Disclosure of reserves in the annual reports of Australian mining and petroleum firms

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Abstract

This article investigates why some firms in the extractive industries disclose mineral reserves in their annual reports and others do not. It uses an efficient contracting framework to propose that the firm’s disclosure policies are likely to be driven by the constraints of contracts with claimants. Managers adopt the policies that minimize the cost of contracting with claimants. A firm’s decision to disclose reserves in the annual report is likely to depend on its asset structure, debt financing, and the firm’s monitoring process. The determinants of reserve disclosure are hypothesized to be the stage of the firm’s growth, use of project financing, and the use of a quality auditor. Empirical tests indicate that, for the sample firms, the stage of growth and project financing are significant. Further, large firms are more likely to disclose reserves compared to their smaller counterparts. © 2000 Elsevier Science Inc. All rights reserved.

1. Introduction

This article investigates why firms in the extractive industries disclose their reserves in annual reports. It poses the question as to what incentives exist for managers to report reserves in spite of the need for maintaining confidentiality. It examines the determinants of disclosure of reserve quantum in the firm’s annual report.

The article uses an efficient contracting framework and assumes that the firm’s disclosure policies are likely to be driven by the constraints of contracts with claimants. Earlier studies show that the idea of the use of accounting data as a nexus of contracts can apply to
supplemental data in addition to financial statement information (Alciatore, 1994, p. 53). Managers adopt a set of policies that minimize the cost of contracting with claimants.

Managers of firms in the extractive industries are faced with a trade-off between information asymmetry costs on the one hand and proprietary costs of disclosure on the other. The former costs concern reporting of the firm’s mineral reserves. The disclosure is likely to lead to reduce the firm’s cost of equity and debt. Proprietary costs include the harmful reactions of competitors and the costs of potential legal liability. Disclosure of proprietary information is likely to cause a decline in the firm’s value. Therefore, managers aim to achieve an optimum level of disclosure in the firm’s annual report.

A majority of prior studies have examined the reliability and relevance of disclosure of oil and gas reserves by the US firms (Alciatore, 1990). This study differs from the previous studies. It examines the incentives of the managers of Australian mining and petroleum firms to disclose reserve quantum in their annual reports.

The article proceeds as follows. Section 2 outlines the regulatory requirements in the US, Canada, the UK, and Australia. Section 3 summarizes prior research. Section 4 develops hypotheses for disclosure of reserve quantum in the firms’ annual reports. Sections 5 and 6 are devoted to research design and analysis of results. Section 7 presents a summary of the article.

2. Disclosure regulation

No requirement for disclosure of reserves currently exists in Canada and in South Africa. In the UK, the Oil Industry Accounting Committee of the Institute of Chartered Accountants in England and Wales Oil Industry Accounting Committee has issued four statements of recommended practice (SORP). One statement in particular recommends disclosure of quantum of proved reserves, together with the change in the year. However, Luther (1994, p. 17) reports that the statements are not mandatory and the requirement to disclose physical reserves is not complied with. In the US, the Financial Accounting Standards Board in November 1982 issued Statement of Financial Accounting Standards No. 69, “Disclosures about oil and gas producing activities.” The Statement requires the supplementary disclosure about proved oil and gas reserve quantities (paragraphs 10–17) and their standardized measure of discounted future net cash flows (paragraphs 30–34).

In Australia, neither the professional accounting standards nor the Corporations Law require mining and oil and gas firms to disclose reserves quantum. The Australian Accounting Standards Board AAS 7 (Public Sector Accounting Standards Board, 1989) and AASB 1022 (Australian Accounting Standards Board, 1989), “Accounting for the Extractive Industries” recommend amortizing capitalized pre-production costs on the basis of depletion of “economically recoverable reserves,” yet there is no mention of disclosure of such reserves. In July 1989, the Australian Stock Exchange (ASX) incorporated the Australasian Institute of Mining and Metallurgy Code for reporting of ore reserves in its listing rules (4) to (12) of Section 3M. Over time, the requirements have been extended to oil

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2 The Code was issued in February 1989 by the Joint Committee of the Australasian Institute of Mining and Metallurgy and the Australian Mining Industry Council.
and gas firms’ reserves also (rule 3M (8)). The ASX does not necessarily require disclosure of the quantum of mineral reserves. Its listing rules state that when a firm reports reserve quantity, it should report them in a format specified by the AusIMM Code (Australian Stock Exchange, 1992). Further, Corporations Law and not the ASX prescribes the minimum requirements of disclosure in the annual report. In the case of reserves, the law does not require disclosure. In other words, disclosure of mineral reserves in the firm’s annual report is voluntary. In the absence of regulation, firm managers have discretion to choose reporting policies that best suit their particular environments. These policies are likely to be influenced by the firm’s contracting and proprietary costs of disclosure.

3. Prior research

There are a number of issues regarding relevance and choice of mineral reserve disclosure that have been addressed in accounting literature. These include (a) whether reserves quantity estimates have incremental information content and (b) what the incentives are for firm’s management to disclose reserve estimates. Although prior literature focuses on oil and gas firms, its conclusions are equally relevant to mining firms, due to the similarities of operations in the two sectors. A majority of studies focus on the oil and gas industry in the US where the Securities and Exchange Commission (SEC), via ASR Nos. 253 and 269 and the Financial Accounting Standards Board, via SFAS Nos. 19 and 69 regulate disclosure of oil and gas reserves. The US studies investigate the impact of reserve quantity disclosures on share prices. A Canadian study deals with the contribution of the disclosure to earnings per share disclosure. An Australian study investigates the determinants of managers’ choice to disclose oil and gas reserve quantity.

