspend or expel a member. A Competent Person must have a minimum of five years relevant experience in the style of mineralization or type of deposit under consideration and in the activity which that person is undertaking. If the Competent Person is preparing documentation on Exploration Results, the relevant experience must be in exploration. If the Competent Person is estimating, or supervising the estimation of Mineral Resources, the relevant experience must be in the estimation, assessment and evaluation of Mineral Resources. If the Competent Person is estimating, or supervising the estimation of Ore Reserves, the relevant experience must be in the estimation, assessment, evaluation and economic extraction of Ore Reserves." The Competent Person could be an employee of the company or employed by an external firm (see http://www.jorc.org/docs/JORC_code_2012.pdf, last accessed: 13 September 2018).

strength of corporate governance, foreign listing, existence of reserves in foreign jurisdictions, pledging of reserves in debt covenants, leverage, and being audited by a Big 4 audit firm are all positively associated with the extent of disclosure. Bird *et al.* (2013) investigate the market reactions to exploration and reserve disclosures for a sample of 307 Australian mining firms and report that reserve announcements are considerably less frequent than other types of announcements (e.g. exploration) and are typically made by larger, more mature firms. In contrast to the results of similar investigations conducted in the US setting, Bird *et al.* (2013) fail to document a statistically significant effect of such disclosures on cumulative abnormal returns. They note that such a result is not surprising as reserves are based on previously disclosed resources for which there is a 'reasonable level of certainty regarding future extraction' and that could be converted into reserves if certain requirements are met (JORC, 2015). Hence, investors can reasonably predict the conversion of resources to proved or probable reserves on the basis of previously disclosed information. One of the important aspects of the JORC Code is the requirement that all disclosures related to mineral and oil and gas resources and reserves be certified by a CP. Yet very little is known about the effect of the CP on the quality of the disclosures or their value relevance, which is surprising given the levels of uncertainty involved in estimating the quantity and grade of the reserves and resources. A notable exception is Ferguson and Pündrich (2015), who examine whether the expertise of the CP affects the market reactions to reserve disclosures. They base their predictions on the auditing literature and argue that the market reaction should be stronger if the CP is an industry specialist, which they define as being amongst the largest four mining consulting firms by market share in each commodity group (i.e. precious metals, base metals, bulks, oil and gas, and others). Utilizing a sample of Mining Development Stage Entities between 1996 and 2012, they document positive abnormal returns in response to both reserve and resource disclosures. However, their findings suggest that industry expertise of the CP does not significantly impact market reactions. A potential explanation for this puzzling finding is that the quality of assurance in this setting is not relevant due to the low litigation risk. We propose that more extensive investigation on the role of the CP is warranted, perhaps on a broader sample of EI firms and on a wider set of outcomes. For example, future research could study whether the use of industry experts or more reputable CPs affects the direction, probability and magnitude of reserve misstatements.

In the UK, the Oil Industry Accounting Committee (OIAC) has issued statements of recommended practices (SORPs), which were designed to set the best practices of financial accounting and disclosure of oil and gas companies in the UK. The most recent SORP on ‘Accounting for Oil and Gas Exploration, Development, Production and Decommissioning Activities’ was issued in 2001, however, following the adoption of the new UK standards FRS 100–102 (in force since 2015), OIAC has effectively stood down as a SORP-setting body. The main objective of the SORPs was to promote consistency in the absence of corresponding accounting standards. As such, they were to be viewed as a complement to the accounting standards. Oil and gas companies could define their reserves as either: (1) proven and probable gas reserves; or (2) proved developed and undeveloped oil and gas reserves (OIAC SORP, 2001). Regardless of the selected definition, companies were recommended to disclose the net reserve quantities, the source of reserves, and the changes in reserve quantities (due to revisions, purchases, sales, discoveries, or production). Odo *et al.* (2016) empirically examine the reserve disclosure practices of UK firms and the extent to which they follow the OIAC recommendations on a sample of 20 UK oil and gas firms in 2009. Their findings suggest that 65% of the firms in their sample either meet or exceed the disclosure recommendations promulgated by SORP, 25% provided only limited disclosure, while 10% failed to disclose any reserves-related information. Although the OIAC no longer makes updates, the 2001 SORP is still relevant when determining good industry practice with regard to disclosures and definitions of commercial reserve quantities as neither UK accounting standards nor IFRS provide any guidance in this area.¹⁵

Environmental, Social, and Governance (ESG) Reporting

Firms operating in the extractive industries pose significant threats to the environment and the people as their operations often require the use of dangerous chemicals, deforestation, degradation, gas flaring, etc. According to a report by the World Bank, in 2015, gas flaring alone led to the emission of about 350 million tons of carbon dioxide in the atmosphere, leading to serious environmental and social consequences (World Bank, 2018). Given their significant environmental and social impact in combination with public and regulatory attention, EI firms tend to engage in environmental, social, and governance (ESG) reporting. ESG-related issues influence EI firm’s financial statements directly through, for example, the recognition of environmental liabilities,

¹⁵ Source: OIAC: SORP – Current status, <http://oiac.co.uk/sorp-current-status>. Downloaded 16 September 2018.

while other parts of the annual report may include nonfinancial disclosures related to ESG issues. An increasing number of companies also issue stand-alone reports on ESG performance.

A large body of literature related to EI-firms' ESG reporting focuses on the recognition of environmental liabilities and compliance with existing environmental regulations. Environmental liabilities broadly refer to legal obligations levied on companies by different environmental law agencies and can be categorized into (1) decommissioning and remediation liabilities, i.e. the costs associated with cleanup and restoration of extraction sites; and (2) legal liabilities due to noncompliance with relevant environmental regulations. Additional environmental costs arise periodically due to compliance with environmental laws (e.g. costs related to storing and disposal of hazardous waste). Although environmental laws and regulations have been in place in the US since the early 1970s, the early evidence on compliance and informational value of environmental disclosure in the context of EI firms (and related downstream industries) is scarce with a few notable exceptions. For example, Gamble *et al.* (1995) empirically investigate the environmental disclosure practices of 234 firms operating in 12 highly polluting industries including oil and gas in the period between 1986 and 1991. The results, based on a content analysis of environmental disclosures in the annual reports and 10-Ks, indicate that oil and gas firms had significantly lower environmental disclosure quality than firms operating in other industries.¹⁶ The authors also document an overall increase in the environmental disclosure quality during the period under investigation, which they attribute to the increased FASB and SEC regulation and the public pressure after the Exxon Valdez Oil Spill in 1989 and the introduction of the Valdez principles by the Coalition for Environmentally Responsible Economies (CERES) during the same year.¹⁷ Alciatore *et al.* (2004) extend these findings by studying a broad set of environmental disclosures for a sample of 34 petroleum firms in 1989 and 1998. Consistent with the evidence provided by Gamble *et al.* (1995), the authors observe that disclosure quality increased during the

¹⁶ Gamble *et al.* (1995) develop an index to measure environmental disclosure quality based on the relative informational content of the form of the disclosure e.g., they consider disclosure in the footnote to be less informative than a short qualitative disclosure and short qualitative disclosure to be less informative than long qualitative disclosure.

¹⁷ The Valdez Principles (also known as the CERES pledge) consists of ten guidelines on best practices including, but not limited to, sustainable use of environmental resources, protection of the biosphere, reduction of waste disposal, and environmental disclosure to be adopted by companies on a voluntary. (see https://www.iisd.org/business/tools/principles_ceres.aspx, Accessed 18 September 2018).

sample period. For example, while only 12 percent of the firms in the sample disclosed remediation liabilities in 1989, 50 percent of the firms disclosed this information in 1998. The mean (median) dollar amounts reported by the firms decreased from \$381 (355) million in 1989 to \$217 (75) million in 1998.¹⁸ Interestingly, the authors note that, despite the increased regulatory and public pressure during the period, only about 50 percent or less of the firms disclose the dollar amounts of specific environmental liabilities indicating a low compliance rate with the applicable regulations.

In the Australian context, the first regulation related to environmental disclosure was outlined in ASRB 1022 *Accounting for the Extractive Industries*, which required the recognition of site restoration and rehabilitation liabilities. However, the standard was quiet on its application, which led to considerable diversity in the environmental disclosure practices of EI firms particularly with regard to the timing of recognition (Hardy and Frost, 2001).¹⁹ In 1995, to increase the informativeness and comparability of financial reports, the Urgent Issues Group (UIG) issued *Abstract 4 Disclosure of Accounting Policies for Restoration Obligations in the Extractive Industries* (UIG 4), which mandated additional disclosure related to restoration and rehabilitation liabilities such as timing of the recognition, employed method, changes in the estimates, etc. Hardy and Frost (2001) document that UIG 4 had a significant impact on the environmental disclosure practices of Australian EI firms. Specifically, the number of disclosing firms and the extent of disclosures increased after the adoption, although only 58 percent of the firms reported restoration and rehabilitation liabilities. In 1998, the government enacted section 299(1)(f) of Australia's Corporation law, which required firms to disclose their environmental performance with respect to relevant environmental laws in annual reports. Frost (2007) examines the impact of section 299(1)(f) on the environmental reporting practices of listed Australian firms operating in high-polluting industries i.e., resources (mining, oil and gas), utilities and infrastructure, and paper and packaging, and documents a significant increase in statutory disclosure after its enactment. The

¹⁸ The authors indicate that this result is driven mostly by firms that did not report remediation liabilities in 1989 but did so in 1998 and the amounts that they reported were on average lower than the amounts reported by the other firms in 1989.

¹⁹ Hardy and Frost (2001) note that firms applied one of the following approaches: the full liability method, under which provision for restoration costs was recognized during the initial stages of exploration and development, and the incremental method, under which no provision was recorded until the production stage. Often, firms did not disclose what method they were applying.

effect was mostly driven by increased disclosures related to environmental law violations and related fines, thus indicating increased transparency of firms' environmental performance.

