MARKET REACTIONS TO NON-FINANCIAL RESOURCE DISCLOSURES AND REPUTATION EFFECTS OF GEOLOGICAL EXPERTS

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CERTIFICATE OF ORIGINAL AUTHORSHIP

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ABSTRACT

Previous studies in the financial economics literature highlight the value of non-financial information to investors for Internet and telephony stocks (Amir and Lev 1996, Trueman, Trueman and Zhang 2001). Other studies consider the financial performance implications of assurance of non-financial information such as ISO 9000 certification (Corbett, Montes-Sancho and Kirsch 2005) and Total Quality Management awards (Hendricks and Singhal 1997). This thesis provides evidence on the value of non-financial disclosure and assurance in a high information asymmetry setting. Specifically I examine market reactions to resource/reserve disclosures by Australian Mining Development Stage Entities (MDSEs) and the reputational effect of geological experts associated with these disclosures. I might expect geological assurers to matter given that the information environment of MDSEs is characterised by high information asymmetry and the reality that non-financial technical information supersedes financial statement information in terms of importance in firm valuation. In contrast however, the litigation risk attached to such disclosures is argued to be very low, given the absence of cases involving geological attesters. This aspect of the setting suggests the absence of any insurance effect, which might suggest geological assurers won't matter to the market.

Public accounting firms audit and review financial figures compiled by a client. Essentially, the role of auditors is to ensure compliance with Generally Agreed Accounting Principles (GAAP). In contrast, geological assurers are unique in that they receive mineral assay data from clients and then compile the resource estimates that are subsequently announced by the client firm to the market. Thus geological assurers have an information generation role along with a compliance role in that they are required to produce estimates in accordance with the Joint Ore Reserve Committee (JORC) code.

In this thesis I document a significant, positive market reaction to resource/reserve disclosures by MDSEs. Using size of geological experts as a proxy for their reputation, I find weak evidence of greater abnormal returns when these disclosures are assured by larger geological experts. Further, a measure of expert specialisation based on commodity cluster leadership produces the strongest positive and significant results. In supplementary analysis, I test for the implications of switching geological experts and find that firms experience significant, positive abnormal returns when their successor expert is larger. Overall, the weak evidence I documents in this thesis is consistent with an insurance effect interpretation, in that the reputation of geological assurers doesn't matter to the market where litigation risk is low.

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CHAPTER 1

INTRODUCTION

1.1 Overview

This study examines market reactions to resource/reserve disclosures by Australian Mining Development Stage Entities (MDSEs) and the reputational effect of geological experts that assure these disclosures.[1] Research studies in the accounting literature have identified the value of non-financial information. For example, Amir and Lev (1996) examine the cellular telecommunications industry, and find that financial information such as book value, earnings and cash flows are less important in the valuation of mobile phone companies than non-financial information such as population coverage and penetration. Another example is Trueman, Wong and Zhang (2001), who incorporate web usage statistics as 'other information' in valuing Internet stocks. They show an insignificant association between bottom-line net income and market prices; however, when net income is decomposed, gross profits along with unique visitors and page views are associated with stock prices. These prior studies serve to highlight the importance of non-financial information in certain industries.

Assurance of non-financial information has been shown to matter in other settings including the quality assurance literature. For example, Corbett, Montes-Sancho and Kirsch (2005) consider the financial performance implications of ISO 9000 certification by manufacturing firms in the United States. Corbett et al. (2005), apply a matched firm

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[1] Development Stage Entities are defined in Statement of Financial Accounting Standards (SFAS) No. 7, Accounting and Reporting, as entities devoting substantially all of its efforts to raising capital and establishing its business and principal operations, but no sales have as yet been derived from its principal operations.

approach consistent with Barber and Lyon (1996), with control firms selected based on three years of observations of pre-certification ROA, assets and industry. Using a sample of 554 firms gaining ISO 9000 certification and the same number of control firms, they find publically traded manufacturers gain significant improvements in financial performance post accreditation. In other studies of assurance of non-financial information, Hendricks and Singhal (1997) find that firms winning total quality management (TQM) awards as a proxy for implementation effectiveness have better financial performance. The findings in this study are consistent with those in Easton and Jarrell (1998) who find that TQM adoption is associated with both improved financial performance along with higher stock returns.

This thesis is interesting in light of the relevance of non-financial information in firm valuation in the resource industry. The assurance process in this MDSE's setting differs from auditing in the following manner. Broadly speaking, auditors obtain financial information from clients and review that financial information for consistency with accounting standards. In contrast, resource assurers obtain drilling assay data from clients and then compile a resource estimate consistent with the resource and reserve reporting standard. This resource estimate is then provided to the client who discloses it to the Australian Securities Exchange (ASX) via an ASX announcement. By taking responsibility for estimation, it is argued that the resource assurer implicitly has a greater responsibility than a traditional auditor.[2] Hence I expect that the reputation of an industry specialist assurer may matter to investors. This question is relevant to the

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[2] The counter argument that the reason why auditor reputation is valued in a capital markets context is due to an insurance value that clients can claim in the event of an audit failure (Menon and Williams 1994). However, Australia is a low litigation setting, with no known examples of geological expert litigation.

assurance literature since it is of interest to know in what context specialist assurance matters.

To execute this study, I develop a hand-collected proprietary database of project-level resource/reserve disclosure information. This database facilitates collection of resource/reserve data in accordance with the Joint Ore Reserves Committee (JORC) reporting framework.[3] Effectively, this means it is possible to track each firm's resource endowments over each individual project's life from project inception to development.[4] The hand collection of resource/reserve data on a project-by-project basis over each project's life is a necessary approach to accurately classifying and measuring resource/reserve changes by JORC category. In addition, collecting project level resource/reserve data allows the capture of other deposit characteristics, such as commodity types, deposit grades and project locations. This means that I am able to generate an aggregate measure of deposit value change in each resource/reserve disclosure. Moreover, since resource endowments are tracked at the deposit level over each project's life prior to entering production, I am able to control for appropriate sequencing of resource/reserve disclosure in a multivariate model setting. I apply the event-study methodology articulated in Ball and Brown (1968) and Fama, Fisher,

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[3] Mineral resource/reserve disclosure in Australia is governed by the Joint Ore Reserves Committee (JORC) code that requires ASX-listed mining firms to provide the name and professional affiliation of the geological expert assuring or compiling information provided in the firms' ASX releases. This expert must meet specified professional requirements, including membership of one of the approved professional organisations listed in the code. In addition, the expert must hold a minimum of five years' experience with the specific regional geology hosting the firms' deposit in order to hold the responsibility of being the information generator [JORC Code, Clause 9]. The JORC resource categories are arrayed in terms of increasing geological confidence, with '*Inferred* resources' comprising the lowest confidence resources, '*Indicated* resources' being of increasing confidence, with '*Measured* resources' being the highest confidence resource category. Similarly, JORC reserves comprise two categories, these being '*Probable* reserves' and '*Proved* reserves'. The key to understanding the JORC reserve disclosure is to identify the relationship with underlying resource. '*Probable* reserves' correspond to '*Indicated* resources, whilst '*Proved* reserves' correspond with '*Measured* resources'. The key distinction between resource/reserve is in terms of economic viability, which is typically established through the completion of feasibility studies.
[4] This means I am able to decompose resource changes into respective JORC *Inferred*, *Indicated* and *Measured* resource categories and/or JORC *Probable* and *Proved* reserves.

Jensen and Roll (1969). The objective is to examine the behaviour of firms' stock prices around resource/reserve disclosure events and the reputational effect of geological experts that assure these reports.

1.2 Motivation

Examining the value relevance of non-financial disclosure and assurance in the MDSE setting has a number of advantages experimentally. First, the relatively sparse information environment surrounding MDSEs means that announcements of resource/reserve changes can be identified with relative ease. Resource definition events are identifiable through disclosures announced on the Australian Securities Exchange (hereafter ASX). In addition, MDSEs are relatively homogeneous in terms of corporate aims and objectives (Ferguson, Clinch and Kean, 2011). The objectives of MDSEs are quite simple: (1) find economic mineralisation occurrences; (2) define the extent of such occurrences; and (3) investigate the economics of extracting such occurrences with a view to project development. This suggests it is possible to examine the market reactions to resource/reserve disclosures in a low noise setting. Additionally, mining industry non-financial information is relatively well structured and tractable compared to other settings where non-financial information is highly value relevant (e.g., pharmaceutical research and development pipelines (Namara and Bade-Fullen, 2007). A further institutional feature of MDSEs is that there is typically low analyst following (Ferguson, Gross, Kean and Scott, 2011). This may be due to the high information asymmetry and technical nature of the non-financial disclosure, which suggests high risks of making bad recommendations. The lower level of analyst following for MDSEs also suggests the added importance of reputation signals around key resource definition milestones. The value of conventional financial assurance providers (e.g., auditors) is likely to be lower in this non-financial, highly technical information environment. Public accounting firms audit and review financial figures compiled by a client. Geological assurers are unique in that they receive mineral assay data from clients and then compile the resource estimates that are subsequently announced by the client firm to the market

The mining sector is an important constituent of the Australian economy. This can be seen by its increasing prominence in the Australian stock market and importance in wealth generation for investors. The Materials and Mining sector constitutes a significant portion of listed firms on the ASX. In 2012, ‘Materials’ was the largest industry sector by number of companies, with over 761 companies involved in mineral exploration, development and production across over 110 countries.[5]

Additionally, during 2011-12 the Australian mining industry had the highest profit margin (38.3%) and the highest level of capital expenditure ($86.8 billion, or 32.3%) of all industries in Australia.[6] In 2011-12, mining was also the leading industry in terms of exports, contributing around 48% to the value of Australia’s total exports and representing 9.6% of the total Australian GDP.[7] Australia is one of the top countries in mining exploration investment in the world. According to the MEG (2009) survey of worldwide exploration budgets by region, Australia received 14% of the total global exploration spending.

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[5] Source: Metal and mining sector profile, ASX, 2012.
[6] Sources: ABS 8155.0 - Australian Industry, 2011-12.
[7] Sources: ABS 5204.0, 5302.0, 5368.0 and 6291.0.55.003.

1.3 Objectives and research questions

The objective of this thesis is to examine the value relevance of resource/reserve disclosures to capital market participants. It also aims to provide evidence on the structure of the market for geological experts' assurance services and whether investors value the experts' reputation. Specifically, I address the following research questions:

1. What is the market structure for geological experts?
2. What is the impact of resource/reserve disclosures on firm value in a capital markets context?
3. To what extent are changes in share prices around resource/reserve disclosures driven by the magnitude of the resource/reserve change?
4. Are more reputable geological experts that accompany resource/reserve disclosures valued by the capital market?

1.4 Summary of major findings and contributions

The results from this thesis indicate a positive relation between disclosures of resource/reserve changes by firms and abnormal returns. Evidence of a positive return on the day of the resource/reserve disclosure is presented, suggesting resource/reserve definition events are value relevant. Another intuitive result is that larger resource/reserve changes are associated with higher abnormal returns. When decomposing the model by JORC categories, I find the multivariate results primarily driven by the lowest-confidence (*Inferred*) resource and (*Probable*) reserve category, suggesting changes in these lower-confidence categories may better reflect future deposit growth expectations. Further, I find evidence that the market values the assurance of geological experts associated with resource/reserve disclosures, with higher returns associated with larger experts (experts with greater market share) who are specialist commodity leaders. The size (proxy for reputation) of geological experts that assure such reports is significant in the cross-sectional model explaining abnormal returns, with the strongest evidence found for specialist (commodity-leading) geological experts. The analysis indicates that these commodity-leader results for geological experts are driven by deposit complexity or base metals resource/reserve changes.

In summary, this thesis contributes to the non-financial disclosure/assurance literature by identifying the value of resource and reserve disclosure in a capital markets setting and by examining the reputational effect of geological experts after controlling for the quantum of resource/reserve upgrade and other firm-level and deposit attributes. Hence, this study provides the first evidence demonstrating that changes in share prices around resource/reserve disclosures are driven by the quantum of the changes in mineral deposits disclosed and the reputation of the expert assuring the information in the market disclosure. These results may provide further motivation for testing reputation effects of experts in other non-financial settings.[8]

1.5 Structure of the thesis

The remainder of this thesis is structured as follows. Chapter 2 describes the resource/reserve disclosure framework and the JORC code requirement on the role of geological experts in these reports. Chapter 2 then provides an explanation of the sample selection and data collection process. Further, characteristics of variables related to this setting and the market for geological experts' services are also explored.

[8] A further contribution is the broadening of the existing focus of the reserve valuation literature from the Oil and Gas sector in prior US studies (such as Raman and Tripathy (1993) and Boone (1998), who examine the impact of reserve disclosures by US oil and gas companies in a market microstructure context) to the hard-rock mining setting.

Chapter 3 presents the literature review and hypotheses. The literature review includes a discussion of classic studies on the economics of signalling, such as Akerlof (1970), followed by a review of the extant literature on reputational effect of experts in different market settings, including initial public offerings (IPOs), takeovers and auditing. Further, the literature on the value of non-financial information in the capital markets setting is reviewed.

Chapter 4 presents and discusses the results of the market reactions to resource/reserve disclosures and the importance of geological experts' reputation associated with these disclosures. Drawing on prior literature, tests are conducted on daily and intraday abnormal returns. Liquidity, bid-ask spread and abnormal returns are also examined in a microstructure context. In addition, a variety of model specifications and robustness tests are undertaken, including alternative event window duration, alternative performance benchmarks and various ways of partitioning the sample.

Chapter 5 summarises the findings from previous chapters. Potential contributions and limitations of the research design are discussed along with suggestions for future research.

CHAPTER 2

RESOURCE/RESERVE DISCLOSURES AND GEOLOGICAL EXPERTS

2.1 Introduction

In this chapter, I describe the characteristics of resource/reserve disclosures and the accompanying geological experts. Resource/reserve disclosures in Australia are organised and structured in accordance with the Joint Ore Reserves Committee (JORC) code.[9] The main requirements of the JORC code regarding the disclosure of non-financial, mineral deposit information are described in Section 2.2. The JORC code requires that a 'Competent Person' be present in each resource/reserve disclosure. The Competent Person is responsible for preparing resource/reserve data pursuant to the requirements of the JORC code. The description of the Competent Person, including their responsibilities, is discussed in Section 2.3. Section 2.4 contains a discussion of the sample selection, variable description, market structure of geological experts and summary statistics on resource/reserve disclosures.

2.2 Resource and reserve disclosures

According to the JORC code (2004), a company must disclose any relevant information concerning a mineral deposit that could materially influence the economic value of that deposit to the company. Resource and reserve disclosures are the outcome

[9] The Joint Ore Reserves Committee (JORC) Code is a Code of practice which sets minimum standards for public reporting in Australia and New Zealand of Exploration Results, Mineral resources and Ore Reserves. It provides a mandatory system for classification of tonnage/grade estimates according to geological confidence and technical/economic considerations in reports prepared for the purposes of informing investors, potential investors and their advisers.

of a company's obligation in promptly reporting any material changes in its resources or reserves. Mineral resources or reserves must be classified based on their geologic certainty and economic value. The JORC code (2004) requires that mineral information is subdivided in categories in order of increasing geological confidence. Figure 2.1 depicts the resource/reserve categories defined by the JORC code, namely, *Inferred*, *Indicated* and *Measured* resources and *Probable* and *Proved* reserves. *Inferred* resources comprise the lowest confidence resources, *Indicated* resources is of higher confidence, with *Measured* resources being the highest confidence resource category. Similarly, JORC reserves comprise two categories, with *Probable* reserves comprising the lower confidence and *Proved* reserves the higher confidence category. The key to understanding the JORC reserve disclosure is to identify the relationship with the underlying resource categories. *Probable* reserves correspond to *Indicated* resources, whilst *Proved* reserves correspond with *Measured* resources. The key distinction between resource and reserve is in terms of economic viability, which is typically established through the completion of feasibility studies.[10]

An example of a resource disclosure made by Crusader Resources Limited (ASX: CAS) is provided in Appendix B.1 and Appendix B.2. Several features of the disclosure are worth noting. First, the stated resource is JORC compliant, the project name is Borborena and the project location is Brazil. Appendix B.1 shows the initial resource/reserve disclosure depicting *Inferred* resources. Appendix B.2 shows subsequent resource/reserve disclosure (for the same project), including both growth in resources and increased confidence as a portion of resources has been reclassified from *Inferred* to *Indicated* category. By comparing the report on Appendix B.2 with the $t-1$

[10] Thus, *Indicated* resources can be termed *Probable* reserves once economic viability has been established through a suitable feasibility study.