A study by Bell (1983, p. 2) investigates stock market reaction to the first public disclosures of RRA information required by the US SEC’s ASR No. 253 (1978) and whether investors reacted to RRA reserve value estimates in spite of their imprecision. The sample of the study consists of 51 firms that disclosed 1978 RRA data on a Form 8 required by the SEC and 21 control firms. Abnormal stock returns behavior over a 26-day period (days −5 to +20) surrounding the disclosure date (day 0) for each sample firm is investigated. The results show that a majority (37 out of 51) of the firms experienced positive cumulative abnormal returns near the RRA disclosure date.

The Clinch and Magliolo (1990, p. 4) study maintains that proved reserves are often derived from production data and that, unlike proved reserves, production is observable and no assumptions are required to determine it. The study focuses on the cross-sectional association between implied market reserve estimates embedded in oil price response coefficients and the firms’ reserve disclosures. It addresses two questions: (a) which of the

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3 According to Heazlewood (1980), the reason for confining regulation to disclosure of oil and gas reserves was largely political. The focus of regulation on oil and gas reserves was due mainly to “the time constraint imposed by the Energy Policy and Conservation Act (2 years)” on the Financial Accounting Standards Board (1982, p. 14).

4 The RRA measure is described by Bell (1983, p. 1) as similar to the standardized measure of discounted future net cash flows related to proved reserves.
three reserve quantity disclosures are used by investors in the valuation of oil and gas firms: proved reserves, proved developed reserves or current production; and (b) whether the association between market valuation and firms’ reserve quantity disclosures differs across firms according to characteristics of the disclosed data.

For the first question, the authors examine reserve quantity disclosures. In relation to the second question, they investigate whether reliance on disclosures differs for the size and direction of reserve estimate revisions and for the ratio of proved developed reserves to proved reserves. For the first question, the authors examine reserve quantity disclosures. In relation to the second question, they investigate whether reliance on disclosures differs for the size and direction of reserve estimate revisions and for the ratio of proved developed reserves to proved reserves. For a sample of 86 oil and gas firms.

Yearly cross-sectional multiple regressions of estimated oil price response coefficients are performed on reported production, proved reserves, and proved developed reserves. The results indicate that, in 3 of the 4 years and for the complete 4-year period, oil price response coefficients are significantly associated with reported production numbers. There is no significant incremental relation between oil price response coefficients and proved reserves or proved developed reserves in any of the 4 years (Clinch & Magliolo, 1990, p. 6). The authors conclude that estimates of proved and proved developed reserves generally do not provide additional value-relevant information to market participants once production is known.

A study by Teall (1992) examines the incremental information content of historic capitalized costs, reserve quantities, and discounted cash flows, to that provided by earnings per share. The author uses the annual reports for the years 1983–1987 of 67 Canadian oil and gas firms. Multiple regression analysis is performed to evaluate the extent to which each of the three alternative reserve disclosures account for common stock returns after first recognizing the information provided by earnings per share. The independent variables used are: percentage change in the capitalized costs balance of reserves, percentage change in the proved quantities of equivalent barrels of reserves, percentage change in the discounted cash flow balance of reserves, and a dummy variable designating full-cost firms as 1 and successful-efforts firms as 0. The results show that for the yearly data, the addition of the reserve variable causes a significant incremental increase in the adjusted $R^2$. Each of the results of the 5 individual years shows some evidence of information content, however, the evidence is not consistently significant. The results for any one variable are not consistent throughout the analyses of each of the 5 years. Only in 1 year, 1987, do all the three reserve disclosures provide significant results (Teall, 1992, p. 573). The results of the pooled 5-year analysis show that capitalized costs, quantities, and discounted cash flows all provide incremental information content.

The Craswell and Taylor (1992, p. 295) study claims that the firm’s decision to disclose oil and gas reserves is aimed at reducing the agency costs faced by the various contracting parties. It investigates five variables that are likely to influence managers’ choice to disclose reserve quantity estimates, e.g., leverage, cash flow risk, separation of ownership and control, firm size, and auditor identity. The sample for the study consists of 96 firms listed on the Sydney Stock Exchange at the end of 1984.

Footnote 5: Clinch and Magliolo (1990, p. 4) define a proved developed reserve as one that estimates the reserves expected from those wells already producing; a proved reserve is an estimate of the reserves before drilling takes place.
The results of univariate tests indicate that firm size (total assets) and auditor identity (auditor quality) are both in the predicted direction and statistically significant. Cash flow risk is in the opposite direction to that hypothesized and is significant. This is due to large firms being less risky and disclosing more detailed information about the reserves. The multivariate regressions indicate that auditor identity is the only variable in the predicted direction and significant, all other variables produce mixed results.

4. Theoretical framework

A basic argument of this study is that the firm’s contracts with managers, shareholders, and creditors drive its accounting and reporting policies. Managers adopt policies that best accommodate the interests of claimants, with the minimum cost involved. They aim to reduce information asymmetry by enhancing the information content in the disclosure about the firm’s assets.

Firms exist because it is costly to use the price system to coordinate economic activities (Coase, 1937). They are able to offer cost advantages over markets by capturing economies of scale in repetitive contracting. In comparison to the firm, individual consumers, as infrequent purchasers of factors, incur relatively high contracting costs (Ball, 1988). Contractual relations are the essence of firms, not only with employees but also with suppliers, customers, creditors, and other parties (Jensen & Meckling, 1976, p. 310).