In Canada, in 1990, the Canadian Institute for Chartered Accountants (CICA) issued a standard which mandated Canadian listed firms to disclose restoration and reclamation liabilities. Specifically, the standard required that firms disclose liabilities relating to the restoration of extraction sites to their natural states and accrue such liabilities in the financial statements if they could be reasonably determined. Similar to the findings in the US context, compliance with environmental disclosure regulation during the early 1990s in Canada appears to be limited. A study conducted by CICA in 1993 indicates that only 6 percent of the surveyed firms complied fully with the new CICA standard (as reported in Li and McConomy, 1999). Further, Li and McConomy (1999) examine the adoption of the standard in 1990 and 1991. Using a sample of 166 mining and oil and gas firms, they report that 31 percent of the firms in the sample adopted the new standard in the year before it came into effect and 51 percent adopted it during the mandatory adoption year. The probability to adopt early is positively correlated with profitability and environmental commitment (measured as having an established environmental policy) and negatively associated with uncertainty (measured as the remaining life of the site). Both the current and the accumulated provisions for restoration and reclamation liabilities appear to be value relevant in their sample. After the adoption of IFRS in Canada on 1 January 2011, listed Canadian firms account for decommissioning and restoration liabilities under IAS 37 *Provisions, Contingent Liabilities, and Contingent Assets* and IFRIC 1 *Changes in Existing Decommissioning, Restoration and Similar Liabilities*.

The discount rate represents one of the key inputs in the estimation of environmental liabilities. Given the long duration of these liabilities, the applied discounted rate can significantly impact the amount of liabilities to be recognized. In the US, according to ASC 410, environmental remediation liabilities can be measured on an undiscounted or discounted basis if certain conditions are met, while asset retirement obligations (AROs), which typically include decommissioning, restoration and environmental rehabilitation provisions are measured on a discounted basis using the firm's own credit risk rate.²⁰ Under IFRS, IAS 37 stipulates that the appropriate discount rate for such

²⁰ ASC 410-30-35-12 prescribes that firms could select to discount their environmental remediation liabilities if two criteria are met: (1) the aggregate amount of the liability is fixed or can be reliably determined, and (2) the amounts

liabilities should be the risk-free rate, without specifically disallowing the adjustment for own credit risk. This allows for managerial discretion in the selection of the discount rate and leads to diversity in accounting practices related to environmental liabilities. Indeed, Schneider et al. (2017) document that 71 percent of a sample of listed Canadian EI firms followed IFRS and used the risk-free rate in 2011, while 29 percent chose to use an adjusted discount rate consistent with the reporting practices under US GAAP and pre-IFRS Canadian GAAP. In addition, they report that the probability to let own credit risk affect the discount rate is positively associated with the pre-IFRS size of the environmental liabilities suggesting that the discount rate was strategically chosen by some firms to minimize the amount of reported environmental liabilities. An interesting observation is that neither the choice of the discount rate (i.e. risk-free rate or a rate adjusted for own credit risk), nor the environmental liabilities reported on the balance sheet are value-relevant in their sample. This evidence casts doubts on whether the environmental liabilities recognized on the balance sheets of polluting firms are indeed a fair representation of the *true* value of firm's environmental liabilities. Further, Buccina *et al.* (2013) examine Chevron's contingent environmental liability disclosures under US GAAP and suggest that ASC 450-20 *Loss Contingencies* allows companies to avoid disclosing substantial legal liabilities. Roger and Atkins (2015) note that the discrepancy is particularly evident in bankruptcy cases where the recognized environmental liabilities often underestimate the actual liabilities. Patten (2005) reports that other environmental disclosures are not informative to investors either but are rather used as a means for high-polluting firms to gain legitimacy. For a sample of US firms operating in high-polluting industries, he documents that such disclosures are seldom accurate. Specifically, he studies projections of future environmental capital expenditures (required as part of environmental disclosures under US GAAP) and reports that actual environmental capital expenditures deviate significantly from projected expenditures. Interestingly, projection errors were negative in 76 percent of the cases, i.e., actual expenditures were lower than those projected, in line with the argument that firms manage disclosures to gain legitimacy.

While the evidence discussed thus far suggests that recognized environmental liabilities and disclosures are not value-relevant, investors might be able to infer the *true* value of environmental liabilities from alternative publicly available information. For example, Cormier

and timing of the cash flows are fixed or can be reliably determined. Otherwise, firms should report the undiscounted amount.

and Magnan (1997) suggest that environmental performance (measured as the ratio of a firm's pollution records to the pollution allowed under existing regulations) is negatively associated with market value for a sample of Canadian firms from high-polluting industries after controlling for a number of balance sheet items. They interpret this as evidence of implicit environmental liabilities that are not included in polluting firms' balance sheets and call for regulators' attention to this issue. A potential reason for the reluctance of regulators to tighten the standards related to environmental liabilities and disclosure is the ability of firms operating in high pollution industries to influence the rule-making bodies. For example, Cho *et al.* (2008) investigate how chemical and petroleum firms influenced the passing of the Edgar–Sikorski Amendment, which prescribed additional environmental disclosures, in 1985. Specifically, they examine the Political Action Committee (PAC) contributions to candidates for federal offices and document a significant association between PAC contributions received from chemical and petroleum firms and the legislator votes on the Edgar–Sikorski Amendment. Although the Amendment was passed by a one-vote margin, the evidence provided by Cho *et al.* (2008) suggests that high-polluting firms have the power to exert considerable influence on the adoption of disclosure regulation and are generally opposed to proposals related to increased disclosure. A plausible reason is that changes in ESG disclosure regulation have significant economic effects for EI firms. Christensen *et al.* (2017) examine the real effects of Section 1503 of the Dodd–Frank Act, which requires registrants to disclose mine-safety records. Even though this information had already been publicly available before the adoption of the Dodd-Frank Act in 2010, Christensen *et al.* (2017) document that including mine-safety records in the financial reports is associated with an increase in compliance with mine safety regulations (measured as the number of mining-related citations) and a significant decrease in mining-related injuries. Although the additional disclosure requirements had substantial benefits for the disclosing companies in terms of improved mine safety, they led to a reduction in labor productivity.

Another stream of literature investigates voluntary environmental policies and disclosures and the motivations for managers to voluntarily disclose environmental information. For example, Tilt (1997) conducts a survey of the top 500 listed Australian companies in 1994 and documents that about 45 percent of the survey respondents had established corporate environmental policies and 70 percent of the respondents operating in the mining and chemicals industries had such policies, a proportion that was significantly higher compared to other industries. In a follow-up study, Tilt

and Symes (1999) document that Australian mining and chemical firms also provide significantly more extensive environmental disclosures than firms operating in other industries, measured as the number of sentences related to environmental disclosures in their annual reports. A closer examination of the content of environmental disclosures of mining firms indicate that most of the disclosures relate to rehabilitation of mining sites, which is deductible for tax purposes. Accordingly, the authors argue that tax considerations are an important determinant of firm's environmental disclosures. Yongvanich and Guthrie (2005) also analyze voluntary disclosures by 17 Australian mining firms in 2002 and note that most of the environmental disclosures are related to compliance issues and information on emissions, effluents, and waste. Overall, these studies suggest that EI firms are likely to establish environmental policies and provide voluntary disclosure pertaining to environmental issues mostly to signal compliance with environmental and tax laws. Deegan and Blomquist (2006) provide a different perspective by studying how non-government organizations (NGOs) influence corporate environmental disclosures and the industry environmental code. Specifically, they qualitatively examine the response of Australian mining firms and the Minerals Council of Australia to a 1999 WWF-Australia initiative to evaluate the environmental reports of mining firms with respect to the Australian Minerals Industry Code for Environmental Management and suggest that mining firms changed their reporting behavior to comply with the Code following the WWF assessment.²¹ Yet, the authors note that improving disclosure might not reflect a *true* commitment to improving environmental performance. This view is in line with legitimacy theory, which postulates that firms provide social and environmental disclosures to gain, maintain, and repair their legitimacy (O'Donovan, 2002). To the extent that ESG disclosures enhance firms' legitimacy, one would expect that firms operating in high-polluting industries such as minerals and oil and gas will be likely to provide extensive ESG disclosures to increase or maintain their legitimacy. The empirical evidence in support of legitimacy theory with respect to voluntary environmental disclosures of EI firms is mixed. On the one hand, Freedman and Jaggi (2005) suggest that firms provide extensive disclosure to alleviate societal and institutional pressures and maintain their legitimacy. In particular, they document that country-level ratification of the Kyoto Protocol is positively associated with the environmental disclosures of high-polluting firms domiciled in the country. On the other hand, de Villiers and

²¹ The Australian Minerals Industry Code was developed by the minerals industry in 1996 to provide a framework for environmental management. Adoption of the Code by individual firms is voluntary.

van Staden (2006) examine the predictions of legitimacy theory on a sample of South African firms in the period between 1994 and 2002 and report that, overall, voluntary environmental disclosures decreased in 2000 after an initial increase between 1994 and 1999. While mining firms on average provided more extensive disclosures than firms operating in other industries throughout the sample period, consistent with findings in the Australian context (e.g. Tilt and Symes, 1999; Yongvanich and Guthrie, 2005), their environmental disclosures decreased substantially in 2000. De Villiers and van Staden (2006) conclude that environmental disclosures can be detrimental to corporate legitimacy for firms with high negative environmental impact, which explains mining firms' reporting behavior. Aerts and Cormier (2009) complement de Villiers and van Staden (2006)'s findings by examining the effect of the extent and quality of environmental disclosure on media legitimacy. Based on a sample of North American firms, they document that the positive association between environmental disclosures and media legitimacy is negatively moderated for firms operating in high-polluting industries in line with the arguments that disclosures by these firms may damage firms' reputations and even if the news were positive, they might be perceived as less credible. Nonetheless, EI firms might be able to enhance the credibility of their ESG disclosure by providing more quantified information that is objective and easily verifiable (Clarkson *et al.*, 2011; Comyns and Figge, 2015).