(Appendix B.1) report, it is possible to assess the relative growth in total resources and the change in confidence categories. The reports indicate that the project is in milestone 2 according to the classification in Table 2.1. In addition, the details of the geological experts, as well as the mentioning of the JORC code, are found in both the body and the footnote of the document. The geological experts in the role of a Competent Person are Mr Simon Bernardo Viana (Appendix B.1) and Mr Ian Dreyer (Appendix B.2), who are both external geological experts from Coffey Mining. A further example is presented in Appendix B.3 that shows a maiden resource (i.e., first ever resource declaration in a project's lifecycle) containing 185,600 ounces of gold at the Mt Jewel project, located in Western Australia. The 'Responsible Parties' section of the report declares that the information has been produced by the geological expert CSA and complies with the 2004 JORC code. It depicts the geological expert's opinion pertaining to the robustness of the resource disclosure and provides some institutional information about the geological expert (CSA). It lists the roles undertaken by the geological expert, including independent assessments of resources and reserves, project evaluations and audits, Competent Person reports, independent audits, and independent feasibility evaluations to bankable standards on behalf of exploration and mining companies and financial institutions worldwide.

2.3 Competent Person

According to the JORC code, the Competent Person has the responsibility to prepare exploration results, estimate or supervise the estimation of mineral resources, and evaluate the economic extraction of ore reserves. The geologist in the role of a Competent Person (or qualified person) is an important feature of the JORC code. The expert responsible for a report must meet specified professional requirements, including membership of one of the approved professional organisations listed in the code, in order to qualify as an information generator [JORC code, Clause 9].

A Competent Person must be a member or fellow of a recognised professional organisation with appropriate experience. Clause 10 of the JORC code states that:

> *A 'Competent Person' must have a minimum of five years experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which that person is undertaking*.

2.3.1 Liability profile of the Competent Person

Phillips (2000) outlines some of the situations in which directors and mining professionals may become exposed to legal liability in common law and under statute in connection with reporting on resources and reserves. The author argues that the geological expert's reputation will be at stake if the work is done with insufficient care, such that the information may be said to be misleading or deceptive either by commission or omission.

Apart from the reputational effect, Phillips (2000) confirms that the legal liability for loss flowing from defective disclosure may attach to the professional, as well as to the disclosing company and its directors. He states that defective reporting may amount to an offence under the *Corporations Act 2001*. Philips (2000) describes how, under s728 of the Corporations Act, that it is an offence for a person to offer securities under a disclosure document if there is a misleading statement contained within it. Alternatively, if material required by the Corporations Act is omitted and the statement or omission is materially adverse from the point of view of an investor, an offence will occur.

Phillips (2000) cites s729 of the Corporations Act to show that a person who suffers loss or damage because an offer of securities under a disclosure document contravenes s728 may recover the loss from (amongst others):

a. each director (including a shadow director), in relation to any loss or damage caused by any contravention of s728;

b. a person named in the disclosure document with their consent as having made a statement that is included therein or upon which such a statement is based, in relation to loss or damage caused by the inclusion of the statement in the disclosure document; and

c. a person who contravenes (or is involved in a contravention of) s728, in relation to any loss or damage caused by that contravention.

The author explains that apart from the liability arising under the Corporations Act, geological experts in the role of a Competent Person can be (in tort) directly liable to the person who has suffered loss and (in contract) to the company for breach of an implied or express duty of care in the consultancy agreement. The following lines are quoted from Phillips (2000):

> *Where a breach of contract arises from a failure to perform a contractual obligation to the required standard of duty, the breach may be termed a negligent breach and often there will be a concurrent liability in tort for negligence. (Page 116)*

The liability of the Competent Person for JORC disclosures is also discussed by Livesley (2008). The author argues that this minimum hurdle of required professional experience is in accordance with the third of the three principles of the JORC code, namely, competence. The first two principles—transparency and materiality—set the background for the obligations of the Competent Person in favour of the investors and their professional advisers. Livesley (2008) affirms that any failure on the part of the Competent Person in the performance of those obligations may give rise to liabilities.

According to Livesley (2008), the potential liabilities for the Competent Person range from administrative orders (such as reprimand, suspension or expulsion of membership from the professional organisation) through to statutory and civil liabilities (such as damages for economic loss, and incarceration).

2.3.2 The A1 Minerals case

The following section aims to profile the role and actions of a Competent Person in the A1 Minerals case. This example illustrates an event where the conduct of a company's geological expert was brought into question. On 3 March 2011, A1 Minerals announced to the ASX that its board of directors had doubts about the veracity of the geological information and resource modelling at A1's North Laverton tenements provided by its former managing director, John Williams, and the independent geological expert, Anthony Ryall (both considered Competent Persons, as defined by the JORC code). The company alleged that, since the director's departure, the board had found reason to doubt the geological data provided by Williams and Ryall since the geological modelling at the Brightstar Project could not be located. Hence, the board was unable to verify or substantiate the reserves and resources calculated by the former director.

The effect of this event was significant in terms of market reaction, with the share price falling by 43% in the 15 days following the event. In the announcement to the ASX on 3 March 2011, the importance of the reliability issue associated with the resource estimate was highlighted by A1's Chairman (AAM 2011):

> *It is disappointing that the Board has had to conduct a review of its geological database and in particular its gold resource inventory. However, in the circumstances, the Board considers it essential to ensure that the market can have confidence in A1's published geological data.*

The company responded by hiring an independent geological expert to revaluate the resource inventory. As can be seen in the following extract of the report (AAM 2011), it confirms the importance of reputation signals involved in hiring a reputable independent geological expert:

> *The Board has therefore referred these North Laverton resources at Delta and Epsilon to a reputable independent resource consultant for review. The results of this review are expected during March 2011 and will be released to the market upon receipt of the external report.*

Subsequently, the company announced on 5 April 2011 a new resource estimation calculated by the independent geological expert. The company disclosed that the geological expert undertaking the review was Andrew Hawker, principal geologist of Hawker Geological Services Pty Ltd. The company further added that the geologist is familiar with regional geology, having experience in working on important gold projects previously, and that he is suitably qualified (i.e., a member of the Australasian Institute of Mining & Metallurgy) to provide Competent Person statements under the JORC code.

In terms of outcomes of the review, the independent geologist examined the prior estimation and showed that the gold inventory was actually 46% lower than estimated by the prior in-house geologist. Although the report indicated substantially lower resources, the market reacted positively, with a 15% rise in share price on the day of the announcement. The A1 case serves to highlight the potential magnitude of market reactions to resource disclosures by MDSEs and the central importance of the Competent Person in such disclosures.

2.4 Descriptive statistics

2.4.1 Sample identification

In this section I describe the data collected for resource/reserve estimates and other variables related to the disclosure attributes, such as the length and tone of the disclosure. I develop a hand-collected proprietary database of project-level resource/reserve disclosure information, as described in Appendix D. The sample contains companies from the Materials sector listed on the ASX, which qualify as MDSEs according to the definition adopted by Ferguson, Clinch and Kean (2011) (hereafter FCK). As articulated in FCK, the mine lifecycle follows a predictable progression. Typically, exploration firms commence with grassroots exploration on projects they acquired from other mining entities or on tenements they applied for. Following a discovery and more extensive drilling programs, MDSEs will start investigating the quantification of the mineralisation. Once resource delineation has taken place subject to the firm's satisfaction, economic studies can begin. A description of the mining lifecycle is presented in Table 2.1.

To ensure that only MDSEs, and not mining producers, are included in the sample, I apply a filtering rule restricting the sample to companies with product revenues less than 5% of market capitalisation. Some MDSEs might evolve from exploration to production during the sample period. I address this lifecycle transformation issue by excluding the resource/reserve change observations when the firm ceases to meet the definition of a MDSE, that is, when it commences commercial mineral production.[11] I identify a sample of 2,061 resource/reserve disclosures, released by 414 MDSEs which

[11] The definition of a MDSE is consistent with that adopted in the prior literature in that the company has less than 5% product revenues compared to its market capitalisation. My sample includes one firm that commences production, but does not meet the 5% revenue threshold due to it being in the ramp-up phase, effecting one resource/reserve change.

made at least one JORC-compliant resource/reserve disclosure over the period 1996 to 2012.[12] The sample period was chosen due to the fact that the JORC framework was created after 1989 and amended in 1996. Thus, disclosures made post 1996 benefit from additional JORC requirements in the form of the inclusion of geological expert's name in the report. This sample represents all identifiable disclosures between January 1996 and 1999 and the known population of resource/reserve disclosures made by MDSEs after 1999, which are available on Morningstar's DatAnalysis database and searchable electronically.

For companies with mineral deposits that are not publically traded (and hence the price of the commodity is not available), I removed them from certain tests. For example, a total of 79 disclosures of mineral sands and rare earth resource/reserve changes were included in tests which do not require commodity prices but excluded otherwise. In addition, some resource/reserve disclosures constituting reference points or project acquisitions are not utilised in empirical testing but are instead used for calibrating the initial resource estimates to enable the change in resource/reserve categories to be assessed based on subsequent resource/reserve disclosures.[13] Table 2.2 indicates that there were 325 resource/reserve reference point disclosures used for such

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[12] Typically, MDSEs commence operations with grassroots exploration of projects they either have directly applied for, or acquired from other mining entities. Following an initial discovery and more extensive drilling programs, MDSEs will seek to quantify the mineralisation. Reporting of quantified resources/reserves then takes place through the JORC framework, which specifies reporting categories of resources/reserves. Once resource delineation has taken place, subject to the firm's satisfaction, economic feasibility studies can begin.

[13] For example, a reference point might be where a project was drilled and a resource identified in 1990, which was then followed by adverse firm-level economic conditions and a-10 year exploration hiatus. If deposit development then re-commenced during the year 2000, with a resource upgrade in 2002, I pick up the original 1990 resource as a reference point.

calibration purposes. 'Bad news disclosures' (190) are defined as any resource/reserve disclosure representing a downgrade in terms of total resource or total reserve.[14]

2.4.2 Variable description

Resource/reserve values

To measure the value associated with changes in resource/reserve estimates, I first construct two variables, *ValueResources* and *ValueReserve*, to represent the dollar value of mineral resources and reserves, respectively, disclosed by a sample firm, calculated as the product of the resource/reserve estimate and the price of the commodity concurrent with the disclosure. I then calculate the dollar value change between consecutive resource/reserve disclosures (indicated by time t and $t-1$)[15] by the same firm. To control for the effect that firm size has on the measures, I scale this dollar value change by the average market capitalisation of the firm in a 6-month period ending two months before the current announcement at time t to convert it into value change multiples. Following this procedure, I obtain two variables, *RSC* and *RSV*, for the scaled value change in resource and reserve estimates, respectively, from two consecutive disclosures by the firm. The detailed calculations are given as follows:

$$ValueResources\ or\ ValueReserves = (Resources\ or\ Reserves) * PRICE\_COMMODITY \quad (2.1)$$

$$RSC = \left(\frac{ValueResources_t - ValueResources_{t-1}}{MV}\right) \quad (2.2)$$

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[14] The classification method chosen for bad news disclosures is conservative, since it does not take into consideration the value of the commodity at the announcement date.

[15] Note that the notation t and $t-1$ only represents the fact that the two announcements are consecutive. However, the actual duration between t and $t-1$ is not fixed and does not represent calendar time.

$$RSV = \left(\frac{ValueReserves_t - ValueReserves_{t-1}}{MV}\right) \quad (2.3)$$

where, $Resources$ or $Reserves$ indicates the total amount of mineral resources or reserves disclosed, $PRICE\_COMMODITY$ is the price of the primary deposit commodity on the date closest to the day of the announcement event, and MV is the average market capitalisation of the firm in a 6-month period ending two months before the announcement at time t. For example, in the report from Appendix B.1, the total amount of estimated resources equals 728,000 ounces of gold.[16] Assuming the average gold price prior to the disclosure is $1,197 per ounce and using equation (2.1), the dollar value of the resources at time $t-1$ is calculated as follows:

$$ValueResources_{t-1} = TotalResources_{t-1} * PRICE\_COMMODITY_{t-1}$$

$$ValueResources_{t-1} = 728{,}000 * \$1{,}197$$

$$ValueResources_{t-1} = \$871{,}416{,}000$$

Next, using the information from Appendix B.2 (the resource revision), the total estimated amount of gold resources is 839,000 ounces. Assuming that the average gold price during the six months prior to the disclosure date is $1,225 per ounce, the dollar value of the resources at time t is calculated as follows:

$$ValueResources_t = TotalResources_t * PRICE\_COMMODITY_t$$

$$ValueResources_t = 839{,}000 \ * \$1{,}225$$

[16] The mine cut-off grade is the level of mineral in an ore below which it is not economically feasible to mine it. When multiple cut-off grades are provided, I select the one mentioned in the body or headline of the report. For example, in Appendix B.1 two cut-off grades are provided: one at 0.5 g/t and other at 1.0 g/t. The one mentioned in the headline (13.88Mt at 1.63 g/t) refers to the cut-off grade at 0.5g/t and therefore is the value used for this test.

$$ValueResources_t = \$1{,}027{,}775{,}000$$

Finally, assuming an average market value before the current announcement at time t of $61,000,000, the total value change (in market value multiples) in resource estimates is:

$$RSC = \frac{1{,}027{,}775{,}000 - 871{,}416{,}000}{61{,}000{,}000}$$

$$RSC = 2.56$$

In order to investigate the deposit categories arrayed in terms of increasing geological confidence, I decompose *RSC* and *RSV* into each of the five respective JORC resource/reserve categories (*Inferred*, *Indicated*, *Measured* resources*;* *Probable* and *Proved* reserves) as follows:

$$RSV = (PROVED + PROBABLE) \tag{2.4}$$

$$RSC = (MEASURED + INDICATED + INFERRED) \tag{2.5}$$

The scaled value change for individual resource/reserve categories are measured as follows:

$$INF = \frac{ValueResourcesInferred_t - ValueResourcesInferred_{t-1}}{MV} \tag{2.6}$$

$$IND = \frac{ValueResourcesIndicated_t - ValueResourcesIndicated_{t-1}}{MV} \tag{2.7}$$

$$MEA = \frac{ValueResourcesMeasured_t - ValueResourcesMeasured_{t-1}}{MV} \tag{2.8}$$

$$PRB = \frac{ValueReserveProbable_t - ValueReserveProbable_{t-1}}{MV} \tag{2.9}$$

$$PRV = \frac{ValueReserveProved_t - ValueReserveProved_{t-1}}{MV} \qquad (2.10)$$

where INF, IND, MEA, PRB and PRV are the value change multiples associated with inferred, indicated, measured, probable and proved categories, respectively.