The fact that disclosure of reserves in the firms’ published annual reports is voluntary, makes it an important issue. Managers expand disclosure because they (a) perceive their firms to be undervalued by investors and (b) view undervaluation as costly because it increases the cost of raising new finance and lowers the value of management stock options (Healy et al., 1995). The increase in disclosure helps in both redressing the undervaluation and reducing costs of financial intermediation for the firm’s shares. Therefore, managers are likely to disclose information that they are confident of and withhold those that they consider uncertain. In other words, there exists an “optimum” level of disclosure for individual firms, and managers aim to achieve this level to accommodate contracts.

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6 Cash flow risk is associated with firms with more volatile returns or “riskier” firms. Craswell and Taylor (1992, p. 299) state that “these firms are expected to face higher finance-related agency costs such as higher cost of borrowing. The cost of additional equity funding can also be expected to be higher, as potential shareholders are less certain about the stochastic future cash flows arising from their investment.”

7 According to Verrecchia (1990, pp. 245–246):

Although there is presently at most a handful of papers in the accounting literature that studies a manager’s incentive to disclose or withhold information whose revelation is not required, arguably this is the quintessential accounting problem. As a research topic it has not had the attention it deserves, perhaps because in our quest to focus on mandated or regulated disclosure, accounting researchers have lost sight of voluntary disclosure as an alternative mechanism for managers to eliminate or reduce information asymmetries between themselves and external parties. Whether (and when) managers voluntarily disclose is a problem that arises naturally in many accounting settings.
4.1. Proprietary costs and information asymmetry

There are two types of proprietary costs involved in the disclosure of mineral reserves. The first is the proprietary cost of disclosing the existence of reserves. On discovery, the information about the reserves is to be disclosed to the ASX and other relevant government agencies. The proprietary value associated with the discovery of reserves is likely to be dissipated as soon as the discovery is announced. The second proprietary cost is the cost associated with the extraction of minerals from the ground. This cost relates to the firm’s management strategy, the cost of production, the uniqueness of the production process and the costs and the prices to be obtained on sale of product. Information about these features of reserves is valuable to the competitors and is only likely to become public gradually as the firm extracts minerals.

Managers are likely to weigh the costs of reducing information asymmetry and the proprietary costs of disclosure to decide whether or not reserves should be disclosed in the annual reports. Consider the following from Myers and Majluf (1984, p. 196).

There can also be information asymmetries when there is no need to guard proprietary information. Educating investors takes time and money. After all, the managers’ information advantage goes beyond having more facts than investors do. Managers also know better what those facts mean for the firm. They have an insider’s view of their organization and what it can and cannot do. This organizational knowledge is part of managers’ human capital; they acquire it as they work, by conscious effort as well as by trial and error. An outside investor who tried to match an equally intelligent manager on this dimension would probably fail. By this argument, the separation of ownership from professional management naturally creates asymmetric information.

In the case of the extractive industry firms, information asymmetry is likely to be reduced by disclosure of mineral reserves. The managers have to supply adequate information about the reserves to indicate to the market the true value of their firms’ assets. They are likely to sacrifice some of the proprietary cost of the information about reserves.

4.2. Estimates of reserve quantum

Mineral reserves quantity estimates are normally prepared by the geologists either employed by the firm or outside consultants. In addition, the firm’s management and/or its geologists determine the estimated timing of the future production of the proved reserve quantities (Alciatore, 1990, p. 6). Two terms are used for mineral deposits, e.g., “resources” and “reserves.” A mineral resource is defined as an identified in situ mineral occurrence from which valuable minerals may be recovered (Miskelly, 1994, p. 20). A reserve is the part of a resource that is actually mined and from which minerals are extracted. It represents a more advanced stage of development of a mineral deposit than a “resource.” A resource is simply a precursor of a reserve.

A variety of terms were in use for reserves prior to the adoption of the AusIMM Code by the ASX in 1989. The Exposure Draft that preceded AAS 7 identified three categories of reserves (Henderson et al., 1995). Proved reserves were those reserves for which volume and
grades could be computed within close limits. Probable reserves included reserves for which volumes and grades could be estimated with reasonable assurance on the basis of geological evidence. Possible deposits/fields consist of mineral deposits or oil and natural gas fields for which volume can be only tentatively assessed on the basis of broad geological assumptions (p. 774). However, AASB 1022 treats the proved and probable reserves as one, economically recoverable reserves.\(^8\) This study too collapses the proved and/or probable categories into one measure, reserves. The dependent variable is disclosure of reserves in the firm’s published annual report and includes quantities of probable and proved reserves, disclosed separately or in aggregate. Disclosure of resources is excluded because resources are “too indefinite” (Lindley et al., 1976, p. 427).

4.3. Uncertainty surrounding reserve quantum

Uncertainty and risk are at the core of the extractive industries. Large sums are spent at the exploration and evaluation stages and there is doubt about finding economic mineral reserves. Once a reserve is identified, the technical feasibility of extraction has to be carried out and shafts sunk, mountains moved, off-shore platforms built, and so forth; and all this expenditure is incurred before any saleable product is obtained (Luther, 1994, p. 4). In addition to this, there is normally a substantial time lag between exploration, development, construction, and production stages during the life of the mine. Uncertainty results from insufficient drilling and evaluation that does not lead to an estimation of reserve quantum or even to a conclusion that a reserve exists. Uncertainty is more likely to constrain than lead to disclosure of reserves in the firm’s annual report.