The literature reviewed hitherto suggests that the extent and quality of voluntary disclosures by firms operating in the extractive industries is predominantly driven by regulation (e.g., Alciatore, 2004; Frost, 2007; Hardy and Frost, 2007; Li and McConomy, 1999), taxation (e.g., Tilt and Symes, 1999), legitimacy concerns (de Villiers and van Staden, 2006; Freedman and Jaggi, 2005), pressure groups (Deegan and Blomquist, 2006), and credibility (Clarkson *et al.*, 2011). Islam *et al.* (2017) suggest that country-level perceived social risks also significantly influence voluntary disclosure. They study the factors that affect human-rights performance disclosures by Australian mineral companies with foreign operations and document that companies operating in countries identified as having high human-rights risk provide more human-rights performance information (measured as the number of disclosed items) than their peers operating in low human-rights risk countries. Another stream of literature suggests that firms increase their voluntary disclosures in the aftermath of high-impact events affecting peer firms. For example, Coetzee and van Staden (2011) document that South African mining firms increase the amount and quality of safety-related disclosures following major mining accidents. Heflin and Wallace

(2017) examine the intra-industry effects of the BP oil spill in 2010 and document that peer firms increased their disaster-plan disclosures following the accident, but no other components of their environmental disclosures. Additionally, providing extensive pre-accident disclosure appears to be beneficial in case an industry peer is involved in a major accident (Heflin and Wallace, 2017; Patten and Nance, 1998). Indeed, Patten and Nance (1998) document that pre-accident environmental disclosure was positively associated with cumulative abnormal returns of petroleum firms following the Exxon Valdez oil spill in 1989.

While most of the research related to ESG reporting of EI firms focuses specifically on the environmental or the social component, a number of recent studies take a holistic perspective and consider corporate social responsibility (CSR) disclosures more comprehensively. For example, de Villiers and Alexander (2014) complement the studies on the determinants of voluntary disclosure by comparing the CSR reporting of mining companies operating in Australia and South Africa in terms of quantity, tone, position, and quality. The authors document noteworthy similarities between the CSR disclosure of Australian and South African companies and conjecture that ‘...the structure of CSRR is subject to isomorphic pressures related to the similarities in institutional environments and capital markets’ (de Villiers and Alexander, 2014, pp. 209-210). Herbohn *et al.* (2014) empirically examine the relationship between sustainability performance and sustainability disclosure on a sample of Australian EI firms and find that sustainability disclosure is significantly positively associated with sustainability performance. The link between sustainability performance and sustainability disclosure appears to be weaker in developing countries. Lauwo and Otusanya (2014) and Lauwo *et al.* (2016) scrutinize the sustainability disclosures of gold mining companies in Tanzania and suggest that these companies disclose CSR information selectively and omit relevant social and environmental issues related to their sustainability performance. Further, they question the adequacy and effectiveness of the country’s regulatory framework to ensure transparency and accountability with respect to sustainability issues and call for greater involvement of NGOs. Herbohn *et al.* (2014) also express concern over the level of sustainability performance in Australia as the average sustainability performance score for their sample is 0.861, out of a maximum score of five.

Our review of the literature of ESG reporting by EI firms reveals several areas warranting future research especially relating to social and governance issues e.g., factors that affect disclosure,

value-relevance of social and governance disclosure and performance. Owing to the nature of their operations, EI firms often operate in high corruption risk countries. Hence, we specifically encourage research that focusses on anti-corruption initiatives.

Additional Issues: Earnings management and Opportunistic Behavior, Voluntary Disclosures

Much of the empirical research on earnings management in the context of EI firms draw on the political cost hypothesis advanced by Watts and Zimmerman (1978), according to which the higher the political costs faced by firms, the higher the propensity to defer earnings to future periods. Consistent with the predictions of the political costs hypothesis, the empirical evidence in this area suggests that firms in the oil and gas industry that experience high political costs are more likely to implement income-decreasing financial reporting practices (Byard *et al.*, 2007; Cormier and Magnan, 2002; Hall, 1993; Han and Wang, 1998). In particular, studies show that following high impact events such as the 1990 Persian Gulf crisis (Han and Wang, 1998) or hurricanes Katrina and Rita (Byard *et al.*, 2007), large oil and gas firms manage their earnings downward to reduce perceived political costs, whereas no abnormal behavior is observed for smaller firms, that are subject to less scrutiny. Further, Monem (2003) studies the implications of the introduction of tax on the income from gold-mining activities in Australia in 1991 for the financial reporting practices of the affected firms. He documents that gold-mining firms engaged in income-decreasing earnings management during the period of high political costs before the change in legislation was formally approved. After the approval, but before the legislation came into force, the firms switched to income-increasing earnings management. While these studies predominantly focus on earnings management as a tool to reduce political costs around high-impact events, Pincus and Rajgopal (2002) suggest that oil and gas firms use accruals for income smoothing purposes. Specifically, for a sample of US oil and gas firms, the authors document that managers use accrual earnings management and commodity hedging to reduce the volatility of their earnings.

Another stream of literature examines whether the differential implementation guidance of impairment of oil and gas assets in the US during the period between 1996 and 2001 created opportunities for self-serving behavior (Al-Jabr and Spear, 2004; Boone and Raman, 2007). Specifically, firms applying the FC method of accounting followed SEC Regulation SX 4-10,

which provides detailed implementation guidance.²² Instead, SE firms recognized impairment losses as prescribed by SFAS No. 121 (superseded by FAS No. 144 in 2001), which was in effect principles-based and as such provided very little implementation guidance.²³ In line with the expectation that the limited implementation guidance under SFAS No. 121 allowed for opportunistic behavior, Al-Jabr and Spear (2004) note that SE firms recognized more frequent write-downs (on average), a practice that allowed them to effectively smooth their earnings in periods of fluctuating oil and gas prices. Conversely, FC firms recorded impairment losses less frequently and of larger magnitude. Interestingly, the authors observe that the post-impairment net operating assets, earnings, and equity were not significantly different between FC and SE firms. Boone and Raman (2007) also report that recognizing impairment losses under SFAS No. 121 was associated with opportunistic incentives. Yet, this did not affect the value-relevance of write-downs of SE firms. In contrast, Regulation SX 4-10 was effective in limiting opportunistic behavior, but also compromised the value-relevance of write-downs of FC firms. Finally, Dharan and Mascarenhas (1992) and Chen and Lee (1995) study the extent to which accounting choices of oil and gas firms are affected by opportunistic motives. For example, Chen and Lee (1995) examine whether executive bonuses affected the decision to switch from FC to SE method or take a write-down of oil and gas assets during the 1985-1986 period, when oil prices dropped significantly.²⁴ They find that although there were no significant differences in the compensation structure between switch and write-down firms, managers of FC firms whose bonuses would have been affected by a write-down, chose to switch to the SE method, while managers of FC firms

²² According to SEC Regulation SX 4-10, full-cost firm are mandated to periodically apply a rigorous impairment test (i.e., the 'ceiling test') and recognize an impairment loss if the book value of their oil and gas assets exceeds a 'cost center ceiling'. SEC Regulation S-X 4-10(v)(4) defines a cost center ceiling as equal to the sum of: '(A) The present value of estimated future net revenues computed by applying current prices of oil and gas reserves (with consideration of price changes only to the extent provided by contractual arrangements) to estimated future production of proved oil and gas reserves as of the date of the latest balance sheet presented, less estimated future expenditures (based on current costs) to be incurred in developing and producing the proved reserves computed using a discount factor of ten percent and assuming continuation of existing economic conditions; plus (B) the cost of properties not being amortized pursuant to paragraph (i)(3)(ii) of this section; plus (C) the lower of cost or estimated fair value of unproven properties included in the costs being amortized; less (D) income tax effects related to differences between the book and tax basis of the properties referred to in paragraphs (i)(4)(i) (B) and (C) of this section.'

²³ Boone and Raman (2007) note that the general provisions of SFAS No. 121 are relatively unchanged in FAS No. 144.

²⁴ Due to the collapse of oil prices in 1986, FC firms had to either write-down their oil and gas assets as postulated by SEC Regulation SX 4-10 or switch to the SE method. Before the issuance of SFAS No. 121 in 1995, SE firms were not required to test for impairment and write-down their assets if they had been impaired.

which were already experiencing losses and were not entitled to a bonus during the year chose to write-down oil and gas assets.

Overall, the findings of the studies on earnings management indicate that accounting choices of EI firms are associated with opportunistic incentives. But we know very little about other practices that managers could employ to achieve their objectives, such as misstatements of reserve disclosures.

Next we summarize the empirical literature on the voluntary disclosure practices of EI firms other than disclosures related to ESG issues and oil and gas reserves. A number of studies investigate the factors that explain the extent and quality of voluntary financial disclosure of EI firms. For example, Malone *et al.* (1993) document that leverage, listing status, and ownership concentration explain to a large extent the systematic differences in financial disclosure of oil and gas firms. Further, Taylor and Tower (2011) report that for a sample of Australian EI firms in the 2002-2006 period, the applied financial disclosure ratio is positively associated with income tax exposure and negatively associated with tax transparency. In contrast to the findings of Malone *et al.* (1993), they do not report any significant relationship between listing status and financial disclosure. Other studies explore the factors that affect financial instrument disclosure. Taylor *et al.* (2011) find that tax considerations, size, ownership concentration, and leverage are significantly associated with financial instrument disclosure. Birt *et al.* (2011) complement Taylor *et al.*'s (2011) findings by documenting that larger firms with higher leverage and a Big-4 auditor provide more extensive financial instrument disclosures. There is also some evidence on the value-relevance of voluntary financial disclosure of EI firms. Gianfrate (2017) examines the equity market reaction to World Gold Council's (WGC) Guidance Note on non-GAAP All-in Sustaining Cost (AISC) issued in 2013, which applies to gold-mining firms.²⁵ He documents significant positive abnormal returns at the issuance of the WGC Guidance Note indicating that investors view the new metric as value-relevant. While the aforementioned studies focus on voluntary financial disclosure, Gallery and Nelson (2008) examine the informativeness of pre-production cash outflow forecast disclosures that are mandatory for all mining firms listed on the Australian Stock Exchange (ASX). They note a high level of compliance with the requirement, but a considerable degree of forecast inaccuracy. Their evidence raises doubts about the decision-usefulness of such disclosures and

²⁵ AISC is a voluntary comprehensive metric that includes all the costs of gold production over the lifecycle of a mine.

suggests that mandatory forward-looking financial disclosure may intensify information asymmetry rather than attenuate it.