To control for variations in the length of the disclosure across sample firms, I construct the variable *LNPAGES*, which is the natural log of the number of pages in each report. I also use the variable *GROWTH* to capture the importance of the news disclosed by the sample firms. It is a dummy variable which equals 1 if the announcement header contains keywords that represent substantial growth (such as 'major increase', 'doubles', 'triples', 'large', 'significant', etc.) and 0 otherwise.

Project location

To control for differences in project domicile across the sample, I include *FOREIGN* as a dummy variable to indicate offshore (outside of Australia) projects. I also use *GDP_PC,* the average gross domestic product per capita during the sample period for each country, to control for the difference in the level of economic development across countries where the projects are domiciled.

Geological experts' size ranking

The ranking used to differentiate geological experts in terms of size is measured by *GEO_SIZE*. For each geological expert, I measure the number of resource/reserve disclosures issued by each of its client firms in a year, weighted by each client's relative market value (relative to the average market value of all possible client firms in the sample), and then sum over clients (from 1 to *n_clients*) and years (from 1996 to *cur_year*). The weighting scheme tends to assign more weight to disclosures made by larger client firms. Specifically, the definition is given as follows:

$$GEO\_SIZE = \sum_{1996}^{cur\_year} \sum_{1}^{n\_clients} \frac{MarketValue_c * Num\_Announcements_c}{Average(MV\_Possible\ Clients)} \quad (2.11)$$

where cur_year is the current year, *c* is each client of the geological expert, *n_clients* is the number of clients of the geological expert in the current year and $Average(MV\_Possible\ Clients)$ is the average market value of all clients in the MDSE sample.

The quality of geological experts, proxied by expert size, is measured in three ways using equation (2.11): firstly, Big 4 geological experts (*B4*); secondly, specialist commodity-leading geological experts (*SPEC*); and thirdly, specialist leaders that also belong to the Big 4 group (i.e., *B4*SPEC*). Further, to capture the effect of switches in experts on client firms, I define a dummy variable *UPB4* which equals one if a client switches to an expert with a higher reputation (i.e., switching from non-Big 4 to Big 4). Similarly, I use the dummy variable *DNB4* to capture the switching to an expert of lower quality (i.e., switching from Big4 to non-Big 4). The two switch variables are determined by the expert's size ranking as defined in Equation (2.11).

2.4.3 Market structure of geological experts

This section explores the market structure of geological experts accompanying resource/reserve disclosures in the Australian MDSE setting. I collect a sample of 1,657 disclosures over the period 1996-2012 (described in Table 2.2) to provide evidence on the market structure of geological experts in Australia. As was discussed in the previous section, I define three different gradations of expert quality (*B4*, *SPEC* and *B4*SPEC*) based on the variable *GEO_SIZE* as described on Equation (2.11).

Size of geological experts as a proxy for quality

The JORC code establishes that a mining firm can engage either 'external' or 'internal' geological experts.[17] Figure 2.2 indicates that only 23% of the sample used an internal geological expert, whilst the majority of firms (77%) hired external geological experts. Figure 2.3 depicts the market share of the leader (Hellman and Schofield) using the *GEO_SIZE* measure (Equation 2.11), which is close to 30,000 for 2012. These descriptive statistics are featured in Table 2.4, Panels A and B, where name and size of geological experts are represented respectively. For most of the sample period, the Big 4 group is characterised by Hellman and Schofield followed by Snowden Mining Industry Consultants, Coffey Mining and SRK, with *GEO_SIZE* ranging from 8,000 to 30,000 based on the size-adjusted measure.[18,19] My configuration of a 'Big 4' is based on the four firms occupying the top four positions in terms of market share for the year calculated using individual firm market shares as depicted in Table 2.4.[20,21,22] The remaining experts are small companies or sole practitioners with a *GEO_SIZE* of below 3000.

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[17] While there is no need to be 'independent' in the JORC code, there is a requirement for a Competent Person to fulfil his or her professional obligations separate from the company, whether he or she is an independent contractor to the company, or an employee or officer of the company. To the extent of their professional obligations as a Competent Person, they are independent. The JORC code requires you, if you are full-time employee of the company, to state that fact in any compliance statements (refer clause 8 of the JORC code). Your relationship with the client, be it employee, independent contractor or officer/director of the company (Livesley, 2008), should be disclosed.

[18] Simunic (1980), Francis (1984), Francis and Stokes (1986) and Palmrose (1986) demonstrate that large auditor's fees are higher than small auditor's fees.

[19] In additional sensitivity analysis in Section 4.6, I reconfigure the large expert group by dropping the smallest member of the Big 4 group and test a Big 3 and a Big 2 construct. I also examine the impact of a Big 5 group.

[20] Note that this measure is dynamic in that I allow changes to the composition of the 'Big N' as market share rankings change year by year.

[21] The leader Hellman and Schofield belongs to the Big 4 group but distinguishes as a leader from the rest of the group in terms of size.

[22] Using this size measure I rank geological experts by their respective percentage market shares in Table 2.4 and 2.5, Panel C. Inspection of Table 2.4 and 2.5, Panel C, indicates that Hellman and Schofield is a market leader based on *GEO_SIZE*. There appears to be a natural break point between either the 4th largest or 5th largest consulting geologist. Given the 4 largest consulting geologists hold respective market share of from 74% to 86% over the 2004 to 2012 period.

Figure 2.4 depicts the market growth for geological experts in light of changes in the JORC code. During the 1998 version of the JORC code, which did not require a client to disclose the name of the geological expert responsible for the clients' resource/reserve disclosure, the data indicates the presence of only four geological experts. In 2004 a revised version of the JORC code was released, making the disclosure of the name of the geological expert mandatory. Accordingly, the number of geological experts increased approximately four times in the following eight years (35 to 130 distinct geological experts). Table 2.4 presents the ranking of geological experts over the time period from 1996 to 2012. Note that the composition of the top 4 geological experts change year by year and so does the measure of the Big 4 geological experts. For example, in 2002, the Big 4 group included Hellman and Schofield, RSG Global, Snowden Mining and Golder Associates; in 2008, the composition changed to Hellman and Schofield, Snowden Mining, Golder Associates and SRK Consulting.[23,24]

Leading geological experts (specialists) based on commodity clusters

I estimate leading geologists (specialists) based on different commodity clusters. The sample in this thesis includes mineral deposits that broadly fall into six different commodity groups: 'Precious metals', 'Base metals', 'Bulk commodities', 'Oil and gas', 'Solid fuel/uranium', and 'Other', as defined in Table 2.3. Consistent with prior research in the economics of auditing literature in the financial setting, I extend the

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[23] According to an ASX announcement released on 4 September 2006 by Coffey International, Coffey acquired RSG Global Consulting in order to expand its mining expertise and further globalise its operations, particularly in Africa and America.

[24] To accommodate the effect of mergers on the reputation ranking of experts, I combine the merging firms market share as calculated by equation (2.11) after 2006, adopting the name of the merged entity 'Coffey Mining'.

classification of the size/quality relation by considering specialisation of geological experts in the non-financial setting.

Figure 2.5 depicts the size (in terms of *GEO_SIZE*) of the specialist geologists for each commodity group. Panel A shows that the *GEO_SIZE* for the leader of ‘Precious metals’ (Hellman and Schofield) is close to 7,000 for 2012. ‘Base metals’ had Golder Associates as a leader until 2009, with a size of 400. After 2009, the leading geologist of ‘Base metals’ was assumed by Snowden Mining, with a size measure of approximately 900 for 2012. Panel C depicts the leading geologist for ‘Bulks’. Interestingly, Panel B and C show that Golder Associates and Snowden Mining swapped their specialisation groups. Snowden Mining, with a size measure of 1,000, is the leader of ‘Bulks’ until 2009, when Golder Associates assumed the leadership with a *GEO_SIZE* measure of 3,000 for year 2012. Panel D presents the market for ‘Oil and gas’ expertise, led by Netherland, Sewell & Associates with a size measure of 2,000 for year 2012. Panel E describes the leader for ‘Solid fuels’ (Hellmann and Schofield) with a size measure of approximately 1,500 for year 2012. The last commodity group depicted in Panel F, ‘Other metals’, is led by Hoye with a size measure of 5. In 2009 the leadership position in this sector was assumed by Hellman and Schofield with a *GEO_SIZE* measure of approximately 14 in 2012.

Table 2.5 depicts the ranking of geological experts over the time period 1996-2012 for each commodity group, showing the growth in the market for geological experts for each commodity group. For the year 2012, the largest group is ‘Precious metals’, with a total of 66 geological experts, followed by ‘Bulks’ with 40, ‘Base metals’ with 36, ‘Oil and gas’ with 13, ‘Solid fuels’ with five, and ‘Other metals’ with three.

2.4.4 Summary statistics

Table 2.6 presents the summary statistics for the 1,467 resource/reserve disclosures included in this study. The mean value change multiple associated with resource upgrades (*RSC*) is 64.89 times, whilst the mean value change multiple for reserve upgrades (*RSV*) is 1.07 times.[25] Of the full sample, there are 1,266 (86% of total observations) resource change disclosures, whilst there are only 248 (17% of total sample) disclosures containing reserve changes. The smaller number of reserve change disclosures relative to resource changes is expected, as the former is likely to be more prevalent for mineral producers than explorers. Cases where both resource and reserve updates are disclosed (*RSC*RES*) represent a mere 3.2% of the total number of observations and has a mean value change multiple of 18.75 times. The lower confidence JORC resource and reserve categories (*Inferred* and *Probable*) are associated with a higher mean value change and higher sample representation. *Inferred* (*INF*) has a mean value change multiple of 42.58 times, present in 86% of the total sample disclosures. *Indicated* (*IND*) has a mean of 9.94 times and is present in 56% of all disclosures. *Measured* (*MEA*) has a mean of 1.03 times, present in 19% of all observations. In terms of reserves, *Probable* (*PRB*) has a mean of 0.66 times and is found in 16% of the total sample, whilst *Proved* (*PRV*) has a much lower mean of 0.13 times and is present in only 9% of all disclosures. These descriptive statistics indicate that in terms of deposit value change, *INF* is by far the greatest, which would have been expected for a lower confidence resource category.

Table 2.6 reveals that the 400 listed sample firms have a mean (median) market capitalisation (*SIZE*) of approximately $239 million ($48 million). The minimum

[25] Note that these value changes are scaled by the average pre-announcement market value of the disclosing firms.

market capitalisation is $1 million, whilst the maximum is $20.4 billion.[26] The mean number of pages in each resource/reserve disclosure (*PAGES*) is 6.7. Altogether, there are 552 disclosures, representing 37% of the total sample, using announcement header terminology that is suggestive of significant resource/reserve growth (*GROWTH*). The number of disclosures accompanied by Big 4 geological experts (*B4*) is 327 (22% of total), commodity specialist geological experts is 175 (12% of total), whilst 48% of all announcements are accompanied by either small geological firms or sole practitioners. There are 145 disclosures (9% of the sample) where specialists also belong to the Big 4 group (*B4*SPEC*). In addition, there are 32 switches from non-Big 4 to Big 4 experts (captured by *UPB4*) and 41 switches from Big 4 to non-Big 4 experts (captured by *DNB4*).

In terms of project domicile, Table 2.6 shows that a total of 638 (43%) resource/reserve disclosures are related to projects outside of Australia (*FOREIGN*). Further information about the projects' location is depicted in Figure 2.6. It shows that in terms of offshore projects, the majority are located in Africa (246 projects), followed by Asia (102 projects), South/North America (62/70 projects) and Europe (47 projects). A closer examination of the project domicile indicates a mean per-capita GDP (*GDP_PC)* of $24,191 across 189 countries in the sample. The *GDP_PC* measure ranges from $153 (Congo) to $60,038 (Norway).

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[26] The $20.4 billion observation is FMG (Fortescue Metals Group). The next closest observation in terms of size is Arrow Energy, with a market capitalisation of approximately $3 billion.

2.5 Summary

In this chapter, I examine the characteristics of resource and reserve disclosures by MDSEs and the role of the geological experts in that process. Resource/reserve disclosures are the outcome of a company's continuous disclosure obligation to promptly report any material changes in its resource/reserve estimates. Such estimates must be classified based on their geological certainty and economic value and assured by a geological expert to be present in the disclosure as a Competent Person. The geological expert in the role of the Competent Person has the responsibility to prepare exploration results, estimate or supervise the estimation of mineral resources, and evaluate the economic viability of the extraction of ore reserves. The importance of the Competent Person is discussed throughout the chapter. The chapter also defines the sample selection process and various constructs and variables to be used in later chapters of the thesis. This is followed by an exploration of the structure of the market for geological experts in Australia, which indicates the presence of a market leader (specialist), a 'Big 4' group, a second tier of experts and sole practitioners. This market structure closely resembles the structure of the market for auditing services. I conclude the chapter by describing the summary statistics of the variables introduced throughout the chapter.

2.6 Chapter 2 figures and tables

Figure 2.1: JORC resource and reserve disclosure taxonomy

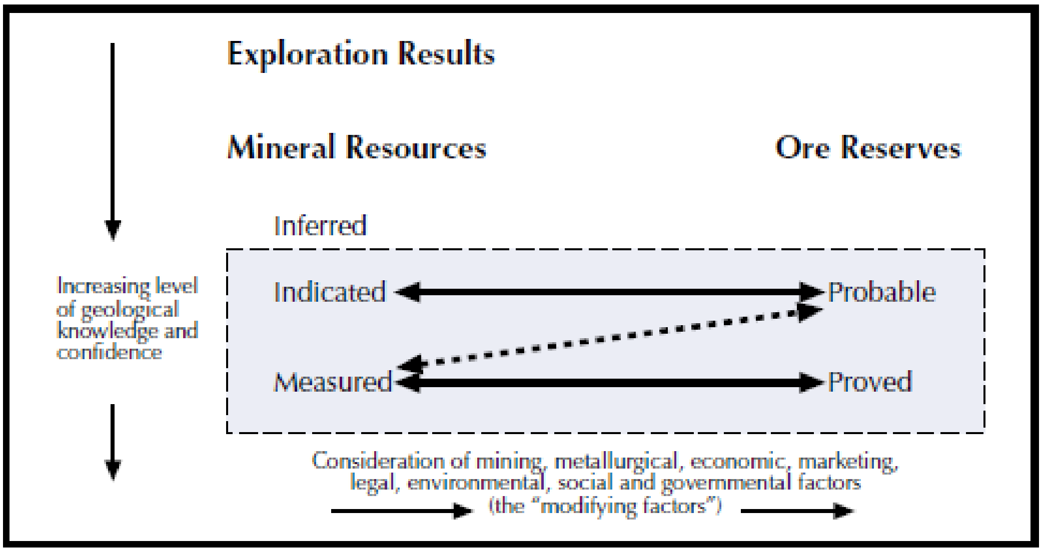


Figure 2.2: Distribution of geological experts by type

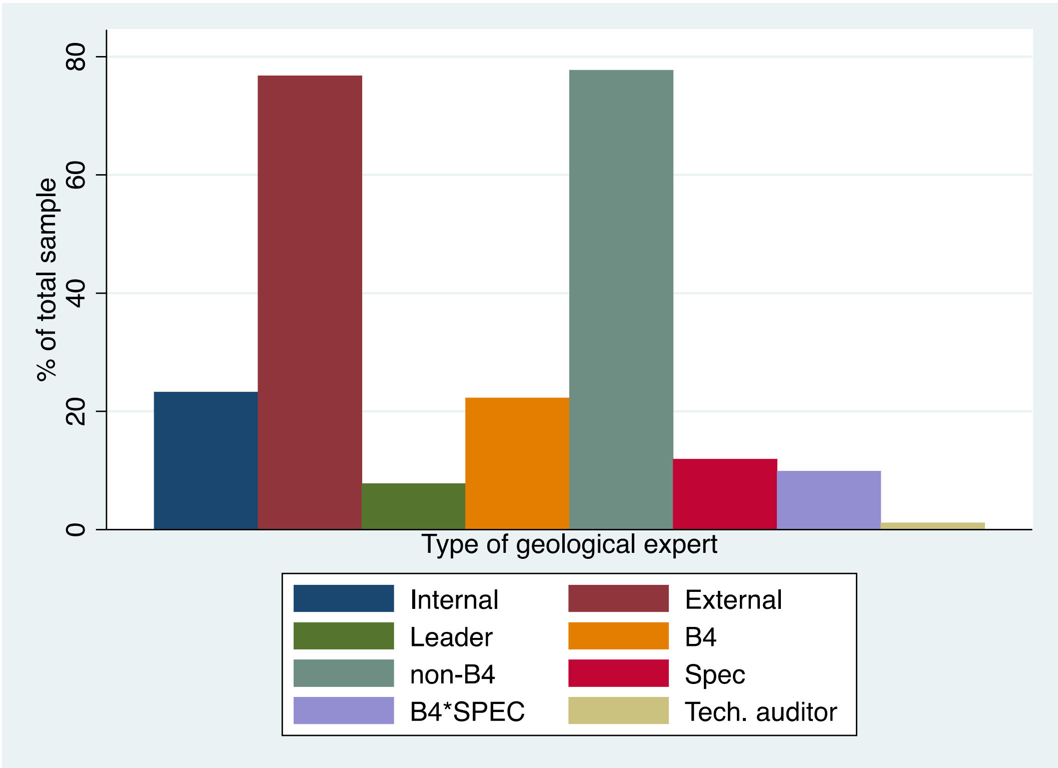


Figure 2.3: Distribution of the size (*GEO_SIZE*) of the top 100 external geological experts: 2004 to 2012