It is often argued that proprietary costs of information in the extractive industries influence reserve disclosure. According to Healy et al. (1995), increased disclosure is likely to be costly for the firms, potentially revealing valuable information to competitors or increasing legal costs. This perhaps explains why many managers are reluctant to provide additional public disclosure (p. 1). However, managers are unlikely to withhold from the market information that has the potential of increasing the firm’s share price. In the long run, an increased level of certainty about the existence of reserves and reduced proprietary costs are likely to lead to reserves’ disclosure. The proprietary cost is a continuous, decreasing function of time that approaches zero after some interval has elapsed (Verrecchia, 1983, p. 192).

4.4. Stage of the firm’s growth

In the extractive industries, there is likely to be an association between the level of uncertainty surrounding the existence of reserves and a firm’s stage of growth. As the firm finds and develops reserves and extracts minerals, the uncertainty surrounding the operations decreases. That is, a firm at the exploration stage has greater uncertainty about the existence of reserves than the one that is producing minerals and is earning revenue.

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\(^8\) The term “economically recoverable reserves” is used in the Standard in relation to the amortization of exploration and evaluation costs and not reporting or recognition of reserves as such.
At the exploration stage, the degree of uncertainty surrounding the lease or a project is likely to be high. Until a resource is converted into a proven reserve, its chances of becoming a producing mine are fairly low. Although at the development stage, reserves are proven, the final product is still in the ground, and the uncertainty about its quantum and value persists. Table 1 demonstrates a likely association between the stage of growth of the firm and the degree of uncertainty surrounding its reserves.

Apart from uncertainty, the proprietary costs of disclosing reserves of a project that is at the development stage are likely to be higher than those of one at the production stage. The reason is that at the development stage, a reserve’s estimate has the added noise in geological features and expected production and sales estimates. As the firm moves from development stage to production, the degree of uncertainty surrounding the reserves and proprietary costs decreases. If disclosure is costless, then managers are always forced to disclose what they know, since otherwise external parties anticipate the worst (Verrecchia, 1990, p. 246). Therefore, an incentive exists at the production rather than the development stage for managers to disclose reserve quantum. Disclosure of reserves is likely to be partially determined by the stage of the firm’s growth.

4.5. The use of project-specific financing

In the extractive industries, large sums are needed to develop discovered reserves. To acquire funds, the firm is able to offer its assets as a security. These assets consist of two types: assets in place and growth opportunities. Firms are likely to finance their mineral development and production programs by borrowing on specific projects. “Project finance” is a financing of a particular economic unit in which a lender is satisfied to look initially at the cash flows and earnings of the economic unit as the source of funds from which a loan will be repaid and at the assets of the economic unit as collateral for the loan (Nevitt, 1983, p. 3).

Firms use project-specific loans for a variety of activities such as development of iron ore deposits or coal reserve and construction of associated plants. In the case of gold mining firms, an additional type of project-specific financing arrangement is the use of gold loans and gold funding facilities. A gold loan is a form of project finance where a physical commodity is borrowed, instead of currency (Jacks, 1990). Lenders tailor gold loans to suit the borrowers’ production plans, thus, enabling borrowers to return the agreed quantity of gold bullion in an orderly fashion (Heaney et al., 1997, p. 129).

Apart from sharing risk with the lender, project financing benefits the borrower in several ways. First, the lender’s recourse is limited to the assets and cash flow of the project for which the loan has been borrowed. Repayments and the loan maturities are tailored to suit the cash

<table>
<thead>
<tr>
<th>Stage of the firm’s growth</th>
<th>Uncertainty surrounding reserves’ estimates</th>
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<tbody>
<tr>
<td>Exploration and evaluation</td>
<td>high</td>
</tr>
<tr>
<td>Proving of mineral reserves and development</td>
<td>low</td>
</tr>
<tr>
<td>Construction and production</td>
<td>very low</td>
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</table>

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flows of the project. In the event of project failure, the lender has no recourse to the other assets of the borrower. Second, the project is evaluated by an external party such as an auditor or an independent consultant before finance is approved. The “due diligence process” enhances the borrower’s confidence in the viability of the project. Finally, because a specific, well-defined project supports the loan, the covenants of the debt contract are likely to be less restrictive than those of a general debt. Lenders focus on the cash flows of the nominated project only. Therefore, project finance is likely to result in lower agency costs of debt relative to the agency costs of general borrowing.

A borrower faces several disadvantages in using project-specific finance, not the least of which is the loss of confidentiality. The process of obtaining finance normally involves evaluation of the project by the lender’s technical advisers, independent consultants, and lawyers, thus, reducing the level of confidentiality. Other drawbacks of project financing include the complexity of the contracts and additional legal and financing costs.

Firms in the extractive industries are likely to offer a lease, an “area of interest,” or an ore body as a security for the loan. While the lenders have access to reserves’ estimates, withholding this information from investors is likely to be inefficient. Further, to add credibility to their claims, managers have an incentive to include reserve estimates in the firm’s annual report.