EI firms might also intentionally obfuscate their disclosures. For example, in a study of the disclosure practices of multinational petroleum firms, Cannizzaro and Weiner (2015) document that multinationals strategically manage their disclosures. Specifically, their analysis shows that cross-border transactions are less transparent than domestic transactions in line with the investor sophistication theory, i.e. in the presence of high information asymmetry, investors might interpret lack of disclosure as either hiding information or having nothing to disclose. Moreover, multinationals strategically aggregate geographic disclosures to hide operations in tax havens (Akamah *et al.*, 2018). Disclosure transparency is further impaired for firms facing high political costs (Akamah *et al.*, 2018; Cannizzaro and Weiner, 2015). Finally, Otusanya (2011) suggests that multinational operating in developing countries such as Nigeria understate their income and manipulate their financial disclosures to avoid paying taxes.

Another stream of literature studies EI firms' risk disclosures. In 1997, in the US, the SEC introduced FRR No. 48, which requires firms to provide quantitative forward-looking market-risk disclosures in their 10-K filings. Specifically, the rule asserts that firms may choose one of three reporting options, i.e., value-at-risk, tabular presentation, or sensitivity analysis for material market risk categories such as interest rate risk, foreign currency exchange rate risk, commodity price risk, equity price risk, etc. Extant literature suggests that such market risk disclosures provide relevant information in the context of oil and gas firms (Rajgopal, 1999, Thornton and Welker, 2004). For example, Rajgopal (1999) provides early evidence on the usefulness of FRR No. 48 disclosures by showing that FRR No. 48 disclosure proxies are significantly associated with the market perception of oil and gas price sensitivity. Similarly, Thornton and Welker (2004) report that oil and gas firms disclosing value-at-risk and sensitivity information for the first time experience greater commodity beta shifts than non-disclosers. Operational risk disclosure may also provide value-relevant information. In an experimental study, Cai *et al.* (2017) show that mining company's segment level water reports influence investors' earning predictions. In particular, the study participants revised downward their earnings estimates when at least one segment report indicated high water risk, suggesting that segment-level operational risk disclosure is informative to potential investors. As the evidence on risk disclosure in the context of EI firms is scarce, we encourage more research

on the topic and specifically on the value-relevance of different risk disclosures. Lastly, we currently know very little about the risk management strategies of EI firms and the factors that affect them. A notable exception is Godfrey and Yee (1996) who examine whether Australian mining firms change their foreign exchange risk management strategies in response to the introduction of ASRB 1012 *Foreign Currency Translation* in Australia in 1987 and indicate that affected firms modify their capital structures as a strategy to manage increased foreign currency exchange rate risk.²⁶

Conclusions and Future Research

In this paper we first identified some important economic characteristics of EI and associated accounting challenges, in order to ensure alignment with the IASB research project on EI, together with an overview of how current accounting standards deal with these challenges. Second, we conducted a review of extant research on EI reporting analyzed around the key areas of (a) international accounting diversity and issues relating to user information needs.; (b) standard-setting processes and lobbying behavior, that deals with why the IASB (and other standard setters) have not succeeded in developing rigorous standards for extractive activities; (c) the reporting of oil, gas and mineral reserves, given that large proportions of the assets of EI firms (the reserves) are off-balance sheet; (d) environmental, social and governance (ESG) reporting dealing with how EI firms have increased their reporting of ESG information in response to regulatory demands and pressure for voluntary disclosures; and (e) selected additional topics such as earnings management behavior and voluntary disclosures.

Overall, there would seem to be substantial scope for further analytical and empirical research that can point to how financial reporting information would best serve information users in the extractive industries, having regard to the accounting challenges identified and the research findings to date as reviewed in our paper.

²⁶ ASRB 1012 required firms to immediately recognize in the income statement unrealized exchange gains and losses on long-term foreign currency monetary items.

As we show in our paper, the literature comprising international comparative studies on accounting practices across EI firms is very limited. The empirical evidence that is available, together with de jure comparisons of IFRS Standards and national GAAPs, suggests that there is substantial accounting diversity both within and between countries. In addition, the country-based differences observed for general samples of firms does not seem to apply to EI firms. Based on our review, there would seem to be substantial scope for more research examining the current state of international accounting diversity among EI firms especially with regard to EI-specific items currently not covered by rigorous IFRS Standards (e.g., E&E activities). There is also a need for research on EI firms' accounting policies more generally, i.e. including EI-related items that are covered by existing IFRS Standards. We suggest, as a hypothesis, that the leeway given to EI firms in IFRS 6 to continue with existing local practices may have led to a perception among EI preparers that IFRS Standards are flexible. This may have been reinforced by (i) the IASB decision to not move forward with standard-setting in this area and to classify its research project on extractive activities as inactive; (ii) flexibility in national GAAPs. In practice, when IFRS Standards are perceived to be diffuse or principles perceived to be difficult to apply, it is not uncommon that IFRS preparers and their auditors consider the US GAAP treatment, i.e. US GAAP tends to meet the strong preparer demand for detailed guidance. While the US regulations include many detailed disclosure requirements, with regard to recognition and measurement US GAAP is also flexible which may contribute to increased preparer flexibility also for non-US preparers, and less power for auditors. If this is the case, we would observe EI-firms applying IFRS Standards differently compared to firms in other industries, notably in respect of IAS 2 (Inventories), IAS 16 (Property, Plant and Equipment), IAS 36, IAS 37 (Provisions, Contingent Liabilities and Assets), IAS 38, IFRS 11 (Joint Arrangements), and IFRS 13 (Fair Value Measurement).

Prior research on analysts and investors suggest that analysts' industry expertise is highly appreciated by investors. This is a general observation. However, the few available empirical studies suggest that this is of particular importance in the extractive industries, where analysts appear to develop substantial amounts of private information and add significant value beyond the financial statements. This appears to be an area of great potential for future research as the EI setting provides a somewhat unique combination of high information asymmetry where rigorous IFRS Standards are missing and the level of business uncertainty is very high. A better understanding of how analysts behave and interact with clients in such a context would be valuable

from a theoretical point of view. From the IASB's point of view, however, the unique combination of high business uncertainty and lack of rigorous standards, leaving the responsibility of reducing information asymmetry to financial analysts, may be interpreted as indicating an urgent need for the development of a comprehensive IFRS Standard on extractive activities.

Our review of prior research suggests that lobbying plays a significant role in the context of extractive industries standard setting. With regard to international standard setting, there is some evidence suggesting that the process depends largely on interest relationships between the dominant economic actors and that experts are granted too much importance. Given the significance of lobbying by interested parties on regulators and standard setters revealed by prior research there would seem to be scope for further research that closely monitors lobbying behavior and its consequences in respect of the 'regulatory capture' of future standard setting developments involving the extractive industries. Such research could focus on methodologies that are more qualitative including interview-based and ethnographic studies as well as document analysis.

The prior literature on EI firms' reporting of mineral and petroleum reserves is extensive. Owing to differences in definitions and regulatory requirements across countries, but also between mineral and petroleum (oil & gas), prior research has focused on national contexts for either mineral or petroleum. In the US in the late 1970s, oil and gas firms were required to adopt reserve recognition accounting (RRA), but despite the reported benefits of RRA the requirements were reduced a few years later and a standardized measure related to the value of proved oil and gas reserves was introduced. The US context comprises detailed disclosure requirements regarding reserves and the rich data availability constituted the basis for research studies over many years. Overall, the results are mixed, but RRA and the value relevance of reserves disclosures have been shown to have significant impact in many studies, including the more recent studies where, for example, model misspecifications in prior studies have been addressed. With regard to future research, the potential effects of assurance on the reporting of reserves is an area that is relatively unexplored. Reserve disclosures are essential for understanding the financial position of EI firms and are subject to a high degree of uncertainty due to their subjective nature. Yet we know little about the factors that affect the quality and credibility of reported reserves including the effect of the Competent Person on the quality of the disclosures or their value relevance, which is surprising given the levels

of uncertainty involved in estimating the quantity and grade of the reserves and resources. In addition, there is no evidence on how analysts use reserve disclosures, an issue which could be addressed in future studies. We also encourage future research on reserve disclosures to extend existing research internationally and to consider outcomes such as the probability or magnitude of reserve misstatements. There is limited evidence on the economic consequences of misstatements and whether institutional factors, assurance services, market pressures, or regulatory intervention mitigate opportunistic reserve misstatements.

There is a large body of ESG research that investigates the recognition of environmental liabilities and compliance with environmental regulations. In general, the empirical studies made in different national contexts show material positive effects in response to increased regulation, in terms of compliance and value relevance. However, there are also studies pointing to the misuse of management discretion in connection, for example, with the use of discount rates when measuring the present value of the environmental liability. There are also many studies on voluntary ESG disclosures, where some relate extensive voluntary disclosures to signaling of compliance with environmental and tax laws, whereas other studies suggest that the extensive disclosures do not reflect a true commitment to improving environmental performance. While the majority of ESG studies explore the environmental reporting practices of EI firms, there is a limited understanding of reporting related to social and governance issues (e.g., the factors that affect disclosure, value-relevance of social and governance disclosure and performance). A specific area of interest is reporting on anti-corruption practices. EI firms would seem to be particularly prone to bribery due to large investments, intense regulation, and operations in high-risk countries. Although global efforts towards increased accountability and transparency such as the Extractive Industries Transparency Initiative (EITI) have had a positive effect on corruption disclosure and are of value it appears that companies operating in high corruption risk countries tend to report less. Moreover, mining firms provide less anti-corruption efforts disclosure than firms from other industries. Future research could explore in more detail the anti-corruption efforts and reporting of EI firms as well as compliance with transparency regulation and initiatives. Moreover, while recent evidence suggests that ESG disclosure and performance is relevant for investment purposes, our knowledge about the relevance of ESG disclosure and performance for lending decisions in the context of EI firms is limited and we encourage future studies to address this research gap. Future research could also provide more insights about the compensation schemes of executives of EI firms and

how they vary depending on the scope of firm's operations. A related question is whether environmental and social goals are incorporated in executive compensation contracts.