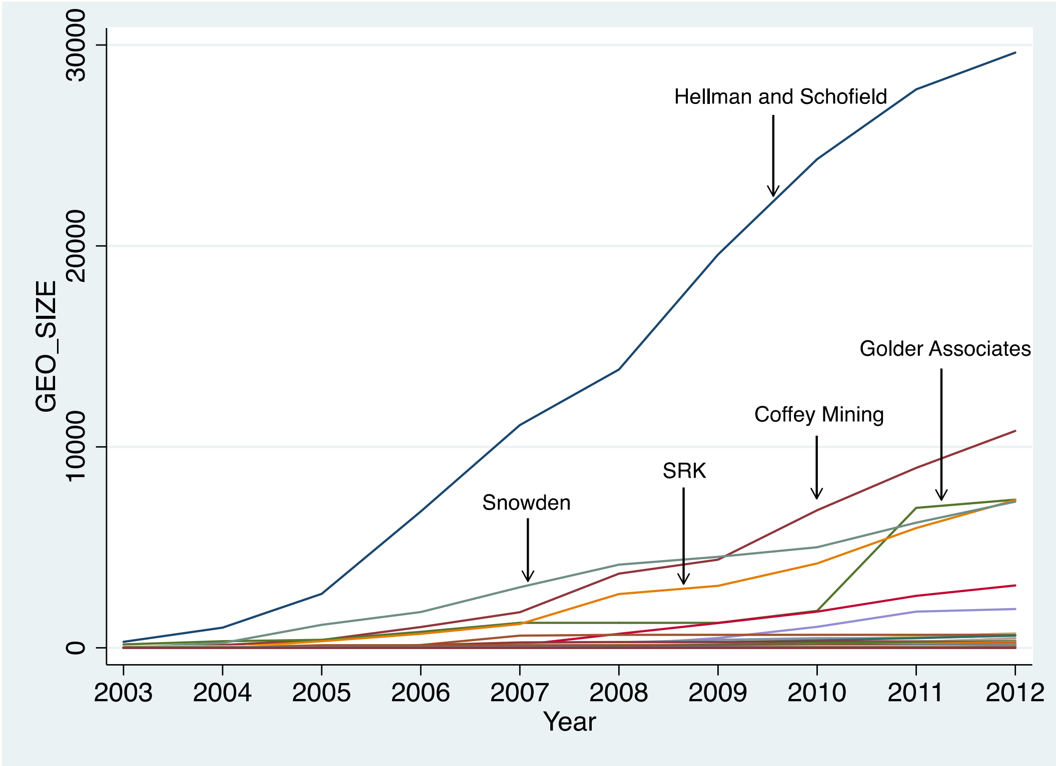


Figure 2.4: Number of geological experts by year

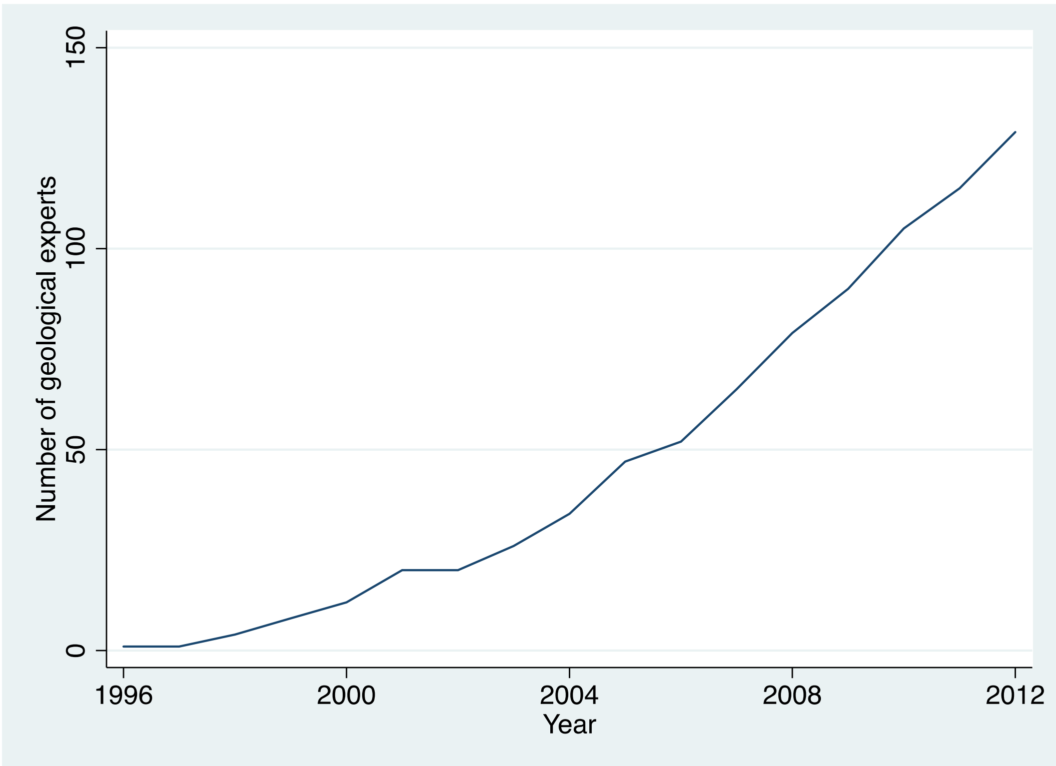
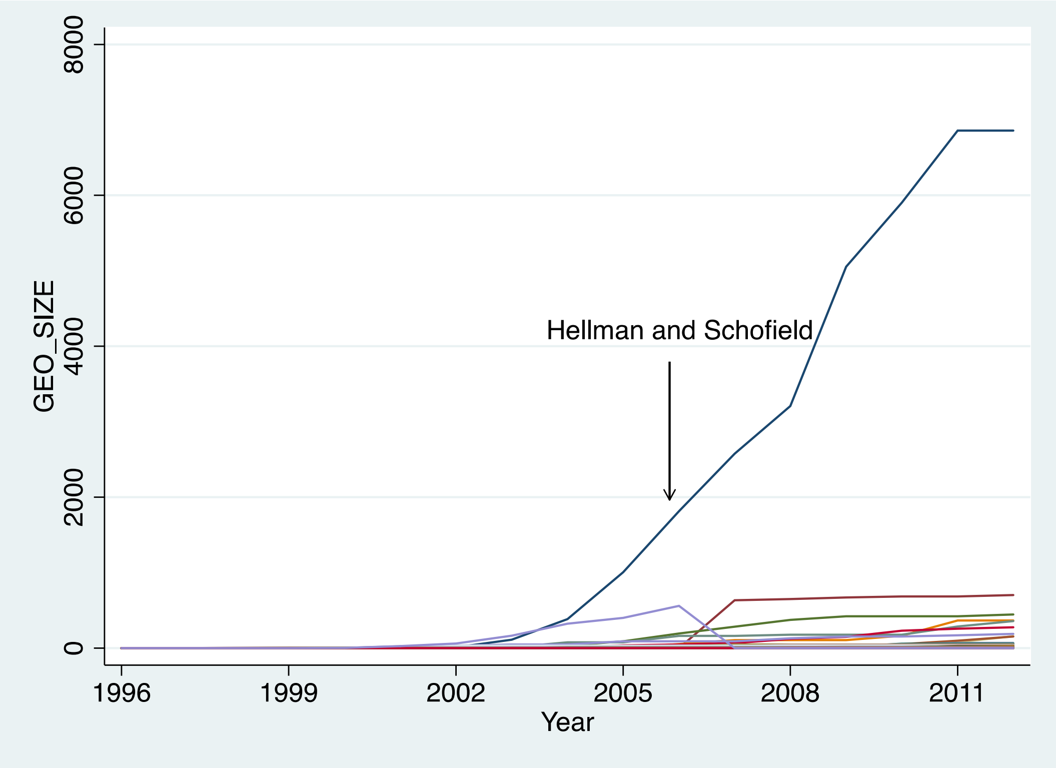
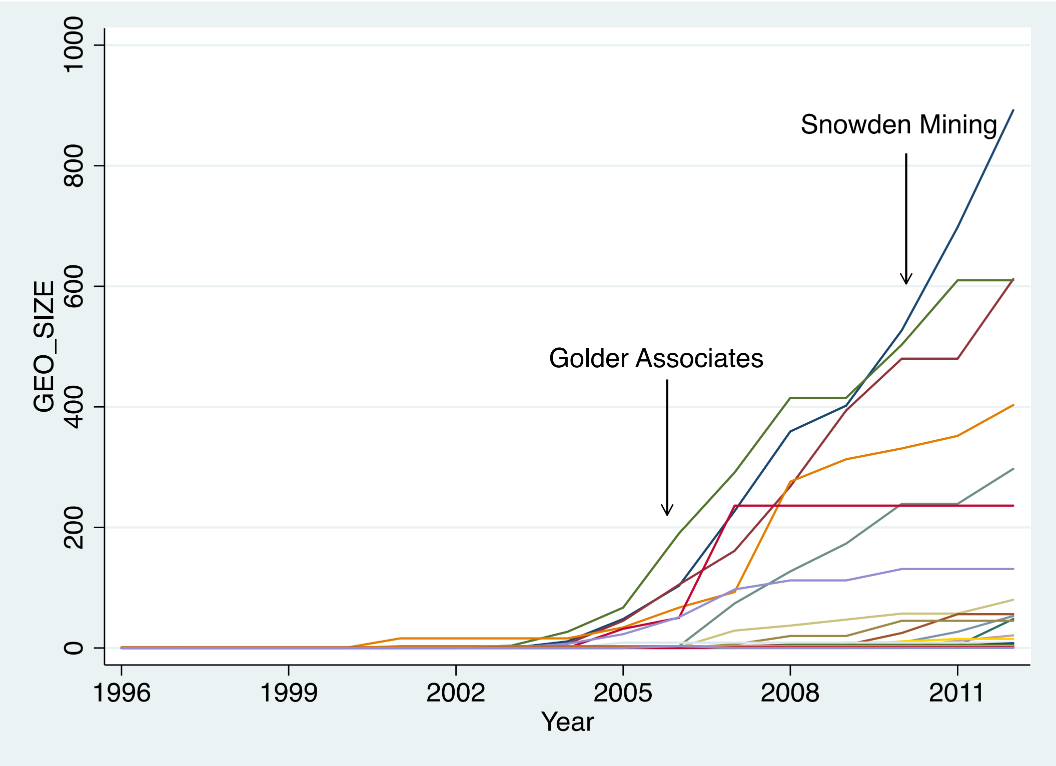


Figure 2.5: Distribution of the size (*GEO_SIZE*) of leading geological experts by commodity group