4.6. Monitoring process

An independent auditor is one of the external advisers to the firm who play several roles in financial reporting. External auditing is a monitoring device that is designed to reduce conflicts of interest among the firm’s claimants. However, auditing firms vary in size, reputation, and specialist skills (Morris & Gordon, 1991, p. 152). There is evidence to suggest that larger firms provide higher-quality audits because they have fewer incentives to compromise their standards to retain clients compared to smaller firms (DeAngelo, 1981; Davidson & Neu, 1993, p. 480). Further, audit firm size and the extent of audit work undertaken are positively related (Moore & Scott, 1989). The following statement from Titman and Trueman (1986, p. 170) is relevant to disclosure in the firm’s annual report, although it is made in relation to initial public offerings.

When a firm’s owners decide to take their firm public they must choose an auditor to help in preparing the firm’s financial statements. The auditor, in the

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9 These roles are described by Gibbins et al. (1990, pp. 132–133) as follows:

First, they [the external advisers] assist in identifying the issues. . . . Second, they may be used to identify the specific formal or informal rules associated with a particular disclosure. Third, they provide technical advice and an opinion which effectively shifts some of the risk of the decision away from management. Fourth, their involvement also adds credibility to disclosures (for example, the role of external auditors and of legal counsel in a prospectus) . . . . Finally, external advisors may be used as a strategic resource in bargaining situations where alternative interpretations of events are possible. Firms may shop for an expert opinion which allows them to pursue a preferred course of action [emphasis added].
course of doing so, supplies information to investors which is useful for valuing the firm... not only is this information important for valuation purposes but that also the quality of the auditor chosen provides information useful to investors; the higher the quality level chosen, the greater will be investors’ assessment of the firm’s value.

Therefore, selection of a quality auditor is a signal to the market that the information disclosures of the firm are of high quality. Because auditors risk losing some of the value of their reputation if they associate with clients whose reporting practices are lower quality (DeAngelo, 1981), “high quality” auditors are likely to encourage their clients to provide detailed disclosure. For this reason, high quality auditors are even likely to create pressure on the clients to provide comprehensive disclosure. Audit firms that are outside the “high quality group” are unlikely to have the same incentives to persuade their clients to provide comprehensive disclosure as their opposite counterparts. In a study of voluntary disclosures in published annual reports, Hossain and Adams (1995) compare the extent of disclosure by firms that employ Big Six auditors with those employing non-Big Six auditors. Their results indicate that firms that employ Big Six auditors disclose more information voluntarily compared to the firms that employ non-Big Six auditors. Fig. 1 shows the association between the reserves’ disclosure and the choice of the audit firm.

In addition to the association shown above, there is likely to be a causal relationship between the level of disclosure and audit firm type. The Big Six firms are likely to possess more depth and breadth of expertise and resources compared to non-Big Six firms. Therefore, the “Big Six” and “non-Big Six” dichotomy is a useful proxy for auditor quality. The dichotomy (Big Eight and non-Big Eight) has been used in tests of auditor choice (Chow, 1982) and in models of audit pricing (Francis & Stokes, 1986).

Quality auditors are likely to associate themselves with firms that provide adequate disclosure in annual reports. As far as mineral reserves’ disclosure is concerned, the Big Six audit firms are likely to encourage their clients to disclose this information for two reasons. First, the auditor’s incentive is aligned with that of the client’s who aims to overcome the
information asymmetry problem. Second, estimates of reserve quantum for the firm are prepared by the geologists as “Competent Persons.” External auditors play no part in calculating reserves; their reputation is enhanced merely due to the fact that reserves’ information is included in the annual report. The firms are still likely to disclose reserves in annual reports if they employed non-Big Six auditors. However, the market’s perception of those reports is unlikely to be as high, as the reports of firms that appoint quality auditors. Furthermore, the firms with high contracting costs have an incentive to employ a quality auditor to reduce their costs of debt and equity by providing information that is perceived to be credible. The alignment of the firms’ and the quality auditors’ incentives is likely to lead the firms with Big Six auditors to disclose reserves.

4.7. The hypotheses

The foregoing arguments lead to the following three hypotheses:

**Hypothesis 1** Producer firms are more likely to disclose their reserves in annual reports, compared to the developer firms.

**Hypothesis 2** Firms with project-specific financing arrangements are more likely to disclose their reserves in annual reports, compared to firms not involved in project-specific financing.

**Hypothesis 3** Firms employing high quality auditors (Big Six) are more likely to disclose their reserves in annual reports, compared to firms not employing high quality auditors.

5. Research design

The year of 1995 is chosen for it is the most recent year for which company annual reports are available. The dependent variable in this study is disclosure of quantity of reserves in the firm’s annual report. Quantity estimates include all probable and proved reserves, irrespective of their being reported as “probable and proved” in aggregate or as separate items. The disclosure is most likely to be included in the firm’s MD&A section of the report.

The variable of disclosure of reserve quantum uses dichotomous specifications of 1 and 0. That is the disclosure is given a value of 1 and non-disclosure, a value of 0. Because the focus of the study is on the disclosure of reserve quantum, the use of a categorical variable is appropriate.

Hypothesis 1 predicts a relationship between the stage of growth of the firm and disclosure of reserves. Firms that have progressed to the stage where they have either probable or proved reserves but have not commenced production are defined as developers. All other firms that have operating mines or operating wells and derive revenue from sale of product are considered as producers. The classification is corroborated with Jobson’s Mining Yearbook 1995/1996. Hypothesis 2 predicts a relationship between the firm’s project financing arrangements and disclosure of reserves. In some instances, firms indicate the use of gold loans. Therefore, gold loans are also included as project financing arrangements.
Hypothesis 3 predicts that firms audited by quality auditors are more likely to disclose reserves in the annual report compared to firms audited by smaller audit firms. To classify audit firms into Big Six and non-Big Six, Chartac Accountancy News (October, 1995, p. 3) is used as a reference. According to this magazine, the Big Six firms in 1995 are: (1) Arthur Andersen, (2) Ernst and Young, (3) Coopers and Lybrand, (4) KPMG Peat Marwick, (5) Price Waterhouse, and (6) Deloitte Ross Tohmatsu.