In general, our review of the empirical literature on the financial reporting of EI firms indicated that most of the studies on the topic are limited to the US, Canadian, Australian, South African and the UK settings. We encourage future research to investigate the financial reporting and disclosure practices of EI firms in other countries (e.g., Brazil, China, Russia, other European countries).

While the findings of the studies on related topics such as earnings management indicate that accounting choices of EI firms are associated with opportunistic incentives, we know very little about other practices that managers could employ to achieve their objectives, such as misstatements of reserve disclosures. Future studies could investigate whether reserve disclosures are manipulated for private benefits and if so, whether institutional factors, assurance services, market pressures, or regulatory intervention limit such behavior. Lastly, we currently know very little about the risk management strategies of EI firms and the factors that affect them. For example, although joint arrangements are very common for EI firms there is very limited research on this issue. Hence, future research could provide more evidence on the accounting choices that EI firms make in structuring and reporting such arrangements.

References

- Abdo, H. (2016), 'Accounting for Extractive Industries: Has IFRS 6 Harmonised Accounting Practices by Extractive Industries? ', *Australian Accounting Review*, Vol. 26, No. 4, pp. 346–359.
- Aerts, W. and D. Cormier (2009), 'Media Legitimacy and Corporate Environmental Communication', *Accounting, Organizations and Society*, Vol. 34, No. 1, pp. 1–27.
- Akamah, H., O. K. Hope and W. B. Thomas (2018), 'Tax Havens and Disclosure Aggregation', *Journal of International Business Studies*, Vol. 49, No. 1, pp. 49–69.
- Alciatore, M. L. (1993), 'New Evidence on SFAS No. 69 and the Components of the Change in Reserve Value', *The Accounting Review*, Vol. 68, No. 3, pp. 639–656.
- Alciatore, M., C. C. Dee, and P. Easton (2004), 'Changes in Environmental Regulation and Reporting: the Case of the Petroleum Industry from 1989 to 1998', *Journal of Accounting and Public Policy*, Vol. 23, No. 4, pp. 295–304.
- Al-Jabr, Y. and N. Spear (2004), 'Oil and Gas Asset Impairment by Full Cost and Successful Efforts Firms', *Petroleum Accounting and Financial Management Journal*, Vol. 23, No. 3, pp. 1–25.
- Asekomeh, A. O., A. Russell and H. Tarbert (2006), 'A Critical Analysis of the Use of Accounting Standards' Comment Letters as Lobbying Tools by Extractive Industry Firms', *Petroleum Accounting and Financial Management Journal*, Vol. 25, No. 3, pp. 55–76.
- Asekomeh, A. O., A. Russell, and H. Tarbert (2008), 'An Empirical Examination of Income Smoothing Intentions in Extractive Industry Firms', *Petroleum Accounting and Financial Management Journal*, Vol. 27, No. 1, 47–68.
- Barkemeyer, R., L. Preuss and L. Lee (2015), 'Corporate Reporting on Corruption: An International Comparison', *Accounting Forum*, Vol. 39, No. 4, pp. 349–365.
- Barker, R. (2000), 'FRS3 and Analysts' Use of Earnings', *Accounting and Business Research*, Vol. 30, No. 2, pp. 95–109.
- Barker, R. and S. Imam (2008), 'Analysts' Perceptions of 'Earnings Quality'', *Accounting and Business Research*, Vol. 38, No. 4, pp. 313–329.

Beattie, V. and M. J. Jones (2002), 'Measurement Distortion of Graphs in Corporate Reports: An Experimental Study', *Accounting, Auditing & Accountability Journal*, Vol. 15, No. 4, pp. 546–564.

Bell, T. B. (1983), 'Market Reaction to Reserve Recognition Accounting', *Journal of Accounting Research*, Vol. 21, No. 1, pp.1–17.

Benjamin, W. P., and J. E. McEnroe (1983) 'The SEC Overruling of SFAS 19 and the Behavior of Security Returns', *Journal of Business Finance & Accounting*, Vol. 10, No. 2, pp. 235–249.

Berry, K. T. and C. J. Wright (2001), 'The Value Relevance of Oil and Gas Disclosures: An Assessment of the Market's Perception of Firms' Effort and Ability to Discover Reserves', *Journal of Business Finance & Accounting*, Vol. 28, No. 5-6, pp. 741–769.

Bird, R., M. Grosse and D. Yeung (2013), 'The Market Response to Exploration, Resource and Reserve Announcements by Mining Companies: Australian Data', *Australian Journal of Management*, Vol. 38, No. 2, pp. 311–331.

Birt, J., M. Rankin and C. L. Song (2013), 'Derivatives Use and Financial Instrument Disclosure in the Extractives Industry', *Accounting & Finance*, Vol. 53, No. 1, pp. 55–83.

Boone, J. P. (1998), 'Oil and Gas Reserve Value Disclosures and Bid-ask Spreads', *Journal of Accounting and Public Policy*, Vol. 17, No. 1, pp. 55–84.

Boone, J. P. (2002), 'Revisiting the Reportedly Weak Value Relevance of Oil and Gas Asset Present Values: The roles of Measurement Error, Model Misspecification, and Time-period Idiosyncrasy', *The Accounting Review*, Vol. 77, No. 1, pp. 73–106.

Boone, J. P. and K. K. Raman (2007), 'Does Implementation Guidance Affect Opportunistic Reporting and Value Relevance of Earnings?', *Journal of Accounting and Public Policy*, Vol. 26, No. 2, pp. 160–192.

Boone, J. P., R. G. Luther and K. K. Raman (1998), 'Market Microstructure Effects of US-Canada Differences Relating to Reserve-based Accounting Disclosures', *Journal of International Accounting, Auditing and Taxation*, Vol. 7, No. 2, pp. 195–214.

Bouwman, M. J., P. A. Frishkoff and P. Frishkoff (1987), 'How do Financial Analysts Make Decisions? A Process Model of the Investment Screening Decision', *Accounting, Organizations and Society*, Vol. 12, No. 1, pp. 1–29.

Bradshaw, M. T. (2004) 'How Do Analysts Use Their Earnings Forecasts in Generating Stock Recommendations', *The Accounting Review*, Vol. 79, No. 1, pp. 25–50.

Brown, L. D., A. C. Call, M. B. Clement and N. Y. Sharp (2015) 'Inside the 'Black Box' of Sell-Side Financial Analysts', *Journal of Accounting Research*, Vol. 53, No. 1, pp. 1–47.

Brown, L. D., A. C. Call, M. B. Clement and N. Y. Sharp (2016) 'The Activities of Buy-Side Analysts and the Determinants of Their Stock Recommendations', *Journal of Accounting and Economics*, Vol. 62, No. 1, pp. 139–156.

Bryant, L. (2003), 'Relative value relevance of the successful efforts and full cost accounting methods in the oil and gas industry', *Review of Accounting Studies*, Vol. 8, No. 1, pp. 5–28.

Buccina, S., D. Chene and J. Gramlich (2013), 'Accounting for the Environmental Impacts of Texaco's Operations in Ecuador: Chevron's Contingent Environmental Liability Disclosures', *Accounting Forum*, Vol. 37, No. 2, pp. 110–123.

Byard, D., M. Hossain and S. Mitra (2007), 'US Oil Companies' Earnings Management in Response to Hurricanes Katrina and Rita', *Journal of Accounting and Public Policy*, Vol. 26, No. 6, pp. 733–748.

Cai, S., J. M. Godfrey and R. Moroney (2017), 'Impact of Segment-level Natural Resource Operational Risk Reporting on Earnings Predictions', *Abacus*, Vol. 53, No. 4, pp. 431–449.

Cannizzaro, A. P. and R. J. Weiner (2015), 'Multinational Investment and Voluntary Disclosure: Project-level Evidence from the Petroleum Industry', *Accounting, Organizations and Society*, No. 42, pp. 32–47.

Chen, K. C. and C. W. J. Lee (1995), 'Executive Bonus Plans and Accounting Trade-offs: The Case of the Oil and Gas Industry, 1985–86', *The Accounting Review*, Vol. 70, No. 1, pp. 91–111.

- Chen, X., S. Wright and H. Wu (2018), 'Exploration Intensity, Analysts' Private Information Development and Their Forecast Performance', *Accounting and Business Research*, Vol. 48, No. 1, pp. 77–107.
- Cho, C. H., J. C. Chen and R. W. Roberts (2008), 'The Politics of Environmental Disclosure Regulation in the Chemical and Petroleum Industries: Evidence from the Emergency Planning and Community Right-to-Know Act of 1986', *Critical Perspectives on Accounting*, Vol. 19, No. 4, pp. 450–465.
- Christensen, H. B., E. Floyd, L. Y. Liu and M. Maffett (2017), 'The Real Effects of Mandated Information on Social Responsibility in Financial Reports: Evidence from Mine-safety Records', *Journal of Accounting and Economics*, Vol. 64, No. 2–3, pp. 284–304.
- Chung, K. H., D. Ghicas and V. Pastena (1993), 'Lenders' Use of Accounting Information in the Oil and Gas Industry', *The Accounting Review*, Vol. 68, No. 4, pp. 885–895.
- Clarkson, P. M., M. B. Overell and L. Chapple (2011), 'Environmental Reporting and its Relation to Corporate Environmental Performance', *Abacus*, Vol. 47, No. 1, pp. 27–60.
- Clinch, G. and J. Magliolo (1992). Market Perceptions of Reserve Disclosures under SFAS No. 69', *The Accounting Review*, Vol. 67, No. 4, pp. 843–861.
- Coetzee, C. M. and C. J. Van Staden (2011), 'Disclosure Responses to Mining Accidents: South African Evidence', *Accounting Forum*, Vol. 35, No. 4, pp. 232–246.
- Collins, D. W. and W. T. Dent (1979), 'The Proposed Elimination of Full Cost Accounting in the Extractive Petroleum Industry: An Empirical Assessment of the Market Consequences', *Journal of Accounting and Economics*, Vol. 1, No. 1, pp. 3–44.
- Collins, D. W., M. S. Rozeff and D. S. Dhaliwal (1981), 'The Economic Determinants of the Market Reaction to Proposed Mandatory Accounting Changes in the Oil and Gas Industry', *Journal of Accounting and Economics*, Vol. 3, No. 1, pp. 37–71.
- Collins, D. W., M. S. Rozeff, and W. K. Salatka (1982), 'The SEC's Rejection of SFAS No. 19: Tests of Market Price Reversal', *The Accounting Review*, Vol. 57, No. 1, pp. 1–17

Comyns, B. and F. Figge (2015), 'Greenhouse Gas Reporting Quality in the Oil and Gas Industry: A longitudinal Study Using the Typology of 'Search', 'Experience' and 'Credence' Information', *Accounting, Auditing & Accountability Journal*, Vol. 28, No. 3, pp. 403–433.