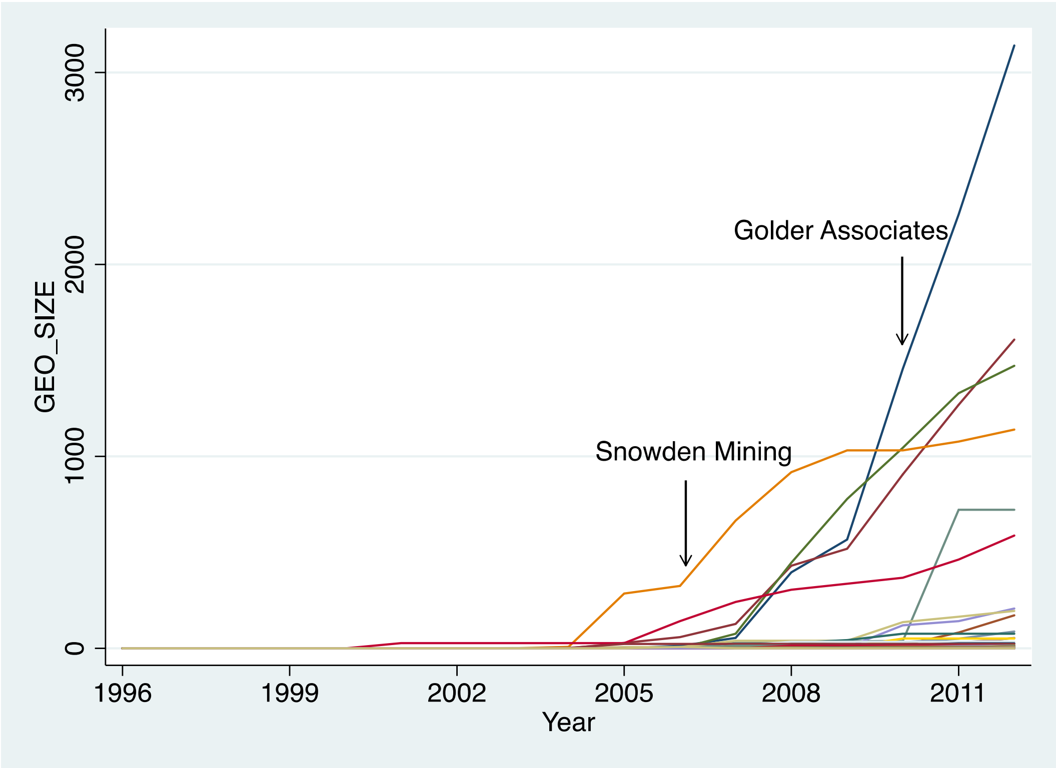
Panel A – Precious metals



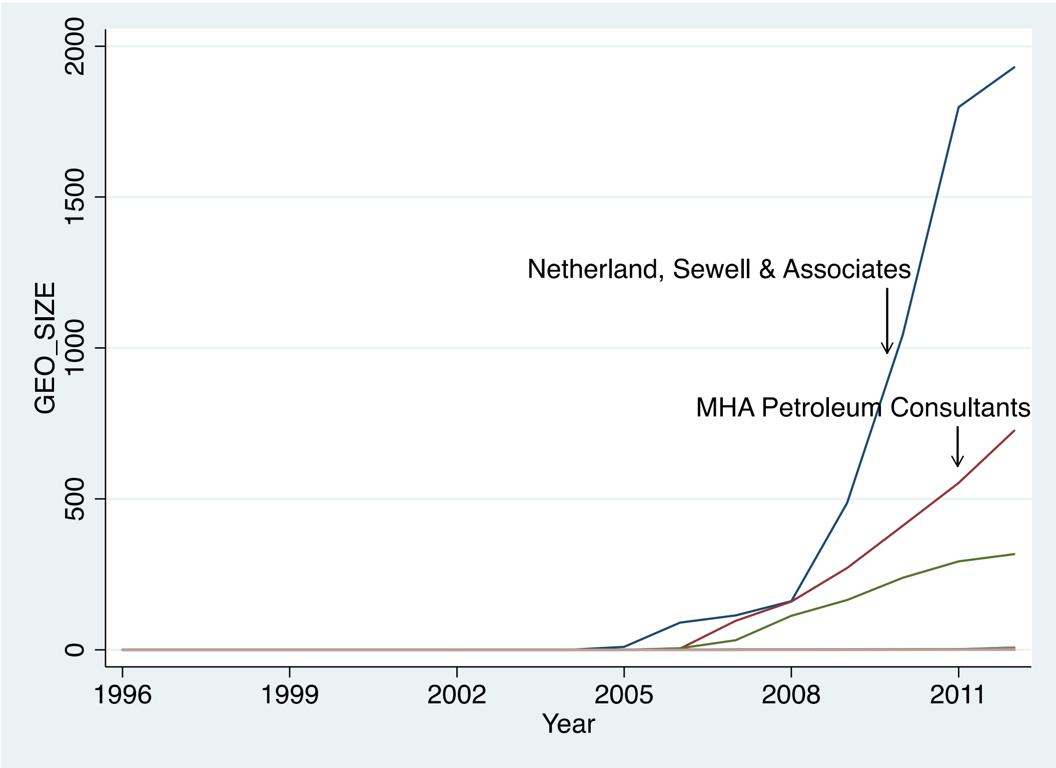
Panel B – Base metals



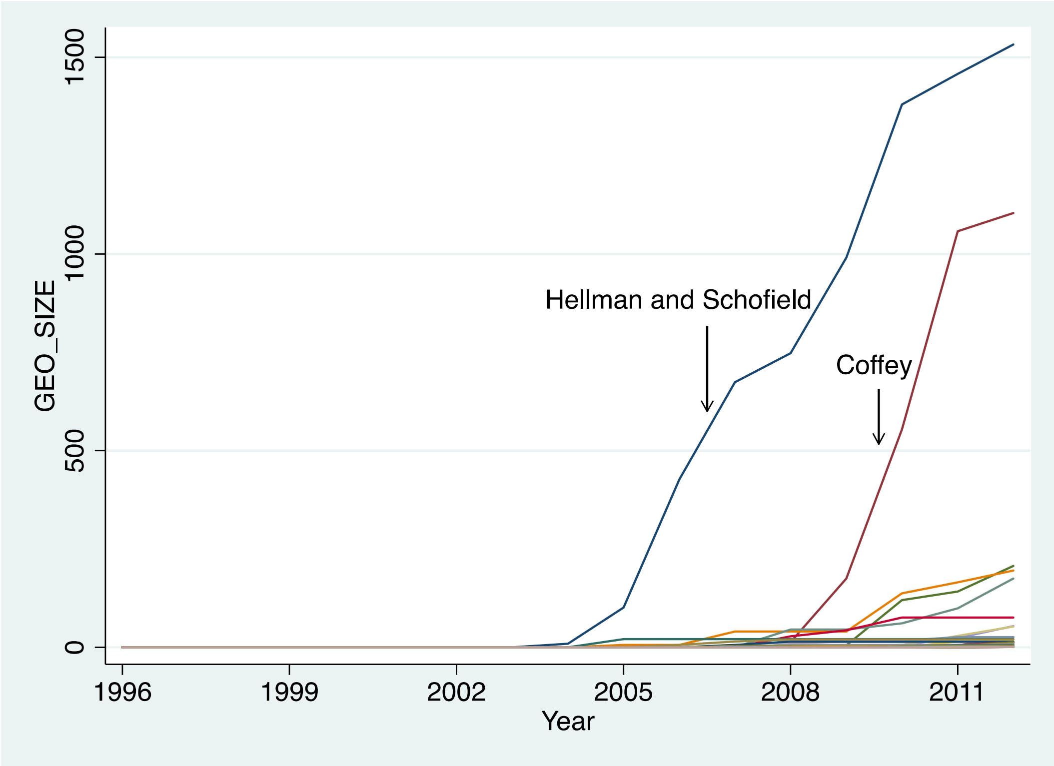
Panel C – Bulks



Panel D – Oil and Gas



Panel E – Solid Fuels



Panel F – Other Metals

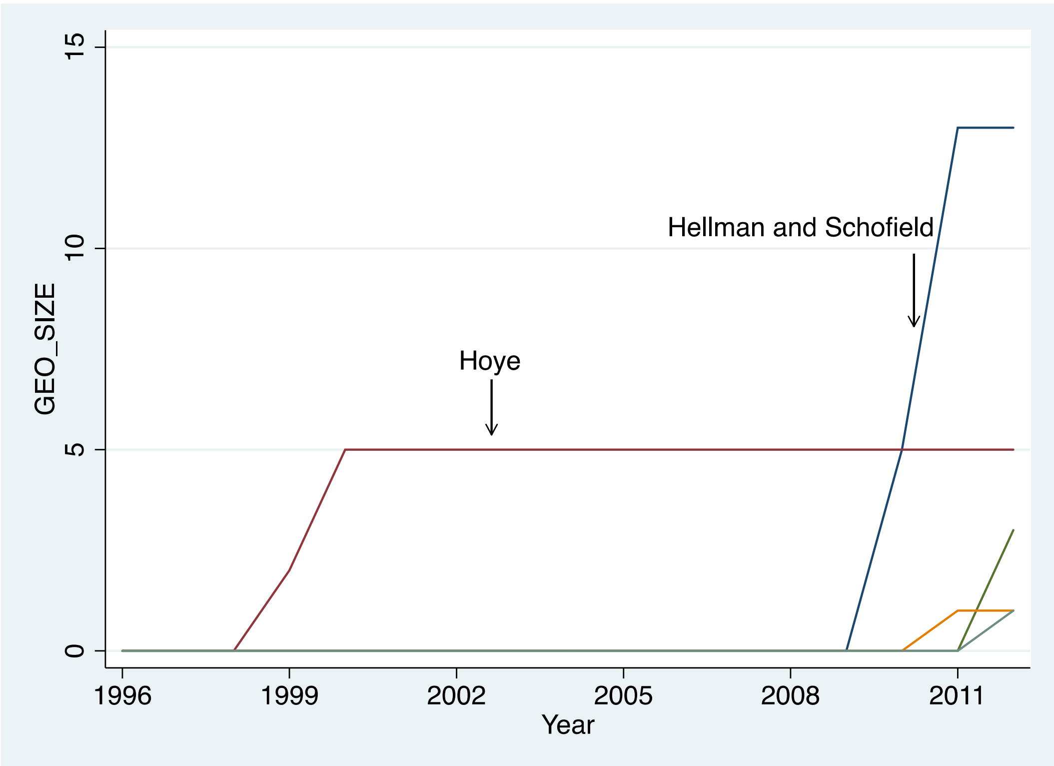
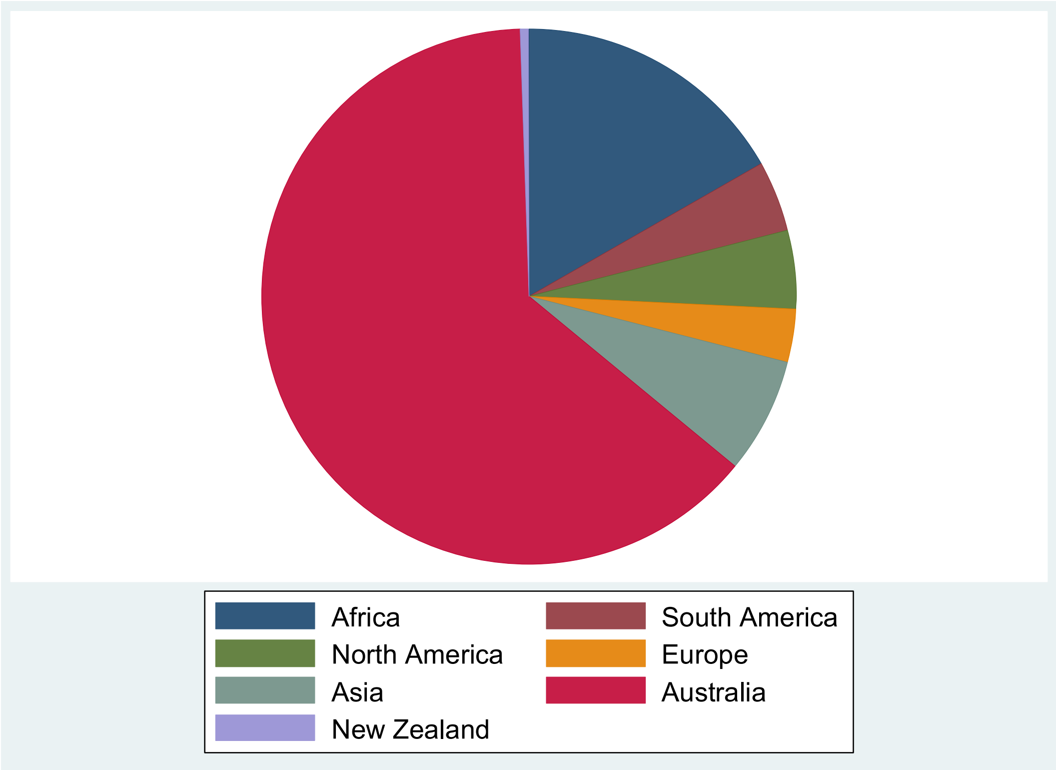


Figure 2.6: Geographical distribution of project domicile in resource/reserve disclosures

Panel A – Graphical representation of the geographical distribution of disclosures



Panel B – Supplementary numbered representation of the geographical distribution

Location	Number of Projects
Africa	246
South America	62
North America	70
Europe	47
Asia	102
Australia	932
New Zealand	8

Table 2.1: Stages of mine development lifecycle

Stage No.	General Stage	Specific Stage
1	Exploration	Project Acquisition, Tenement Application/Grant.
2		Grassroots Exploration
3		Discovery
4		Resource Definition
5	Scoping and Feasibility	Scoping Study Commencement
6		Scoping Study Completion
7		Pre-Feasibility Study Commencement
8		Pre-Feasibility Completion
9		Full Feasibility Study Commencement
10		Full Feasibility Study Completion
11	Development	Approval
12		Financing
13		Construction
14		Commissioning
15	Production	Production

Table 2.2: Sample selection

	Action	Companies	Obs.
Original sample	Collect	414	2061
Observations only for reference	Less	229	325
Subtotal		**414**	**1736**
Bad news disclosures	Less	136	190
Subtotal		**408**	**1546**
Projects with commodity prices unavailable (REO, Sand Minerals)	Less	19	79
Final sample	-	400	1467

Table 2.3: Sample distribution by commodity type

Precious	Base	Bulks	Oil & Gas	Solid Fuel	Other
Gold	Cobalt	Coal	Gas	U3O8	Lithium
Platinum	Cooper	Iron	Oil	Coal	Magnesium oxide
Silver	Nickel				Phosphate
	WO3				
	Zinc				
	Lead				
	Tin				
	Bauxite				
	Molybdenum				
	Vanadium				
	Manganese				
555 Obs.	339 Obs.	360 Obs.	87 Obs.	229 Obs.	20 Obs.
38% Total	23% Total	25% Total	6% Total	16% Total	1% Total

Table 2.3 shows the sample distribution by commodity type. The total represents the final sample observations (1,467) depicted in Table 2.2 without bad news. Note that Coal is duplicated in both Bulks and Solid Fuel groups due to alternative classification tests.

Table 2.4: Market structure of geological experts across all commodities by year

Panel A: Market structure representing the name of geological experts' organization

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	GRD	GRD	WGM	Geoval	GRD	H&S	H&S	H&S	H&S	H&S	H&S	H&S	H&S	H&S	H&S	H&S	H&S
2	Sole	Sole	PGM	WGM	Geoval	RSG	RSG	RSG	RSG	Snowden	Snowden	Snowden	Snowden	Snowden	Golder	Golder	Golder
3			Geoval	MCS	Hoye	GRD	MCS	MCS	Snowden	RSG	Golder	Golder	Golder	Golder	Snowden	Coffey	Coffey
4			GRD	PGM	WGM	MCS	Boyer	Boyer	Golder	Golder	RSG	Coffey	SRK	SRK	SRK	Snowden	SRK
5			Sole	Henry	Lionore	SRK	GRD	Golder	MCS	SRK	SRK	SRK	Coffey	Coffey	Coffey	SRK	Snowden
6				Hoye	MCS	Boyer	SRK	GRD	Boyer	GRD	GRD	FinOre	CSA	CSA	CSA	CSA	CSA
7				GRD	RSG	Geoval	Snowden	SRK	ResVal	MCS	FinOre	ResVal	FinOre	FinOre	NSAI	NSAI	NSAI
8				Signet	PGM	Hoye	Geoval	Snowden	Raven.	ResVal	ResVal	Newe.	ResVal	NSAI	FinOre	FinOre	MHA
9				Sole	Henry	WGM	Hoye	Hackch.	GRD	FinOre	MCS	GRD	Newe.	Newe.	Newe.	MHA	FinOre
10					Boyer	Lionore	Golder	Geoval	SRK	Newe.	Newe.	CSA	Cube	ResVal	MHA	Cube	Newe.
11					Signet	Newn.	WGM	BFP	AMC	Cube	NSAI	MCS	MCS	MHA	Cube	Newe.	Cube
12					Raven.	Speijers	Lionore	Hoye	Hackch.	Boyer	Cube	NSAI	NSAI	Cube	ResVal	ResVal	AMC
13					Sole	PGM	Newn.	WGM	Newe.	Raven.	Raven.	Raven.	MHA	GCA	Raven.	MCS	Raven.
14						Henry	Speijers	Lionore	Cube	GRD	Boyer	MHA	GRD	Raven.	GRD	Raven.	MCS
15						Speijers	PGM	Newn.	Geoval	Widenbar	Widenbar	Cube	Raven.	GRD	MCS	GCA	Runge
16						Snowden	Henry	Speijers	BFP	AMC	GRD	JB	GCA	MCS	GCA	AMC	ResVal
17						Signet	Speijers	PGM	Hoye	Maxwell	AMC	QuantGr	QuantGr	QuantGr	Widenbar	Widenbar	GCA
18						Raven.	Signet	Henry	WGM	NSAI	Maxwell	GCA	Widenbar	Widenbar	JB	Orelogy	Widenbar
19						Golder	Raven.	Speijers	Lionore	Hackch.	QuantGr	Boyer	JB	AMC	Xenith	Runge	Xenith
20						Rsc Svc	Rsc Svc	McKe.	Newn.	Mike Barr	Hackch.	Widenbar	AMC	Salva	AMC	JB	JB
N	2	2	5	9	13	21	22	27	35	48	53	66	80	91	106	116	130

Panel B: Market structure representing the size of geological experts' organization as measured by GEO_SIZE

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	1	1	4	7	11	27	98	296	1007	2681	6789	11084	13850	19569	24315	27782	29615
2	1	1	2	4	7	26	62	165	324	1145	1784	3011	4136	4529	6841	8952	10792
3			2	3	5	21	32	66	239	401	1036	1774	3686	4386	4999	8208	8615
4			1	2	4	19	31	31	135	390	794	1248	2680	3082	4201	6232	7348
5			1	2	4	16	21	30	66	330	701	1182	1412	2051	3085	5956	7270
6				2	3	9	16	21	31	132	144	610	693	1237	1803	2583	3104
7				1	3	7	11	16	24	114	132	268	644	644	1044	1798	1930
8				1	2	5	7	11	24	58	126	161	291	487	644	644	726
9				1	2	4	5	9	21	52	114	138	268	394	480	553	644
10					2	4	5	7	16	45	105	132	194	291	411	485	612
11					1	3	4	7	13	38	90	130	190	271	365	480	607
12					1	3	4	5	9	31	49	114	161	266	321	321	478
13					1	2	3	4	7	24	33	107	160	248	282	320	459
14						2	3	4	7	21	31	96	132	165	239	304	342
15						2	2	3	7	16	30	76	121	153	221	293	323
16						2	2	3	7	13	21	40	113	132	152	276	321
17						1	2	2	5	13	13	33	65	96	137	189	317
18						1	1	2	4	10	13	32	42	89	132	174	291
19						1	1	2	4	9	11	31	40	47	120	168	207
20						1	1	2	3	9	9	30	40	43	107	165	195
N	2	2	5	9	13	21	22	27	35	48	53	66	80	91	106	116	130

Table 2.4 presents the rank by size (*R*) of the top 20 geological experts as defined by Equation (2.11). *N* is the number of external geological experts per year. Appendix A shows the full name of geological experts as per abbreviation.