In this study, dichotomous or dummy specifications are used so that the variables are able to be represented by a “yes” or “no” proxy. Although continuous specifications represent finer proxies, the use of dichotomous specifications is more appropriate for the variables of this study. Table 2 shows a list of variables and abbreviations used.

To control for omitted variables, the study includes leverage, size, and issue of equity capital; prior literature indicates these factors influence accounting and reporting policy choice. Leverage is used in studies of asset revaluations by Zimmer (1986), Brown et al. (1992), and Cotter and Zimmer (1995). High leverage is likely to be an incentive for managers to disclose firms’ assets, either in monetary or in physical terms. The variable of leverage is used on the assumption that the incentives that drive the firms’ accounting policies are likely to be relevant to their disclosure policies as well. In this study, the ratio of total liabilities to total assets represents the firm’s leverage.

Despite the criticism that the firm’s size is likely to proxy for many different phenomena such as competitive advantage, industry, and management expertise (Ball & Foster, 1982), researchers have used size as a proxy for political sensitivity. For instance, Guenther (1994) considers whether accounting earnings of US firms are managed in response to changes in the corporate income tax rate introduced by the Tax Reform Act 1986. His results indicate that large firms did in fact reduce income via large negative accruals in the year prior to the tax rate reduction. Similarly, Bowen et al. (1981) and Lilien and Pastena (1982) report that larger firms in the oil and gas industry are more likely to use income reducing accounting policies.

Table 2
List of variables and abbreviations used

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hypothesis</th>
<th>Direction</th>
<th>Definition and measure</th>
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<tbody>
<tr>
<td>DISCLOSURE</td>
<td></td>
<td></td>
<td>Disclosure of reserves’ quantum. Dummy variable: $= 1$ if the firm discloses reserves. $= 0$ in all other cases.</td>
</tr>
<tr>
<td>STAGE</td>
<td>Hypothesis 1</td>
<td>+</td>
<td>Firm’s stage of growth. Dummy variable: $= 1$ if the firm is a producer. $= 0$ in all other cases.</td>
</tr>
<tr>
<td>PFINAN</td>
<td>Hypothesis 2</td>
<td>+</td>
<td>Use of project-specific finance. Dummy variable: $= 1$ if the firm has project finance. $= 0$ in all other cases.</td>
</tr>
<tr>
<td>AUDITQ</td>
<td>Hypothesis 3</td>
<td>+</td>
<td>Firms employing a quality auditor. Dummy variable: $= 1$ if a quality auditor is employed. $= 0$ in all other cases.</td>
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</table>

Hypothesis 3 predicts that firms audited by quality auditors are more likely to disclose reserves in the annual report compared to firms audited by smaller audit firms. To classify audit firms into Big Six and non-Big Six, Chartac Accountancy News (October, 1995, p. 3) is used as a reference. According to this magazine, the Big Six firms in 1995 are: (1) Arthur Andersen, (2) Ernst and Young, (3) Coopers and Lybrand, (4) KPMG Peat Marwick, (5) Price Waterhouse, and (6) Deloitte Ross Tohmatsu.
Firm size is often used as a proxy for political costs because larger firms also tend to be more successful and more visible compared to their smaller counterparts.  

Support for the size hypothesis has been found outside of the oil and gas industry as well (Watts & Zimmerman, 1978; Hagerman & Zmijewski, 1979; Daley & Vigeland, 1983), indicating that the size variable is applicable across industries and need not be industry-specific. Further, a positive association is shown to exist between voluntary financial disclosure and size (Meek et al., 1995). As far as mineral reserves’ disclosure in the firm’s annual report is concerned, because of a fixed component of disclosure costs, larger firms are likely to provide greater disclosure (Lang & Lundholm, 1993).  

In this study, size is represented by the firm’s total assets. Because extractive industries are capital intensive, “total assets” is a highly relevant proxy for size. Earlier studies, such as Craswell and Taylor (1992), use total assets as a proxy for firm size. Further, the choice of total liabilities over total assets as a proxy for leverage and total assets for size is pragmatic, as these items are clearly identified in the firm’s financial statements.  

Finally, as far as the raising of equity is concerned, Myers and Majluf (1984) argue that outside investors expect the firm to issue equity when stock market prices are higher than “true” values, leading investors to negatively adjust stock prices. Managers of firms issuing additional equity are likely to make greater public disclosure to facilitate issue of new securities. The results of the Gibbins et al. (1990) study support the view that there exists a relationship between security issue and disclosure. Therefore, the firms issuing additional equity are more likely to disclose reserves compared to the firms not involved in equity issue. For the purpose of this study, capital issued to external parties is considered as additional equity. Shares issued to management and employees are excluded, so are bonus share issues, conversion of options, and notes to share capital.  

In this study, $\chi^2$ tests and $t$-tests are used to consider the effects of hypothesized independent variables and leverage, firm size, and issue of equity, on the dependent variable. Logistic regressions are used to explain the effects of all independent variables collectively on the dependent variable. In logistic regressions, the coefficients that make the observed results most “likely” are selected. Because only two values are assigned to the dependent variable, i.e., 0 and 1 for an event occurring or not occurring, predicted values can be interpreted as probabilities.  