Connor, J. E. (1979), 'Reserve Recognition Accounting: Fact or Fiction?', *Journal of Accountancy*, Vol. 148, No. 000003, pp. 92–99. I

Cormier, D. and M. Magnan (1997), 'Investors' Assessment of Implicit Environmental Liabilities: An Empirical Investigation', *Journal of Accounting and Public Policy*, Vol. 16, No. 2, pp. 215–241.

Cormier, D., and M. Magnan (2002), 'Performance Reporting by Oil and Gas firms: Contractual and Value Implications', *Journal of International Accounting, Auditing and Taxation*, Vol. 11, No. 2, pp. 131–153.

Cortese, C. L., H. J. Irvine and M. A. Kaidonis (2009), 'Extractive Industries Accounting and Economic Consequences: Past, Present and Future', *Accounting Forum*, Vol. 33, No. 1, pp. 27–37.

Cortese, C. L., H. J. Irvine and M. A. Kaidonis (2010), 'Powerful Players: How Constituents Captured the Setting of IFRS 6, an Accounting Standard for the Extractive Industries', *Accounting Forum*, Vol. 34, No. 2, pp. 76–88.

Costabile, M., S. Soltys and N. Spear (2012), 'The Market Implications of Earnings and Reserve Surprises', *Petroleum Accounting and Financial Management Journal*, Vol. 31, No. 1, pp. 57–76.

Craswell, A. T. and S. L. Taylor (1992), 'Discretionary Disclosure of Reserves by Oil and Gas Companies: an Economic Analysis', *Journal of Business Finance & Accounting*, Vol. 19, No. 2, pp. 295–308.

Deakin, E. B. (1989). Rational Economic Behavior and Lobbying on Accounting Issues: Evidence from the Oil and Gas Industry. *The Accounting Review*, Vol. 64, No. 1, pp. 137–151.

De Villiers, C. and C. J. van Staden (2006), 'Can Less Environmental Disclosure Have a Legitimising Effect? Evidence from Africa', *Accounting, Organizations and Society*, Vol. 31, No. 8, pp. 763–781.

De Villiers, C. and D. Alexander (2014), 'The Institutionalisation of Corporate Social Responsibility Reporting', *The British Accounting Review*, Vol. 46, No. 2, pp. 198–212.

Deegan, C. and C. Blomquist (2006), 'Stakeholder Influence on Corporate Reporting: An Exploration of the Interaction between WWF-Australia and the Australian Minerals Industry', *Accounting, Organizations and Society*, Vol. 31, No. 4–5, pp. 343–372.

Dharan, B. G. (1984), 'Expectation Models and Potential Information Content of Oil and Gas Reserve Value Disclosures', *The Accounting Review*, Vol. 59, No. 2, pp. 199–217.

Dharan, B. G., and B. Mascarenhas (1992), 'Determinants of Accounting Change: An Industry Analysis of Depreciation Change', *Journal of Accounting, Auditing & Finance*, Vol. 7, No. 1, pp. 1–21.

Donker, H., A. Ng and K. Rai (2006), 'Proved or Probable Oil Reserves: Does it Matter? An Empirical Study on Canadian Oil and Gas Companies', *Petroleum Accounting and Financial Management Journal*, Vol. 25, No. 3, pp. 94–102.

Doran, B. M., D. W. Collins and D. S. Dhaliwal (1988), 'The Information of Historical Cost Earnings Relative to Supplemental Reserve-based Accounting Data in the Extractive Petroleum Industry', *The Accounting Review*, Vol. 63, No.3, pp. 389–413.

Dyckman, T. R., & A. J. Smith (1979), 'Financial Accounting and Reporting by Oil and Gas Producing Companies: A Study of Information Effects', *Journal of Accounting and Economics*, Vol. 1, No. 1, pp. 45–75.

E&Y (2005), *How Fair is Fair Value?* IFRS Stakeholder Series. E&Y.

Economist (2018), 'Too much in the tank: why investors in oil firms should worry about climate change', *The Economist*, August 11–17, p. 52.

Floyd, E. and J. A. List (2016), 'Using Field Experiments in Accounting and Finance', *The Journal of Accounting Research*, Vol. 54, No. 2, pp. 437–475.

Freedman, M. and B. Jaggi (2005), 'Global Warming, Commitment to the Kyoto Protocol, and Accounting Disclosures by the Largest Global Public Firms from Polluting Industries', *The International Journal of Accounting*, Vol. 40, No. 3, pp. 215–232.

Frost, G. R. (2007), 'The Introduction of Mandatory Environmental Reporting Guidelines: Australian Evidence', *Abacus*, Vol. 43, No. 2, pp. 190–216.

Frost, C. A., and V. L. Bernard (1989), 'The Role of Debt Covenants in Assessing the Economic Consequences of Limiting Capitalization of Exploration Costs', *The Accounting Review*, Vol. 64, No. 4, pp. 788–808.

Gallery, G. and J. Nelson (2008), 'The Reliability of Mandatory Cash Expenditure Forecasts Provided by Australian Mining Exploration Companies in Quarterly Cash Flow Reports', *Accounting Research Journal*, Vol. 21, No. 3, pp. 263–287.

Gamble, G. O., K. Hsu, D. Kite and R. R. Radtke (1995), 'Environmental Disclosures in Annual Reports and 10Ks: An Examination', *Accounting Horizons*, Vol. 9, No. 3, pp. 34–54.

Gerhardy, P. G. (1999), 'Accounting for Pre-production Costs: Extracting Consensus', *Australian Accounting Review*, Vol. 9, No. 18, pp. 51–63.

Gianfrate, G. (2017), 'All that Glitters: Gold Mining Companies' Market Reaction at the Issuance of the "All-in Sustaining Costs" Guidance', *Journal of Accounting and Public Policy*, Vol. 36, No. 6, pp. 468–476.

Ghicas, D. and V. Pastena, V. (1989), 'The Acquisition Value of Oil and Gas Firms: The Role of Historical Costs, Reserve Recognition Accounting, and Analysts' Appraisals', *Contemporary Accounting Research*, Vol. 6, No. 1, pp. 125–142.

Godfrey, J. M. and B. Yee (1996), 'Mining Sector Currency Risk Management Strategies: Responses to Foreign Currency Accounting Regulation', *Accounting and Business Research*, Vol. 26, No. 3, pp. 200–214.

Gorton, D. E. (1991), 'The SEC Decision Not to Support SFAS 19: A Case Study of the Effect of Lobbying on Standard Setting', *Accounting Horizons*, Vol. 5, No. 1, pp. 29–41

Hall, S. C. (1993), 'Political Scrutiny and Earnings Management in the Oil Refining Industry', *Journal of Accounting and Public Policy*, Vol. 12, No. 4, pp. 325–351.

Han, J. C. and S. W. Wang (1998), 'Political Costs and Earnings Management of Oil Companies during the 1990 Persian Gulf Crisis', *The Accounting Review*, Vol. 73, No. 1, pp. 103–117.

Hardy, M. and G. R. Frost (2001), 'Corporate Reporting and Urgent Issues Group Abstracts: The Impact of UIG 4 on the Australian Extractive Industries', *Australian Accounting Review*, Vol. 11, No. 23, pp. 15–25.

Heflin, F. and D. Wallace (2017), 'The BP Oil Spill: Shareholder Wealth Effects and Environmental Disclosures', *Journal of Business Finance & Accounting*, Vol. 44, No. 3–4, pp. 337–374.

Hellman, N., P. Andersson and E. Fröberg (2016), 'The Impact of IFRS Goodwill Reporting on Financial Analysts' Equity Valuation Judgements: Some Experimental Evidence', *Accounting & Finance*, Vol. 56, No. 1, pp. 113–157.

Hellman, N., S. J. Gray, R. D. Morris and A. Haller (2015), 'The Persistence of International Accounting Differences as Measured on Transition to IFRS', *Accounting and Business Research*, Vol. 45, No. 2, pp. 166–195.

Herbohn, K., J. Walker and H. Y. M. Loo (2014), 'Corporate Social Responsibility: The Link between Sustainability Disclosure and Sustainability Performance', *Abacus*, Vol. 50, No. 4, pp. 422–459.

IASB (2010), *IFRS Staff Paper on Research Programme: Research Update*. IASB Agenda Ref 8. July 2016.

IASB (2016), *Extractive Activities. IASB Discussion Paper DP/2010/1*. Prepared for the IASB by the following staff of the national accounting standard-setters Australia, Canada, Norway and South Africa: Glenn Brady, Riaan Davel, Sue Ludolph, Aase Lundgaard, Joanna Spencer, Mark Walsh.

IASC (2000), *Extractive Industries Issues Paper*. IASC Steering Committee on Extractive Industries, IASC.

Imam, S. and C. Spence (2016), 'Context, not Predictions: A Field Study of Financial Analysts', *Accounting, Auditing & Accountability Journal*, Vol. 29, No. 2, pp. 226–247.

Islam, M. A., S. Haque and R. Roberts (2017), 'Human Rights Performance Disclosure by Companies with Operations in High Risk Countries: Evidence from the Australian Minerals Sector', *Australian Accounting Review*, Vol. 27, No. 1, pp. 34–51.