Panel C: Market structure representing the market share of geological experts' organization as measured by GEO_SIZE

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	50%	50%	40%	30%	24%	17%	32%	43%	52%	48%	56%	55%	48%	51%	49%	42%	40%
2	50%	50%	20%	17%	15%	17%	20%	24%	17%	21%	15%	15%	14%	12%	14%	14%	15%
3			20%	13%	11%	13%	10%	10%	12%	7%	9%	9%	13%	11%	10%	12%	12%
4			10%	9%	9%	12%	10%	5%	7%	7%	7%	6%	9%	8%	8%	9%	10%
5			10%	9%	9%	10%	7%	4%	3%	6%	6%	6%	5%	5%	6%	9%	10%
6				9%	7%	6%	5%	3%	2%	2%	1%	3%	2%	3%	4%	4%	4%
7				4%	7%	4%	4%	2%	1%	2%	1%	1%	2%	2%	2%	3%	3%
8				4%	4%	3%	2%	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%
9				4%	4%	3%	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
10					4%	3%	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
11					2%	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
12					2%	2%	1%	1%	0%	1%	0%	1%	1%	1%	1%	0%	1%
13					2%	1%	1%	1%	0%	0%	0%	1%	1%	1%	1%	0%	1%
14						1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
15						1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
16						1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
17						1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
18						1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
19						1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
20						1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
N	2	2	10	23	46	156	311	686	1953	5532	12025	20297	28918	38180	49899	65883	74196

Table 2.4 presents the rank by size (*R*) of the top 20 geological experts as defined by Equation (2.11). *N* is the number of external geological experts per year. Appendix A shows the full name of geological experts as per abbreviation.

Table 2.5: Market structure of leading geological experts by commodity group

Panel A: Market structure representing the name of geological experts' organization

Panel A.1: Precious metals

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1			WGM	Geoval	Geoval	RSG	RSG	RSG	H&S	H&S	H&S	H&S	H&S	H&S	H&S	H&S	H&S
2			Geoval	WGM	GRD	MCS	MCS	H&S	RSG	RSG	RSG	Coffey	Coffey	Coffey	Coffey	Coffey	Coffey
3			Sole	MCS	WGM	GRD	Boyer	MCS	Snowden	MCS	Golder	Golder	Golder	Golder	Golder	Golder	Golder
4				PGM	Lionore	Boyer	GRD	Boyer	MCS	Golder	Snowden	Snowden	Snowden	Snowden	Cube	SRK	SRK
5				Henry	RSG	Geoval	H&S	Golder	Golder	Snowden	MCS	SRK	MCS	MCS	Snowden	Snowden	Snowden
N	0	0	3	6	12	17	18	23	29	38	39	42	48	55	57	61	66

Panel A.2: Base metals

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	GRD	GRD	GRD	GRD	GRD	SRK	SRK	SRK	Golder	Golder	Golder	Golder	Golder	Golder	Snowden	Snowden	Snowden
2	Sole	Sole	Sole	Sole	Sole	Newn.	Newn.	Golder	SRK	Snowden	Newe.	FinOre	Snowden	Snowden	Golder	Golder	Newe.
3						GRD	GRD	Newn.	Snowden	Newe.	Snowden	Snowden	SRK	Newe.	Newe.	Newe.	Golder
4						Sole	Sole	McKe.	Newe.	SRK	SRK	Newe.	Newe.	SRK	SRK	SRK	SRK
5								GRD	ResVal	FinOre	ResVal	ResVal	FinOre	FinOre	H&S	H&S	H&S
N	2	2	2	2	2	4	4	6	10	14	20	22	26	26	31	32	36

Panel A.3: Bulks

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1						H&S	H&S	H&S	H&S	Snowden	Snowden	Snowden	Snowden	Snowden	Golder	Golder	Golder
2								MCS	Snowden	SRK	H&S	H&S	CSA	CSA	CSA	CSA	SRK
3									GRD	H&S	SRK	SRK	SRK	Golder	Snowden	SRK	CSA
4									MCS	GRD	GRD	CSA	Golder	SRK	SRK	Snowden	Snowden
5										JB	Golder	Golder	H&S	H&S	H&S	Coffey	Coffey
N	0	0	0	0	0	1	1	2	4	8	9	12	20	25	32	36	40

Panel A.4: Oil and gas

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1										NSAI	NSAI	NSAI	NSAI	NSAI	NSAI	NSAI	NSAI
2										Sole	GCA	MHA	MHA	MHA	MHA	MHA	MHA
3											MHA	GCA	GCA	GCA	GCA	GCA	GCA
4											Ecopetrol	WMA	WMA	WMA	WMA	WMA	LKA
5											Sole	Ecopetrol	Ecopetrol	Ecopetrol	LKA	LKA	FGA
N	0	0	0	0	0	0	0	0	0	1	4	5	6	7	9	11	13

Panel A.5: Solid fuel

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1						Sole	Sole	Sole	H&S	H&S	H&S	H&S	H&S	H&S	H&S	H&S	H&S
2									Sole	GRD	GRD	JB	SRK	Coffey	Coffey	Coffey	Coffey
3										JB	FinOre	GRD	JB	SRK	JB	JB	Xenith
4										Sole	JB	FinOre	Salva	Salva	Xenith	Xenith	JB
5											Sole	Camden	GRD	JB	Salva	SRK	SRK
N	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	3	5

Panel A.6: Other metals

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1				Hoye	Hoye	Hoye	Hoye	Hoye	Hoye	Hoye	Hoye	Hoye	Hoye	Hoye	Hoye	H&S	H&S
2															H&S	Hoye	Hoye
3																Sole	Sole
4																	
5																	
N	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	3	3

Panel A presents the rank by size (*R*) of the top five geological experts as defined by Equation (2.11), separated by commodity group as defined in Table 2.3. *N* is the number of external geological experts per year. Appendix A shows the full name of geological experts as per abbreviation.

Panel B: Market structure representing the size of geological experts' organization as measured by GEO_SIZE

Panel B.1: Precious metals

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1			4	7	7	26	62	165	384	1005	1815	2575	3208	5055	5904	6859	6859
2			2	4	4	19	32	111	324	401	560	634	634	634	634	634	634
3			2	3	4	11	31	48	78	90	194	283	374	422	422	422	446
4				2	4	9	11	31	48	89	161	161	178	178	231	365	365
5				2	3	7	11	13	35	78	90	106	129	154	178	286	357
N	0	0	3	6	12	17	18	23	29	38	39	42	48	55	57	61	66

Panel B.2: Base metals

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	1	1	1	1	1	16	16	16	27	67	190	291	415	415	527	698	892
2	1	1	1	1	1	3	3	4	16	48	105	236	359	402	503	610	612
3						1	1	3	11	45	103	227	276	394	480	480	610
4						1	1	2	7	34	67	161	268	313	331	352	403
5							0	1	7	32	51	97	236	236	239	239	297
N	2	2	2	2	2	4	4	6	10	14	20	22	26	26	31	32	36

Panel B.3: Bulks

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1						27	27	27	27	285	325	666	918	1031	1456	2260	3141
2								1	7	28	142	242	446	778	1045	1329	1608
3									2	27	58	127	430	567	1031	1269	1472
4									1	23	23	76	396	519	906	1077	1140
5										6	12	54	305	336	368	694	694
N	0	0	0	0	0	1	1	2	4	8	9	12	20	25	32	36	40

Panel B.4: Oil and gas

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1									1	10	90	114	161	487	1044	1798	1930
2										1	5	96	160	271	411	553	726
3											4	32	113	165	239	293	317
4											1	2	2	2	2	2	8
5											1	1	1	1	2	2	8
N	0	0	0	0	0	0	0	0	1	1	4	5	6	7	9	11	13

Panel B.5: Solid fuel

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1						0	0	0	9	101	427	674	748	991	1380	1458	1533
2										21	21	40	45	175	554	1058	1104
3										6	6	21	40	45	137	165	207
4											6	15	28	43	120	142	195
5												6	21	40	76	99	175
N	0	0	0	0	0	0	0	0	1	3	4	11	19	22	32	39	43

Panel B.6: Other metals

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1				2	5	5	5	5	5	5	5	5	5	5	5	5	5
2															5	13	13
3																1	1
4																	
5																	
N	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	3	3

Panel B presents the rank by size (*R*) of the top five geological experts as defined by Equation (2.11), separated by commodity group as defined in Table 2.3. *N* is the number of external geological experts per year. Appendix A shows the full name of geological experts as per abbreviation.

Panel C: Market structure representing the market share of geological experts' organization as measured by GEO_SIZE

Panel C.1: Precious metals

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1			50%	39%	32%	36%	42%	45%	44%	60%	64%	69%	71%	78%	80%	80%	79%
2			25%	22%	18%	26%	22%	30%	37%	24%	20%	17%	14%	10%	9%	7%	7%
3			25%	17%	18%	15%	21%	13%	9%	5%	7%	8%	8%	7%	6%	5%	5%
4			0%	11%	18%	13%	7%	8%	6%	5%	6%	4%	4%	3%	3%	4%	4%
5			0%	11%	14%	10%	7%	4%	4%	5%	3%	3%	3%	2%	2%	3%	4%
S	0	0	8	18	22	72	147	368	869	1663	2820	3759	4523	6443	7369	8566	8661

Panel C.2: Base metals

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	50%	50%	50%	50%	50%	76%	76%	62%	40%	30%	37%	29%	27%	24%	25%	29%	32%
2	50%	50%	50%	50%	50%	14%	14%	15%	24%	21%	20%	23%	23%	23%	24%	26%	22%
3	0%	0%	0%	0%	0%	5%	5%	12%	16%	20%	20%	22%	18%	22%	23%	20%	22%
4	0%	0%	0%	0%	0%	5%	5%	8%	10%	15%	13%	16%	17%	18%	16%	15%	14%
5	0%	0%	0%	0%	0%	0%	0%	4%	10%	14%	10%	10%	15%	13%	11%	10%	11%
S	2	2	2	2	2	21	21	26	68	226	516	1012	1554	1760	2080	2379	2814

Panel C.3: Bulks

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1						100%	100%	96%	73%	77%	58%	57%	37%	32%	30%	34%	39%
2						0%	0%	4%	19%	8%	25%	21%	18%	24%	22%	20%	20%
3						0%	0%	0%	5%	7%	10%	11%	17%	18%	21%	19%	18%
4						0%	0%	0%	3%	6%	4%	7%	16%	16%	19%	16%	14%
5						0%	0%	0%	0%	2%	2%	5%	12%	10%	8%	10%	9%
S	0	0	0	0	0	27	27	28	37	369	560	1165	2495	3231	4806	6629	8055

Panel C.4: Oil and gas

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1									100%	91%	89%	47%	37%	53%	61%	68%	65%
2									0%	9%	5%	39%	37%	29%	24%	21%	24%
3									0%	0%	4%	13%	26%	18%	14%	11%	11%
4									0%	0%	1%	1%	0%	0%	0%	0%	0%
5									0%	0%	1%	0%	0%	0%	0%	0%	0%
S	0	0	0	0	0	0	0	0	1	11	101	245	437	926	1698	2648	2989

Panel C.5: Solid fuel

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1									100%	79%	93%	89%	85%	77%	61%	50%	48%
2									0%	16%	5%	5%	5%	14%	24%	36%	34%
3									0%	5%	1%	3%	5%	3%	6%	6%	6%
4									0%	0%	1%	2%	3%	3%	5%	5%	6%
5									0%	0%	0%	1%	2%	3%	3%	3%	5%
S	0	0	0	0	0	0	0	0	9	128	460	756	882	1294	2267	2922	3214

Panel C.6: Other metals

R	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1				100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	50%	26%	26%
2				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	68%	68%
3				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	5%
4																	
5																	
S	0	0	0	2	5	5	5	5	5	5	5	5	5	5	10	19	19

Panel C presents the rank by market share (*S*) of the top 5 geological experts as defined by Equation (2.11), separated by commodity group as defined in Table 2.3. *N* is the number of external geological experts per year. Appendix A shows the full name of geological experts as per abbreviation.

Table 2.6: Descriptive statistics

	Mean	Std. Dev.	Min	Max	Obs.	% Total obs.
RSC (RESOURCES)	64.894	146.928	0	600.209	1266	86%
RSV (RESERVES)	1.072	3.076	0	12.001	248	17%
RSC*RSV	18.75	329.356	-98.899	7203.161	47	3.2%
GRADE_RSC	0.987	0.082	0.764	1.164	1266	86%
GRADE_RSV	0.999	0.014	0.901	1.059	248	17%
MEA	1.031	3.404	0	15.996	283	19%
IND	9.938	25.310	-3.171	109.999	819	56%
INF	42.581	104.518	-30.077	423.302	1260	86%
PRV	0.136	0.486	0	2.042	136	9%
PRB	0.661	2.003	0	8.101	235	16%
SIZE	239.041	1079.32	1	20488	1467	100%
LNSIZE	4	1.568	0	9.928	1467	100%
PAGES	6.794	7.534	0	165.000	1467	100%
LNPAGES	1.655	0.81	-9.21	5.106	1467	100%
GROWTH	1	0	0	1	552	38%
B4	1	0	0	1	327	22%
SPEC	1	0	0	1	175	12%
B4*SPEC	1	0	0	1	145	9%
UPB4	1	0	0	1	32	2.1%
DNB4	1	0	0	1	41	2.7%
FOREIGN	1	0	0	1	638	43.5%
GDP_PC	24191.6	14424.93	153.437	39345	1467	100%
GDP_RANK	3.647	1.714	1	10	1467	100%
GDP_HIGH	1	0	0	1	65	4.4%
GDP_LOW	1	0	0	1	300	20.4%

Variable Definitions:
RSC = Value change in mineral growth classified as resources, scaled by pre-announcement market capitalisation.
RSV = Value change in mineral growth classified as reserves, scaled by pre-announcement market capitalisation.
*RSC*RSV* = Interaction term between *RSC* and *RSV*.
GRADE_RSC = Percentage change in resource grade.
GRADE_RSV = Percentage change in reserve grade.
MEA = Value change in resource category classified as *Measured*, scaled by pre-announcement market capitalisation.
IND = Value change in resource category classified as *Indicated*, scaled by pre-announcement market

capitalisation.
INF = Value change in resource category classified as *Inferred*, scaled by pre-announcement market capitalisation.
PRV = Value change in reserve category classified as *Proved*, scaled by pre-announcement market capitalisation.
PRB = Value change in reserve category classified as *Probable*, scaled by pre-announcement market capitalisation.
SIZE = Market capitalization (in $million) of the disclosing firm in the month of the announcement.
LNSIZE = Natural logarithm of *SIZE*.
PAGES = Number of pages in each resource/reserve disclosure report.
LNPAGES = Natural logarithm of *PAGES*.
GROWTH = Dummy variable which equals 1 if the announcement header contains keywords that represent significant growth in resources/reserves and 0 otherwise.
B4 = Dummy variable which equals 1 if a geologist belongs to the top 4 (in terms of *GEO_SIZE*) geological experts across all commodity groups and 0 otherwise.
SPEC = Dummy variable which equals 1 if a geologist is the specialist leading expert by commodity group and 0 otherwise.
*B4*SPEC* = Interaction term between the Big 4 geological experts across all commodities and the specialist leader by commodity.
UPB4 = Dummy variable which equals 1 for switches from non-Big 4 to Big-4 experts and 0 otherwise.
DNB4 = Dummy variable which equals 1 for switches from Big-4 to non-Big 4 experts and 0 otherwise.
FOREIGN= Dummy variable which equals 1 for offshore projects and 0 otherwise.
GDP_PC = Average of GDP per capita of the country where a project is located during the period 1996-2012.
GDP_RANK = Ranking based on the *GDP_PC* deciles.
GDP_LOW = Dummy variable which equals 1 if *GDP_RANK* belongs to the 2 lowest deciles and 0 otherwise.
GDP_HIGH = Dummy variable which equals 1 if *GDP_RANK* belongs to the 2 highest deciles and 0 otherwise.