6. Data analysis and results  

The following multiple regression model is used for the sample of firms:  

$$\text{DISCLOSURE} = \beta_0 + \beta_1(\text{STAGE}) + \beta_2(\text{PFINAN}) + \beta_3(\text{AUDITQ}) + e$$  

(6.1)  

where DISCLOSURE is the disclosure of reserve quantum in the firm’s annual report. The independent variables are: STAGE, which is the stage of firm’s growth; PFINAN, which is
the firm’s involvement in project-specific financing; AUDITQ, which is the auditor quality; and $e$, which is the error term. The following three control variables are also used: LEVER, which is the firm’s leverage (the log of total liabilities over total assets); SIZE, which is the firm’s size (log of total assets); and EQUITY, which is the firm’s raising of additional equity funds in the market.

The sample of Australian firms for the year of 1995 was selected by obtaining Jobson’s Mining Yearbook 1995/1996 and identifying all producers and developers listed. This amounted to 182 firms. After deletion of foreign firms (20), incomplete annual report (1), and those for which annual reports were not available (10), 151 firms remained. Annual reports for the majority of firms are available on the Australian Graduate School of Management database and “Connect 4” on CD-ROM. Others were requested directly from the firms themselves.

The sample consists of 128 producers and 23 developers, in all a total of 151 firms. Table 3 shows the descriptive statistics of the sample.

Table 3 shows that 104 firms include reserve quantum in their annual reports. Thirty-eight firms have project financing arrangements in place. One hundred eighteen firms employ “Big Six” auditors and 33 employ the non-Big Six. Forty-five firms raised additional

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12 The classification of firms into producers and developers was tested by referring to the annual reports. After a cover to cover reading of the annual report, a decision was made to classify the firm as a producer or a developer. As a further check, the firms and their classification into producers and developers was corroborated with Dr. Andrew White, Director of the University of Queensland’s W.H. Bryan Mining Geology Research Unit.
capital in the market during the year 1995. Table 4 shows the descriptive statistics for leverage and size.

For the firms in the sample, the median leverage is 0.32. The mean assets as a proxy for firm size are $789.77 million. Table 5 shows the correlations among the independent variables.

Table 5 indicates that STAGE is significantly correlated with LEVER and with SIZE, while SIZE is also correlated with AUDITQ. These results are not unexpected as producer firms are normally large; they accumulate assets as their operations progress from development to production stage; and they are likely to employ quality auditors. Apart from the

Table 5
Pearson correlation—Independent variables for the sample firms (N = 151)

<table>
<thead>
<tr>
<th>Variable</th>
<th>STAGE</th>
<th>PFINAN</th>
<th>AUDITQ</th>
<th>LEVER</th>
<th>SIZE</th>
<th>EQUITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAGE</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFINAN</td>
<td>0.0759</td>
<td>1.0000</td>
<td>(0.354)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUDITQ</td>
<td>0.1326</td>
<td>-0.0257</td>
<td>1.0000</td>
<td>(0.105)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEVER</td>
<td>0.4327</td>
<td>0.1358</td>
<td>-0.0522</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIZE</td>
<td>0.3159</td>
<td>0.1031</td>
<td>0.2816</td>
<td>0.1980</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>EQUITY</td>
<td>-0.0462</td>
<td>0.1894</td>
<td>-0.0759</td>
<td>-0.0925</td>
<td>-0.1213</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

STAGE is the stage of firm’s growth (producer = 1; developer = 0), PFINAN is the firm’s involvement in project-specific financing (project loan = 1; no project loan = 0), AUDITQ is the auditor quality (Big Six firm = 1; non-Big Six = 0), LEVER is the firm’s leverage (log of total liabilities over total assets), SIZE is the firm’s size (log of total assets), and EQUITY is the firm’s raising additional equity funds in the market (additional capital raised = 1; additional capital not raised = 0).

* Two-tailed significance. Probabilities are shown in parenthesis.

Table 6
Results of $\chi^2$ tests (probability estimates are shown in parenthesis). Disclosure of reserves’ quantum (disclosure) sample for the year 1995, all firms (N = 151)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Reserves disclosed</th>
<th>Reserves not disclosed</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothesis 1: Producers (n = 128)</td>
<td>93</td>
<td>35</td>
<td>5.6071</td>
</tr>
<tr>
<td>Developers (n = 23)</td>
<td>11</td>
<td>12</td>
<td>(0.0178)</td>
</tr>
<tr>
<td>Hypothesis 2: Project finance (n = 38)</td>
<td>31</td>
<td>7</td>
<td>3.8233</td>
</tr>
<tr>
<td>No project finance (n = 113)</td>
<td>73</td>
<td>40</td>
<td>(0.0505)</td>
</tr>
<tr>
<td>Hypothesis 3: Firms with Big Six auditors (n = 118)</td>
<td>87</td>
<td>31</td>
<td>5.9358</td>
</tr>
<tr>
<td>Firms with non-Big Six auditors (n = 33)</td>
<td>17</td>
<td>16</td>
<td>(0.0148)</td>
</tr>
<tr>
<td>Firms raising additional equity (n = 45)</td>
<td>29</td>
<td>16</td>
<td>0.5867</td>
</tr>
<tr>
<td>Firms not raising additional equity (n = 106)</td>
<td>75</td>
<td>31</td>
<td>(0.4436)</td>
</tr>
</tbody>
</table>

* One-tailed tests.
above, the remaining independent variables do not appear to be correlated. Thus, multicollinearity does not appear to be a problem.