- Jaafar, A. and S. McLeay (2007), 'Country Effects and Sector Effects on the Harmonization of Accounting Policy Choice', *Abacus*, Vol. 43, No. 2, pp. 156–189.
- Jain, P. (1983), 'The Impact of Accounting Regulation on the Stock Market: The Case of Oil and Gas Companies: A Further Analysis', *The Accounting Review*, Vol. 58, No. 3, pp. 633– 638.
- Jones, M. J. (2011), 'The Nature, Use and Impression Management of Graphs in Social and Environmental Accounting', *Accounting Forum*, Vol. 35, No. 2, pp. 75–89.
- Kadan, O., L. Madureira, R. Wang and T. Zach (2012), 'Analysts' Industry Expertise', *Journal of Accounting and Economics*, Vol. 54, No. 1, pp. 95–120.
- Kennedy, D. T. and Y. H. Hyon (1992), 'Do RRA Earnings Improve the Usefulness of Reported Earnings in Reflecting the Performance of Oil and Gas Producing Firms?', *Journal of Accounting, Auditing & Finance*, Vol. 7, No. 3, pp. 335–356.
- KPMG (2017), *IFRS Compared to US GAAP*. KPMG.
- Kross, W. (1982), 'Stock Returns and Oil and Gas Pronouncements: Replication and Extension', *Journal of Accounting Research*, Vol. 20, No.2, pp. 459–471.
- Latham, M. (2009), 'Environmental Liabilities and the Federal Securities Laws: A Proposal for Improved Disclosure of Climate Change-related Risks', *Environmental Law*, Vol. 39, No. 3, pp. 647–728.
- Lauwo, S. and O. J. Otusanya (2014), 'Corporate Accountability and Human Rights Disclosures: A Case Study of Barrick Gold Mine in Tanzania', *Accounting Forum*, Vol. 38, No. 2, pp. 91–108.
- Lauwo, S. G., O. J. Otusanya and O. Bakre (2016), 'Corporate Social Responsibility Reporting in the Mining Sector of Tanzania: (Lack of) Government Regulatory Controls and NGO Activism', *Accounting, Auditing & Accountability Journal*, Vol. 29, No. 6, pp. 1038–1074.
- Lev, B. (1979), 'The Impact of Accounting Regulation on the Stock Market: The Case of Oil and Gas Companies', *The Accounting Review*, Vol. 54, No. 3, pp. 485–503.
- Li, Y. and B. J. McConomy (1999), 'An Empirical Examination of Factors Affecting the Timing of Environmental Accounting Standard Adoption and the Impact on Corporate Valuation', *Journal of Accounting, Auditing & Finance*, Vol. 14, No. 3, pp. 279–313.

Luther, R. (1996), 'The Development of Accounting Regulation in the extractive industries: An International Review', *The International Journal of Accounting*, Vol. 31, No.1, pp. 67–93.

Luther, R. (1998), 'The Development of Fixed Asset Accounting in South African Gold Mining Companies: Confronting the Issues of Prudence, Matching, Periodicity and Capital Maintenance', *Accounting and Business Research*, Vol. 28, No. 4, pp. 281–295.

Lys, T. (1984), 'Mandated Accounting Changes and Debt Covenants: The Case of Oil and Gas Accounting', *Journal of Accounting and Economics*, Vol. 6, No. 1, pp. 39–65.

Magliolo, J. (1986), 'Capital Market Analysis of Reserve Recognition Accounting', *Journal of Accounting Research*, Vol. 24, Supplement, pp. 69–108.

Malone, D., C. Fries and T. Jones (1993), 'An Empirical Investigation of the Extent of Corporate Financial Disclosure in the Oil and Gas Industry', *Journal of Accounting, Auditing & Finance*, Vol. 8, No. 3, pp. 249–273.

Meek, G. K., C. B. Roberts and S. J. Gray (1995), 'Factors Influencing Voluntary Annual Report Disclosures by U.S., U.K. and Continental European Multinational Corporations', *Journal of International Business Studies*, Vol. 26, No. 3, pp. 555–572.

Mirza, M. and I. Zimmer (1999), 'Recognition of Reserve Values in the Extractive Industries', *Australian Accounting Review*, Vol. 9, No. 18, pp. 44–50.

Mirza, M. and I. Zimmer (2001), 'Disclosure of Reserve Quantum in the Extractive Industries', *Accounting & Finance*, Vol. 41, No. 1-2, pp. 63–91.

Mitnick, B. M. (1980), *The Political Economy of Regulation: Creating, Designing and Removing Regulatory Forms*. New York, USA: Columbia University Press.

Mohrman, M. B. (1993), 'Debt Contracts and FAS No. 19: A Test of the Debt Covenant Hypothesis', *The Accounting Review*, Vol 68, No. 2, pp. 273–288.

Monem, R. M. (2003), 'Earnings Management in Response to the Introduction of the Australian Gold Tax', *Contemporary Accounting Research*, Vol. 20, No. 4, pp. 747–774.

Moses, O., M. N. Houqe and T. van Zijl (2018), 'What is the Economic Value of the Extractive Industries Transparency Initiative (EITI) Information Disclosure?', *Journal of Contemporary Accounting & Economics*, Vol. 14, No. 2, pp. 216–233.

Nichols, L. M. (2007), 'An Updated Look at the Oil Industry and International Harmonization of Accounting Standards', *Petroleum Accounting and Financial Management Journal*, Vol. 26, No. 3, pp. 123– 139.

Nichols, L. H. (2013), 'The Future of Transparency Disclosures', *Petroleum Accounting and Financial Management Journal*, Vol. 32, No. 3, pp. 93–100.

Nobes, C. W. (2013), 'The Continued Survival of International Differences under IFRS', *Accounting and Business Research*, Vol. 43, No. 2, pp. 83–111.

Nobes, C. W. and C. Stadler (2012), *The Determinants of IFRS Policy Choice*. Working Paper presented at the European Accounting Association conference, May, Ljubljana.

Nobes, C. W. and C. Stadler (2013), 'How Arbitrary are International Accounting Classifications? Lessons from Centuries of Classifying in Many Disciplines, and Experiments with IFRS Data', *Accounting, Organizations and Society*, Vol. 38, No. 8, pp. 573–595.

Noël, C., A. G. Ayayi and V. Blum (2010), 'The European Union's Accounting Policy analyzed from an Ethical Perspective: The Case of Petroleum Resources, Prospecting and Evaluation', *Critical Perspectives on Accounting*, Vol. 21, No. 4, pp. 329–341.

O'Donovan, G. (2002), 'Environmental Disclosures in the Annual report: Extending the Applicability and Predictive Power of Legitimacy Theory', *Accounting, Auditing & Accountability Journal*, Vol. 15, No. 3, pp.344–371.

Odo, C., W. Ani, P. Obialor and D. Ugwunta (2016), 'To What Extent Do United Kingdom Companies Provide Oil and Gas Reserves Information Sufficient to Satisfy Statement of Recommended Practice Requirements?', *Australian Accounting Review*, Vol. 26, No. 1, pp. 34–44.

Olsen, G. T., W. J. Lee and T. Blasingame (2011), 'Reserves Overbooking: The Problem we're Finally Going to Talk About', *SPE Economics & Management*, Vol. 3, No. 2, pp. 68–78.

Otusanya, O. J. (2011), 'The Role of Multinational Companies in Tax Evasion and Tax Avoidance: The Case of Nigeria', *Critical Perspectives on Accounting*, Vol. 22, No. 3, pp. 316–332.

Patatoukas, P. N., R. G. Sloan, and J. Zha (2015), 'On the Pricing of Mandatory DCF Disclosures: Evidence from Oil and Gas Royalty Trusts', *The Accounting Review*, Vol. 90, No. 6, pp. 2449–2482.

Paton, W.A. and Littleton, A.C. (1940), *An Introduction to Corporate Accounting Standards*. American Accounting Association.

Patten, D. M. (2005), 'The Accuracy of Financial Report Projections of Future Environmental Capital Expenditures: A Research Note', *Accounting, Organizations and Society*, Vol. 30, No. 5, pp. 457–468.

Patten, D. M. and J. R. Nance (1998), 'Regulatory Cost Effects in a Good News Environment: The Intra-industry Reaction to the Alaskan Oil Spill', *Journal of Accounting and Public Policy*, Vol. 17, No. 4–5, pp. 409–429.

Pincus, M. and S. Rajgopal (2002), 'The Interaction between Accrual Management and Hedging: Evidence from Oil and Gas Firms', *The Accounting Review*, Vol. 77, No. 1, pp. 127–160.

Power, S. B., P. Clear and R. Donnelly (2017), 'Accounting in the London Stock Exchange's Extractive Industry: The Effect of Policy Diversity on the Value Relevance of Exploration-Related Disclosures', *The British Accounting Review*, Vol. 49, No. 6, pp. 545-559.

PwC (2012), *Financial Reporting in the Mining Industry. International Financial Reporting Standards*. PwC.

PwC (2017), *Financial Reporting in the Oil and Gas Industry. International Financial Reporting Standards*, PwC.

Quirin, J. J., K. T. Berry and D. O'Brien (2000), 'A Fundamental Analysis Approach to Oil and Gas Firm Valuation', *Journal of Business Finance & Accounting*, Vol. 27, No. 7–8, pp. 785–820.

Rajgopal, S. (1999), 'Early Evidence on the Informativeness of the SEC's Market Risk Disclosures: The Case of Commodity Price Risk Exposure of Oil and Gas Producers', *The Accounting Review*, Vol. 74, No. 3, pp. 251–280.

Raman, K. K. and N. Tripathy (1993), 'The Effect of Supplemental Reserve-based Accounting Data on the Market Microstructure', *Journal of Accounting and Public Policy*, Vol. 12, No. 2, pp. 113–133.

Rogers, G. and C. Atkins (2015), 'Accounting for Oil and Gas Environmental Liabilities in Bankruptcy', *Petroleum Accounting and Financial Management Journal*, Vol. 34, No. 2, pp. 26–54.

Schneider, T., G. Michelon and M. Maier (2017), 'Environmental Liabilities and Diversity in Practice under International Financial Reporting Standards', *Accounting, Auditing & Accountability Journal*, Vol. 30, No. 2, pp. 378–403.