CHAPTER 3

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

3.1 Introduction

The review of literature relevant to this thesis is structured as follows. First, I introduce the literature on the market reactions to disclosures in the extractive industry. Next, I review a classic study on information asymmetry and reputational effect (Akerlof, 1970). I then review studies considering the importance of reputation in three different settings, including initial public offerings (IPOs), takeovers and auditing. In Section 3.4, I review the literature on reputational effect of underwriter expertise in the IPO context. In Section 3.5, I consider the literature on the effect of independent experts' reports in takeovers. The literature on auditor reputation in the capital markets context is reviewed in Section 3.6, which includes a discussion of audit quality, auditor industry specialisation, market reactions to auditor switches, auditing of resource/reserve disclosures and the auditing and assurance effects in the capital markets setting. In Section 3.7, I review the literature on the value of non-financial information in the capital markets setting. Finally, in section 3.8, I develop the research hypotheses for this study.

3.2 Disclosure research in the extractive industries

Magliolo (1986) presents a capital market analysis of the oil and gas accounting method by examining the value relevance of the additional information regarding proven and probable oil and gas reserves required by the FASB (Financial Accounting Standard

Board). He proposes a model that ties the valuation of oil and gas reserves to the current sales prices and extraction costs of oil and gas reserves under certainty. The author concludes that the oil and gas reserve data are not associated with market values or changes in market values. Magliolo (1986) also indicates that the market anticipates information on the reserve disclosures. He suggests that when a firm drills a promising well that has no proved reserves, investors might attach value to the unproved well.

Further research has documented a relation between the announcements of reserve-based present value data and decreases in information asymmetry (Raman and Tripathy, 1993; Boone, 1998). Raman and Tripathy (1993) focus on the petroleum industry in the United States (US). They evaluate present value-based supplemental disclosures of reserves made by US oil and gas firms in annual reports and examine changes in bid-ask spreads around the time of these disclosures. They use a sample of 31 oil- and gas-producing firms for the years 1980–87. They compare the average spread over the 20 trading days following the 10K filing date with the average spread over the 20 trading days ending five trading days before the filing date.

Raman and Tripathy (1993) observe a decline in the bid-ask spreads of oil and gas firms following these routine disclosures of changes in the value of their oil and gas reserves. The magnitude of the reserve-based disclosures is negatively associated with changes in bid-ask spreads. In other words, these disclosures have the effect of reducing information asymmetry. Importantly, the reserve disclosures appear to be informative even after controlling for the usual determinants of bid-ask spreads (such as price variability and trading volume). Raman and Tripathy (1993) conclude that the supplemental disclosure of present values of petroleum reserves constitutes value-relevant information and that public disclosure of this information reduces information asymmetry in the securities markets by reducing the informed trading component of bid-ask spreads.

In a more recent study, Boone (1998) considers a similar issue by using a longer (one-year) event window, allowing examination of changes in the average level of spreads that persisted across a relatively extended period of time. Using the longer window, Boone (1998) provides insight into the sensitivity of the results reported in Raman and Tripathy (1993). Boone (1998) compares the quoted bid-ask spread, as an observable measure of information asymmetry, on common stocks traded by 34 firms in the NASDAQ market before and after a fair value measure of oil and gas reserves was initially released in 1979 by oil and gas firms pursuant to Accounting Series Release (ASR) No. 253 (SEC, 1978).

Boone (1998) finds a reduction in bid-ask spreads that persisted for at least 12 months following the initial mandated disclosure of oil and gas reserve value estimates. The amount of the decline was statistically associated with the absolute value of the difference between the book value of oil reserves and the discounted present value of oil reserves. This result indicates that the findings of Raman and Tripathy (1993) are not merely short-term in nature caused by transitory changes in information asymmetry surrounding routine information releases. Instead, the information release has an effect on market conditions that persisted over an extended period of time. This result may be interpreted as indicating that such reporting changes lower transaction costs faced by investors. I adopt a similar approach to the prior market microstructure studies in the extractive industries setting by examining the impact of resource/reserve disclosures in a new setting— mining firms in Australia.

Apart from these two prior studies in the US, there are only a limited number of studies outside of the US examining resource companies in the capital markets context. Brown and Burdekin (2000) examine the collapse in share prices of MDSEs following the Bre-X Minerals scandal. Bre-X was an infamous case of 'salting' in which precious metals traces were added to samples following drill core extraction and prior to core assay. Subsequently, the company's Busang gold resource in Indonesia, which previously was believed to contain the world's largest gold deposit, was shown to be a fraud. Examining a sample of 59 gold mining companies, Brown and Burdekin (2000) show that not only does news of the Bre-X fraud significantly lower the excess returns across the industry, but also the negative effects are greater for junior mining companies.

In terms of prior Australian studies, Ferguson and Crockett (2003) examine intra-industry information transfer after a successful drill result announcement that sparked significant investor interest in mining companies with tenement holdings in the surrounding area in the Gawler Craton region of South Australia. They argue that mining companies are subject to greater information asymmetry due to the specialised and highly technical nature of geological information. Ferguson and Crocket (2003) report that the discovery by one miner (Helix Resources NL) on their tenement in South Australia impacted the market value of miners with nearby leases, with spatially-closer competitors being greater beneficiaries in terms of abnormal returns.

This evidence of significant information transfers among mineral explorers is consistent with the finding of Poskitt (2005), who examines information-based trading in mining exploration companies as distinct from mineral producers. Poskitt (2005) finds that the 'mining-exploration sector suffers from greater information-based trading than the mining-production sector' (p. 224). An alternative view of this result is that the link between firm activities and market value signalling is much stronger for exploration companies than for mineral producers.

O'Shea, Worthington, Griffiths, and Gerace (2008) investigate the impact of firm-specific disclosures on price volatility of Australian metals and mining firms. They find that greater disclosure has positive volatility effects and that the effects are relatively greater for small and mid-sized firms than large firms. More recently, Ferguson and Scott (2011) examine the market reaction to 817 investor presentations by 326 Australian resource firms. They find that these presentations are informative to the market. Moreover, when they partition their sample based on commodity types, they find that precious metal-focused firms have stronger market reactions to investor presentations than other firms.

Bird, Grosse and Yeung (2011) examine market reactions to resource/reserve disclosures using an Australian sample. They show evidence of significant, positive market reactions to drilling and resource/reserve announcements by Australian mining companies on their exploration activities. The authors use a sample of 1,378 exploration announcements (drilling results, assays and other announcements) disclosed by 307 firms over a period of four years (17 December 2004 and 31 December 2008). I extend Bird *et al*. (2011) in six ways. First, by collecting project-level resource/reserve disclosure data, I am able to classify resource/reserve changes under the JORC reporting framework by tracking firms' changes in resource/reserve endowments over each individual mining project's lifecycle from inception through to development. This means I am able to decompose resource/reserve changes into respective JORC *Inferred*, *Indicated* and *Measured* resource categories, and JORC *Probable* and *Proved* reserve categories. Thus the hand collection of resource and reserve data at the project level is a necessary approach to accurately classifying and measuring resource/reserve changes. My data-capture methodology contrasts with that of Bird *et al*. (2011), who do not distinguish individual JORC resource/reserve categories. Second, by collecting project-level resource/reserve data, I am able to assess the impact of resource/reserve changes in terms of different primary commodities across mineral deposits. Accordingly, I am able to estimate an aggregate measure of deposit value change associated with each resource/reserve disclosure. Bird *et al*. (2011) do not consider the impact of commodity types.

Third, since I track resource/reserve endowments at the deposit level over each mining project's lifecycle, I am able to control for the sequencing of resource/reserve disclosures. Fourth, Bird *et al*. (2011) do not distinguish between MDSEs and existing mineral producers, which have a markedly different information environment.[27] Fifth, Bird *et al*. (2011) is a more descriptive study, with little in the way of robust multivariate analysis. I extend Bird *et al*. (2011) by constructing a multivariate model of stock price reactions to resource/reserve disclosures, controlling for the reputational effect of geological experts. Sixth, project-level data allows me to control for idiosyncratic disclosure attributes, such as document lengths, project location, tone of the announcement and other deposit level characteristics, like grade changes.

[27] In the 708 resource/reserve disclosures analysed by Bird *et al*. (2011), it is not known how many were disclosed by MDSEs or production firms.

3.3 The market for 'lemons'

Akerlof (1970) discusses economic models in which 'trust' is important. The author describes the market for used cars in articulating the problem of quality uncertainty. In this market, there are both good quality cars and bad quality cars (the latter are known in the US as 'lemons') for sale. A new car may be a good car or a lemon, with the same applying to used cars. Akerlof (1970) suggests these goods are sold honestly or dishonestly; hence, quality may be represented faithfully or it may be misrepresented.

The author argues that the buyer of a car does not know ex ante whether it is a good car or a lemon; therefore, the buyer values a used car based on the assumption that it would have 'average' quality. Hence, the owner of a good car will be worse off and unable to sell their car for a fair price. This would lead to owners of good cars withholding their cars from the used car market. When good cars are not sold in the market, the average quality of cars in the market is further reduced, resulting in buyers having even lower expectations in terms of average quality. The author suggests that this process will result in a market only for lemons or market failure.

In this study, Akerlof uses the market for used cars as an example of the impact of information asymmetry on product quality in the market. In this example, the author argues that the cost of misrepresenting quality (i.e., dishonesty) lies not only in the amount by which the purchaser is cheated, but also in the loss incurred from driving legitimate business out of existence. As in the example discussed by Akerlof (1970), who would be interested in a market with only bad cars?

Akerlof (1970) also suggests there is considerable evidence that quality variation is greater in underdeveloped than in developed countries and that numerous institutions counteract the effects of quality uncertainty by guarantees. As a result of this model, risk is borne by the seller rather than the buyer. Hence, consumer durables carry guarantees to ensure the buyer of some normal expected quality. Akerlof (1970) indicates brand names as an institution to counteract the effects of quality uncertainty. He explains that not only do brand names indicate quality but also they provide consumers with a means of retaliation if the quality does not meet expectations. He uses, as an example, the fact that new products are often associated with old brand names, which assure the prospective consumer of the quality of the product.

The author indicates that licensing serves as a way for institutions to reduce quality uncertainty (e.g., doctors, lawyers and barbers). His argument is based on the fact that most skilled labour carries some certification, indicating the attainment of certain levels of proficiency. Certifications, such as high school diploma, PhD, or even the Nobel Prize, to some degree, serve the function of building the 'brand names' of differentiated education and labour markets.

Akerlof observes that informal, unwritten guarantees are preconditions for trade and production. He generalises Gresham's law ('the bad drives out the good') and shows that where these guarantees are indefinite, business will suffer. The work of Akerlof (1970) is highly relevant for this thesis in that the geological expert has an important role to play given that mining is characterised by high information asymmetry. Supporting this argument is recent evidence of high failure rates observed among mining projects (Ferguson, Clinch and Kean, 2011). This suggests that geological experts play an important role in keeping the market for junior mining companies operational. Support for this assertion is found in Brown and Burdekin (2000), as discussed in the previous section. They argue that investor confidence is especially important in asset markets that rely heavily on uncertain future events, such as the junior mining sector. Consistent with Akerlof (1970), they confirm that fraud and misinformation in one instance led investors to re-evaluate the quality of the information provided by similar firms. Brown and Burdekin (2000) conclude that in markets where reputation plays a critical role in assessing the quality of information, such events often lead investors to assume the worst for the remaining firms as well.

In summary, Akerlof (1970) implies that greater quality variation in underdeveloped as opposed to developed countries may also apply in the case of developed/less-developed markets. Under such scenario, a less-developed market (such as an MDSE) would represent potentially higher quality variation. This proposition motivates the chosen setting for this thesis. The fact that new products are often associated with old brand names would also have implications for my current study. For MDSE firms operating in a high information asymmetry environment, a high-reputation geological expert would mitigate the adverse effect of the quality uncertainty faced by investors.

3.4 Underwriter expertise

The function of IPO underwriters bears certain similarities to geological experts. Both experts in the IPO and geological settings convey reputational signals to the markets. In both cases, the respective professionals act to reduce the effect of asymmetric information between firm insiders and outsiders. In contrast to the resource/reserve disclosure and geological experts setting, the reputational effect of underwriters has been extensively explored. I briefly review the literature on IPO underwriters in the following sections.

3.4.1 Underwriter reputation

A substantial body of work on IPOs of common stock examines the effects of underwriter reputation on the initial performance of IPOs. Some of the literature on the relation between underwriter reputation and issuer choice focuses on observable factors, such as initial and long-run underpricing in the IPO market (e.g., Carter, Dark and Singh, 1998; Cliff and Denis, 2004), tombstone rankings (e.g., Carter and Manaster, 1990), and underwriter market share (e.g., Beatty and Ritter, 1986).

Based on prior studies that indicate the average IPO is underpriced (e.g., Ibbotson, 1975; Ritter, 1984), Beatty and Ritter (1986) demonstrate a monotonic relation between the (expected) underpricing of an IPO and the uncertainty of investors regarding its value. They also find that the resulting underpricing equilibrium is enforced by investment bankers who have reputation capital at stake. This indicates that the amount of underpricing is taken as a proxy for underwriters' quality, and issuers with higher quality underwriters would have lower underpricing.

Beatty and Ritter (1986) demonstrate that an investment banker who 'cheats' on this underpricing equilibrium will lose either potential investors (if it does not underprice enough) or issuers (if it underprices too much), and thus sacrifice the value of its reputation capital. They name the uncertainty in the event in which even though on average IPOs are underpriced, an investor submitting a purchase order cannot be certain about an offering's value once it starts public trading as an 'ex-ante uncertainty'. They argue that the greater the ex-ante uncertainty, the greater is the (expected) underpricing.

Beatty and Ritter (1986) suggest that the underpricing equilibrium reflects the fact that an issuing firm, which will go public only once, cannot make a credible commitment that the offering price is below the expected market price once it starts trading. Instead, an issuing firm must hire an investment banker to take the firm public. The investment banker would be in a position to enforce the underpricing equilibrium because it will be involved in many initial public offerings over time. Beatty and Ritter (1986) argue that any investment banker who 'cheats' on the underpricing equilibrium, by persistently underpricing by either too little or too much, will be penalised by the marketplace.