Table 6 shows the results of $\chi^2$ tests for the sample for the year 1995.

The results of $\chi^2$ tests indicate that a larger proportion of producers, firms with project financing arrangements, and firms that employ quality auditors disclose reserve quantum than their counterparts. Because LEVER and SIZE are continuous variables, an independent samples $t$-test is used. Huck et al. (1974, p. 50) predict that if the two sample means are far enough apart, the $t$-test will yield a significant difference, thus permitting the researcher to conclude that the two populations are unlikely to have the same mean. Table 7 shows the results of the $t$-tests for leverage and size variables and disclosure of reserves.

Table 7 shows that the result for the $t$-test for leverage to quantum disclosure variable is, unequal, $t = .48$ ($df = 60.79$), and $p = .318$. As the difference between the groups is not significant, leverage does not influence the firm’s decision to include reserve quantum in its annual report. The result does not support the expectation that high leverage firms are more likely to disclose reserves in annual reports compared to their low leverage counterparts. The result for the size to quantum variable is, equal, $t = -3.98$, ($df = 149$), and $p = .000$. As the difference between the groups is significant, size does influence the firm’s decision to include reserve quantum in its annual report.

The $\chi^2$ and $t$-tests show the relationships of the dependent variable with the independent variables. The tests, however, do not deal with the dependent variable and two or more independent variables; regression analysis is employed to test these relationships. Therefore, logistic regression tests are conducted for the sample firms.

Three independent variables, e.g., the firm’s stage of growth, the use of project financing, and appointment of a quality auditor are regressed. The variables of leverage, size, and equity are also included as controls. Table 8 shows the results of regressions for disclosure of reserve quantum by the sample firms.

The results of logistic regression indicate that for disclosure of reserve quantum, the firm’s stage of growth, project financing, and size are significant and in the hypothesized direction. Leverage is also significant but it is in the opposite direction than that expected. The results of multivariate tests appear to confirm those of the univariate tests, except for
the variable of auditor quality. Hypotheses 1 and 2 are again supported but not Hypothesis 3.

7. Conclusions

In the extractive industries, contracts are likely to be defined by the firm’s asset structure, its particular financing arrangements, and its monitoring process. In addition to this, prior studies suggest that the firm’s leverage and size and the raising of additional equity are also likely to be relevant to managers’ disclosure policies. Therefore, the disclosure of reserve quantum is likely to be influenced by features that are firm- and industry-specific.

Both univariate and multivariate tests are conducted on the sample firms. Results of univariate tests suggest that a larger proportion of producers, firms with project financing arrangements, and firms with quality auditors disclose reserve quantum in their annual reports compared to their opposite counterparts. The results support Hypotheses 1–3. Results of multivariate tests are a little different from those of univariate tests. The regression analysis shows that the firm’s stage of growth, the use of project financing, and size are significant but auditor quality is not. The control variable of leverage is also significant but it is in the direction opposite to that expected.

The major conclusion of this study, therefore, is that the firms’ disclosure policies are likely to be chosen as part of the broader problem of minimizing contracting costs, so as to attain efficient corporate governance. A firm can be viewed as a nexus of contracts; that is, its organization can be largely described by the set of contracts it enters into. The firm will want to minimize costs associated with these contracts, such as costs of negotiation, monitoring of contract performance, possible renegotiation, and expected costs of bankruptcy or other

### Table 8

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Coefficient</th>
<th>Expected sign</th>
<th>Wald statistic</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAGE</td>
<td>1.0132</td>
<td>+</td>
<td>3.1504</td>
<td>0.0379</td>
</tr>
<tr>
<td>PFINAN</td>
<td>1.0283</td>
<td>+</td>
<td>3.9578</td>
<td>0.0233</td>
</tr>
<tr>
<td>AUDITQ</td>
<td>0.5266</td>
<td>+</td>
<td>1.3590</td>
<td>0.1218</td>
</tr>
<tr>
<td>LEVER</td>
<td>−1.0351</td>
<td>+</td>
<td>3.7948</td>
<td>0.0257</td>
</tr>
<tr>
<td>SIZE</td>
<td>0.7454</td>
<td>+</td>
<td>7.3440</td>
<td>0.0033</td>
</tr>
<tr>
<td>EQUITY</td>
<td>−0.3601</td>
<td>+</td>
<td>0.7150</td>
<td>0.1989</td>
</tr>
<tr>
<td>Constant</td>
<td>−2.6849</td>
<td>+</td>
<td>4.0025</td>
<td>0.0227</td>
</tr>
</tbody>
</table>

−2 Log likelihood 160.663  
Goodness of fit 161.009  
Overall percent correct 76.16  

STAGE is the stage of firm’s growth (producer = 1; developer = 0), PFINAN is the firm’s involvement in project-specific financing (project loan = 1; no project loan = 0), AUDITQ is the auditor quality (Big Six firm = 1; non-Big Six = 0), LEVER is the firm’s leverage (log of total liabilities over total assets), SIZE is the firm’s size (log of total assets), and EQUITY is the firm’s raising additional equity funds in the market (additional capital raised = 1; additional capital not raised = 0).

* One-tailed tests.
failures. Mining and petroleum firms are no different. The disclosure of the major asset is greatly influenced by the firms’ contracting costs, and mineral reserves are a major asset of firms in the extractive industries.

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References