Shell Says Overstated Reserves Led to Exaggerated Profits. (2004, July 3). The New York Times. Retrieved from <https://www.nytimes.com/2004/07/03/business/shell-says-overstated-reserves-led-to-exaggerated-profits.html>

Smith, A. J. (1981), 'The SEC 'Reversal' of FASB Statement No. 19: An Investigation of Information Effects'. *Journal of Accounting Research*, Vol. 19, Supplement, pp. 174–211

Spear, N. A. (1994), 'The Stock Market Reaction to the Reserve Quantity Disclosures of US Oil and Gas Producers', *Contemporary Accounting Research*, Vol., 11, No. 1, pp. 381–404.

Spear, N. A. (1996), 'The Market Reaction to the Reserve-based Value Replacement Measures of Oil and Gas Producers', *Journal of Business Finance & Accounting*, Vol. 23, No. 7, pp. 953–974.

Street, D. (2008), 'The Impact in the United States of Global Adoption of IFRS', *Australian Accounting Review*, Vol. 18, No. 3, pp. 199–208.

Taylor, G. and G. Tower (2011), 'Determinants of Financial Ratio Disclosure Patterns of Australian Listed Extractive Companies', *Australian Accounting Review*, Vol. 21, No. 3, pp. 302–314.

Taylor, G., G. Richardson, G. Tower and P. Hancock (2012), 'The Determinants of Reserves Disclosure in the Extractive Industries: Evidence from Australian Firms', *Accounting & Finance*, Vol. 52, pp. 373–402.

Taylor, G., G. Tower and M. Van Der Zahn (2011), 'The Influence of International Taxation Structures on Corporate Financial Disclosure Patterns', *Accounting Forum*, Vol. 35, No. 1, pp. 32–46.

Teall, H. D. (1992), 'Information Content of Canadian Oil and Gas Companies' Historic Cost Earnings and Reserves Disclosures', *Contemporary Accounting Research*, Vol. 8, No. 2, pp. 561–579.

The World Bank (2018), New Satellite Data Reveals Progress: Global Gas Flaring Declined in 2017. Retrieved from <http://www.worldbank.org/en/news/press-release/2018/07/17/new-satellite-data-reveals-progress-global-gas-flaring-declined-in-2017>

Thornton, D. B. and M. Welker (2004), 'The Effect of Oil and Gas Producers' FRR No. 48 Disclosures on Investors' Risk Assessments', *Journal of Accounting, Auditing & Finance*, Vol. 19, No. 1, pp. 85–114.

Tilt, C. A. (1997), 'Environmental Policies of Major Companies: Australian Evidence', *British Accounting Review*, Vol. 29, No. 4, pp. 367–394.

Tilt, C. A. and C. F. Symes (1999), 'Environmental Disclosure by Australian Mining Companies: Environmental Conscience or Commercial Reality?', *Accounting Forum*, Vol. 23, No. 2, pp. 137–154.

Transparency International (2011), Bribe Payers Index 2011. Retrieved from https://www.transparency.org/whatwedo/publication/bpi_2011

van Duuren, E., A. Plantinga and B. Scholtens (2016), 'ESG Integration and the Investment Management Process: Fundamental Investing Reinvented', *Journal of Business Ethics*, Vol. 138, No. 3, pp. 525–533.

Walker, R. G. (1987), 'Australia's ASRB: A Case Study of Political Activity and Regulatory Capture'. *Accounting and Business Research*, 17(67), 269–286.

Watts, R. L. and J. L. Zimmerman (1978), 'Towards a Positive Theory of the Determination of Accounting Standards', *The Accounting Review*, Vol. 53, No. 1, pp. 112–134.

Yongvanich, K. and J. Guthrie (2005), 'Extended Performance Reporting: An Examination of the Australian Mining Industry', *Accounting Forum*, Vol. 29, No. 1, pp. 103–119.

Figures

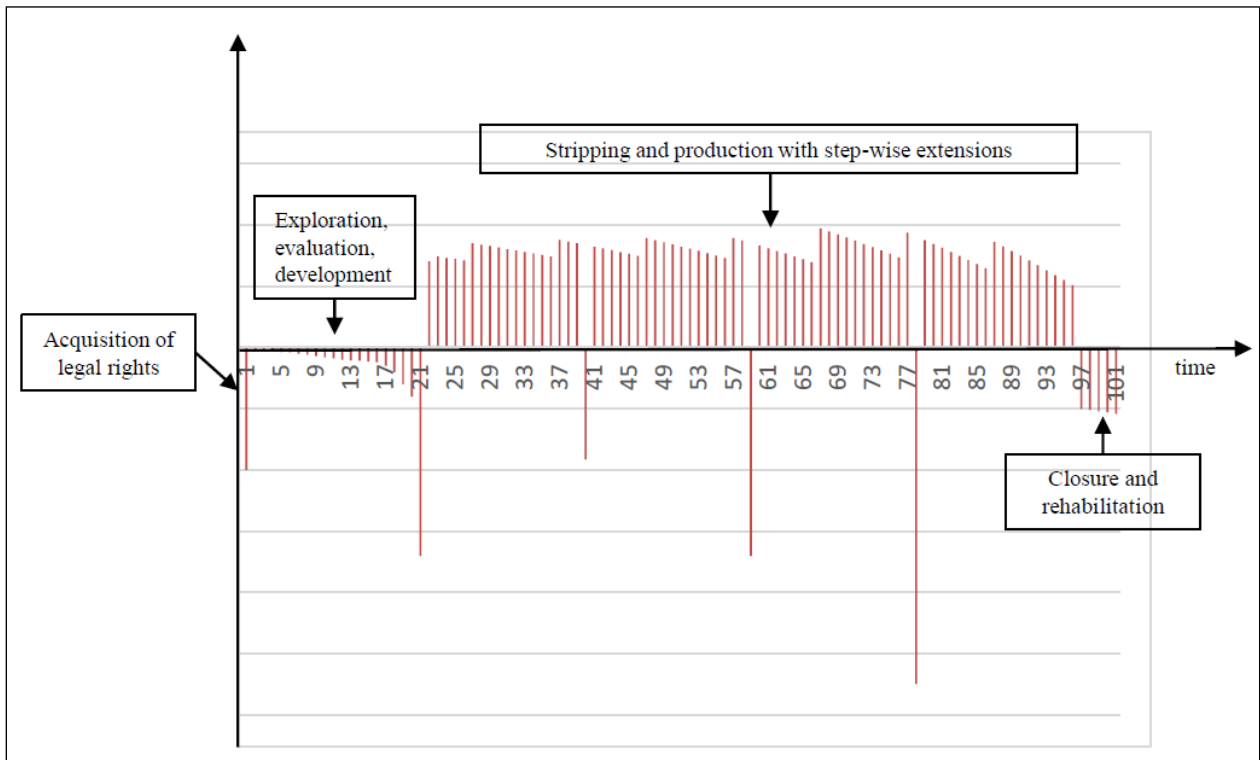


Figure 1. Illustrative example of the expected net cash flow pattern of a 100-year mining project.



Figure 2. Iron ore prices from 1900 to 2010. Example of price variation in extractive industries.

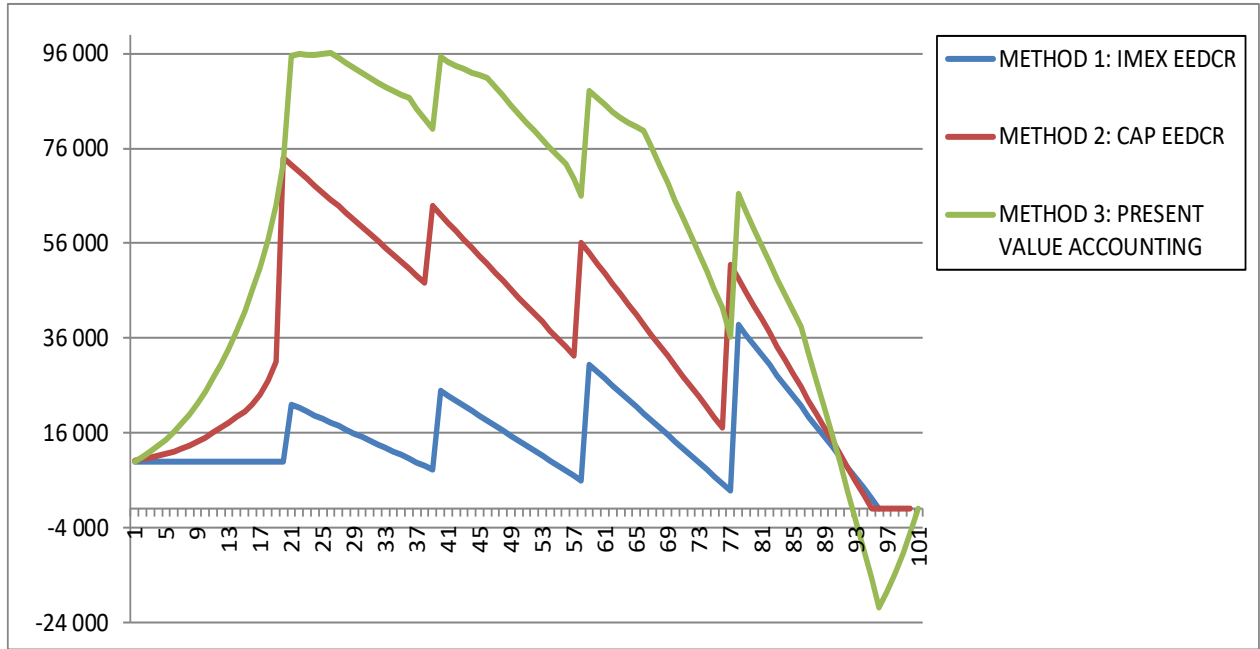


Figure 3. Carrying amounts based on the expected net cash flow pattern of a 100-year mining project under three accounting methods: (1) Present value accounting, (2) Capitalization and amortization of exploration, evaluation, development and closure/rehabilitation, and (3) Immediate expensing of exploration, evaluation, development and closure/rehabilitation. The production phase is capitalized and amortized in all three alternatives.