Beatty and Ritter (1986) test their predictions based on a sample of 1,028 issuers conducting SEC-registered IPOs of common stock during the period 1977-82. To test the hypothesised positive association between ex-ante uncertainty and expected underpricing, they regress initial returns on two proxies of ex-ante uncertainty using a weighted least squares (WLS) approach. Their measure is based on whether underwriters whose offerings had average initial returns that were not commensurate with their ex-ante uncertainty lost in market share subsequently. This is achieved by analysing whether there is a relation between mispricing by investment bankers and subsequent change in market share. The authors compute the market share of all underwriters with four or more initial public offerings during the first sub-period. Beatty and Ritter (1986) find that investment bankers who price off line in one sub-period do in fact lose market share in the subsequent sub-period, although the relation is noisy. They argue the empirical evidence seems to support their proposition that investment bankers enforce the underpricing equilibrium.

Carter and Manaster (1990), motivated by the intuition that issuing firms and underwriters deliberately underprice their IPOs and that the role of the underwriter may be important, develop an empirically testable model of IPO underpricing. The model is an extension of Rock's (1986) model of IPO underpricing. It shows that as the risk of an issue increases, informed demand will increase. Carter and Manaster (1990) show that because low-risk firms cannot credibly distinguish themselves from high-risk firms, they employ high-reputation investment banks to certify that they are low-risk firms. This would allow them to underprice to a lesser extent. They find results consistent with this hypothesis, suggesting that underwriter reputation may itself serve as a surrogate for IPO risk. Low-risk firms will attempt to reveal their low-risk characteristics to the market by selecting prestigious underwriters.

Carter and Manaster (1990) document a significant negative relation between underwriter prestige and the price run-up (underpricing plus returns in the first two weeks of trading) variance for the IPOs that they underwrite. They also find a significant, negative relation between prestige and the magnitude of the IPO price run-up. The model is consistent with, and extends, past empirical results. Moreover, Carter and Manaster (1990) suggest that their measure of underwriter prestige can be applied to other models involving investment bankers, reputation and underwriting. As such, their study bears relevance to this thesis, since the same intuition can be applied to the measuring of geological experts' reputation. In a similar fashion to Carter and Manaster (1990), who measure underwriters' reputation in a ranking from 1 to 9 depending on its location in the announcement (e.g., if an underwriter's name is disclosed in the top or in the bottom of the report), I assign rankings based on the location of the geological expert in the resource/reserve disclosure document (i.e., whether the expert's name appears in the body or footnote of the report).

Studies prior to Carter (1992) tend to suggest a greater likelihood of subsequent offerings for IPOs marketed by prestigious underwriters (e.g., Hayes, Spence, and Marks, 1983). Carter (1992) empirically tests and provides evidence on this question by examining the hypothesis that the likelihood of subsequent offerings is negatively related to IPO risk.

Carter (1992) uses a sample based on 541 IPOs with data on underwriter gross proceeds (the underwriter's transaction charge for the IPO) of at least $2 million issued between 1 January 1982 and 31 December 1983. To examine the effect of underwriter reputation, Carter applies the reputation proxy developed by Carter and Manaster (1990) which entails examining the placement of underwriters below the managing underwriter in tombstone announcements. He tests the difference in mean measures of risk, underwriter reputation, and underwriter gross proceeds between firms with subsequent offerings and those with no subsequent offerings. He also estimates Spearman rank correlation coefficients between the number of subsequent offerings and the four independent variables.

Carter (1992) finds results consistent with Carter and Manaster (1990) in that low-risk issuing firms are more likely to have subsequent offerings within the next five years than high-risk firms. Hence, the likelihood of subsequent offerings is positively related to the IPO underwriter's reputation and negatively related to the IPO gross spread. Carter (1992) concludes that the likelihood of firms switching their IPO underwriter for subsequent offerings decreases with increasing IPO underwriter reputation.

Chemmanur and Fulghieri (1994) model reputation acquisition by investment banks in the equity market. In contrast to many IPO studies, their objective is not to explain the 'underpricing' of IPOs. Instead, they try to relate the reputation of investment banks to their effectiveness in reducing the impact of asymmetric information between firm insiders and outsiders. Chemmanur and Fulghieri (1994) analyse the role of financial intermediaries as information producers, suggesting that reputation acquisition by intermediaries can mitigate the credibility problem. They argue that intermediaries can, even in good faith, generate wrong information due to the complexity of the environment being analysed and therefore it would be difficult to distinguish between good and bad information generators. In the context of an investment bank underwriting a stock issue, the authors model the effect of reputation acquisition in the intermediary's role as a producer of credible information. Using this model, they derive implications for the valuation of financial securities sold by the intermediary.

Chemmanur and Fulghieri (1994) argue that investors do not observe the amount of resources investment banks allocate for the evaluation of IPO projects. In addition, they cannot measure the strictness of investment banks when they recommend investment in a firm. Thus, investors tend to focus on underwriters' past performance, by assessing the quality of firms in which they have sold equity in the earlier period, as a signal of credibility for valuing the equity they market accordingly. Other empirical implications of their model include that investment banks can be more effective in resolving information asymmetry in the equity market due to their reputation and that more prestigious investment banks engage in underwriting contracts with less-risky IPO firms.

In contrast to the prior short-run studies, Carter, Dark and Singh (1998) document the relation between the long-run performance of IPOs and different proxies for underwriter prestige. The authors examine the relationship between initial and three-year returns following the IPO and underwriter reputation. They also provide a comparative evaluation of three existing measures of underwriter prestige (CM, based on Carter and Manaster, 1990; JM, based on Johnson and Miller, 1988; and MW, based on Megginson and Weiss, 1991) in the context of initial returns and three-year after-market performance of IPOs.

Carter, Dark and Singh (1998) conduct tests of underwriter reputation measures using a sample of IPOs issued from 1 January 1979 through to 31 December 1991. Using ordinary least squares regressions, the authors regress the initial returns for each IPO on the three reputation measures (MW, JM and CM), both separately and altogether. They find that each reputation measure examined is significantly related to initial returns. However, among the three alternative reputation proxies, the Carter-Manaster (CM) measure explains more of the variation in the initial returns compared to the Johnson-Miller or the Megginson-Weiss measure. The results indicate that the CM underwriter reputation proxy has a relatively greater explanatory power than the other two proxies.

Carter, Dark and Singh (1998) find that each of the reputation proxies is significantly related to IPO initial returns; the greater the reputation of the underwriter, the less is the short-run underpricing. The results indicate that IPOs underwritten by more prestigious investment banks have lower long-run underperformance. Finally, they conclude that, of the three reputation proxies examined, even though the CM measure is the most costly to compile, it appears to be the best proxy for underwriter prestige.

Dunbar (2000) examines several factors affecting market share of investment banks that act as book managers in IPOs between 1984 and 1995. This study examines the relation between quantifiable factors (such as IPO first-day returns, one-year abnormal performance, abnormal compensation, industry specialisation, analyst reputation) and an investment bank's ability to generate underwriting business as proxied by changes in its IPO market share. Dunbar (2000) uses data from successful firm-commitment IPOs between 1984 and 1995 to calculate the market share, and finds a negative relation between initial overpricing and market share changes for investment banks with an established reputation. In addition, underwriters tend to increase their IPO market share if they have an analyst highly rated in the annual Institutional Investor survey.[28]

Dunbar (2000) finds that the one-year abnormal stock performance has a positive effect on investment bank market-share changes while negative abnormal spreads result in a market share increase, inconsistent with the popular notion that banks do not cut fees to attract business. He argues that, for reputable banks, improvements to the reputation of the bank's analysts have a positive effect on market-share changes. Finally, withdrawals have a negative effect on market-share changes for established investment banks. The author concludes that these factors have less significant effect on market-share changes for less established banks, consistent with the notion that less reputation capital is at risk.

Chen and Mohan (2002) study IPO underpricing by examining its relation with underwriter spread. They argue the spread reflects the underwriter's risk-bearing function and also interacts with the underpricing of IPOs.

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[28] Institutional Investor's All-American Research Team ranking created by the Institutional Investor, which is an international business-to-business publisher, focused primarily on international finance. It publishes magazines, newsletters and journals as well as research, directories, books and maps. It also runs conferences, seminars and training courses and is a provider of electronic business information through its capital market databases and emerging markets information service.

Chen and Mohan (2002) propose a simultaneous equation system in which both underwriter spread and underpricing are endogenous to the system. They associate spread, as a function of underwriter gross proceeds, with IPO offering price, underpricing and other expenses. Underpricing is modelled as a function of underwriter reputation, spread and standard deviation of the after-market returns. The authors test two hypotheses: the first hypothesis relates underwriter spread to the pricing of IPO risk, indicating information about the IPO firm's quality; the second hypothesis tests whether underwriter spread and underpricing are jointly determined. The results for the first hypothesis indicate that underwriter spread bears information about IPO quality. For the second hypothesis, the tests indicate that instead of underwriter spread being a function of underpricing, they exhibit a complementary relation. This could be explained by the fact that underwriters would raise the spread if higher underpricing alone is not enough to compensate for the risk assumed. The authors suggest that the cause of the complementary relation between underpricing and spread may be different for low- and high-reputation underwriter groups.

Chen and Mohan (2002) further examine evidence of market segmentation in the investment banking market and test if an integrated or segmented market has any bearing on the underpricing anomaly. The authors suggest that in a segmented market, new issuers do not have access to some underwriters. This would result in the IPO underpricing reflecting the bias as a consequence of self-selection in a segmented market. The authors utilise the definition of reputation levels of Carter, Dark and Singh (1998) and find evidence of market segmentation.

3.4.2 Underwriter switching

Krigman, Shawm and Womack (2001) examine why so many IPO firms switched to a new lead underwriter for follow-on deals. They are motivated by the fact that these switches affect the competitive landscape and profit allocation among underwriters. To answer this question, they study how and why firms choose a particular underwriter, at the time of the IPO. The authors argue that while the literature provides a few starting points to foray into understanding underwriter quality and choice, it has failed to address some important issues. They suggest one problem with using market share or a proxy like 'tombstone rankings' to measure reputation is that the specific tasks for which the underwriter is rewarded are undefined or, at best, ambiguous. Thus, the authors pose the question of to what extent do higher-quality underwriters promise and presumably deliver.

Krigman, Shawm and Womack (2001) test five hypotheses using both univariate comparisons of the switching and nonswitching groups, and multivariate probit estimations corroborating the univariate results. The first two hypotheses consider the pricing and share placement performance of the lead underwriter on the first day of the IPO. The third hypothesis refers to the market-making activities of the IPO and follow-on underwriters. The fourth hypothesis examines the research coverage provided by the IPO lead underwriter and the possibility that firms switch underwriters to gain additional coverage from higher-prestige analysts. In the fifth hypothesis, the authors examine whether firms switch to gain the services and prestige of a higher-reputation underwriter.

Contrary to their expectations and predictions of prior research, Krigman, Shawm and Womack (2001) find little evidence that firms switch because the IPO lead underwriter made mistakes, such as excessive underpricing or poor share placement, during the IPO process. Instead, they find that IPOs of non-switching firms were significantly more underpriced than IPOs of switching firms. However, switching firms often received smaller proceeds from the IPO than they have originally anticipated (as compared to the mid-point of the filing range), while non-switchers received significantly more than the mid-point value. Overall, their results indicate that the decision to change initial underwriter appears to reflect dissatisfaction with the longer-run service aspects following the IPO.

Cliff and Denis (2004) examine the links among IPO underpricing, post-IPO analyst coverage, and the likelihood of switching underwriters. They show that underpricing is positively related to analyst coverage by the lead underwriter and to the presence of an all-star analyst on the research staff of the lead underwriter. The authors measure the impact of analyst coverage compensation on underpricing of the IPO using a sample of 1,050 issuers completing their IPOs between 1993 and 2000 that also completed at least one subsequent Seasoned Equity Offering (SEO). They find that analysts of the lead underwriters make post-IPO recommendations in 839 of the 1,050 offerings. Of these 839 recommendations, 793 (95%) are either ‘strong buy’ or ‘buy’ recommendations. The authors argue that despite the apparent uniformity in ‘buy’ recommendations, there is a strong correlation between IPO underpricing and both the frequency and perceived quality of the subsequent recommendations. After controlling for other potential determinants of switching, they find that the probability of switching underwriters between IPO and SEO is negatively related to the unexpected amount of post-IPO analyst coverage.

The findings presented by Cliff and Denis. (2004) are consistent with the hypothesis that underpricing is, in part, compensation for expected post-IPO analyst coverage from highly-ranked analysts. In other words, the positive relation between underpricing and analyst coverage is consistent with the hypothesis that issuing firms compensate investment banks for high-quality analyst coverage via the underpricing of the offering.

McKenzie and Takaoka (2008) study the role of the lead underwriter's reputation in determining firms' decision to switch underwriters between their first and second public issues of straight corporate bonds. The authors examine the determinants of firms switching the lead underwriter using Japanese data between 1994 and 2002. Apart from the reputational effect, the authors argue that in the process of preparing for the initial security issue, the lead underwriter may acquire firm-specific information that would provide first-mover advantage in underwriting subsequent issues. In addition, they suggest that the issuing firm may also obtain underwriter-specific information that would influence its subsequent underwriting choices.

McKenzie and Takaoka (2008) rely on the model developed in McKenzie and Takaoka (2005) to explain the switching of the lead underwriter between the initial and second public issues of corporate bonds. They identify the lead underwriter by examining the reputation rating at the time of the initial issue, the changes in the lead underwriter's ratings and market shares between the initial and second issue, and the degree of mispricing of the first issue. As there is no equivalent to the Carter and Manaster (1990) tombstone advertisements measure of underwriter reputation in Japan, the authors use alternative proxies for the lead underwriter's reputation and changes in this reputation. Those proxies are long-term and short-term ratings of the lead underwriter for the firm's initial issue measured at the time of the issue.

McKenzie and Takaoka (2008) find show that improvements in the reputation of the lead underwriter between the initial and subsequent issues lead to a significant reduction in the probability of switching underwriters. In addition, they find that firms which do not switch underwriters tend to have a higher degree of overpricing.

Loureiro (2010) extends the idea of the Bonding Hypothesis, initiated by Stulz (1999) and Coffee (1999, 2002) to the underwriters' context. This hypothesis suggests benefits that foreign firms, especially those from countries with weaker shareholder protection, may achieve after cross-listing on a US stock exchange. The benefits include being located in new an environment with better legal protection of shareholder rights and hence providing more stringent accounting disclosure rules and improvements in firms' corporate governance mechanisms. Following this literature, Loureiro (2010) examines the choice of underwriters by foreign firms and the monitoring benefits versus the cost it imposes on the foreign firm.

Loureiro (2010) uses a sample of equity offerings issued in the US, around the cross-listing events, by foreign firms between 1980 and 2004. The sample consists of firms whose stocks have already been publicly traded in their home markets with SEOs at the time when they cross-list in the US. Loureiro (2010) argues that most of the firms in his sample are less well-known in the US stock market and, therefore, have both lower US analyst coverage and fewer US institutional shareholders. Consequently, the monitoring role of reputable underwriters seems especially important for these companies.

Loureiro (2010) argues that the costs and benefits of choosing a reputable underwriter are affected by the extent of investor protection accorded in the home country of the firm cross-listing in the US. He runs a probit analysis and finds evidence that issuers from countries with low shareholder protection are 15% to 20% more likely to hire a reputable underwriter than their peers. Evidence is found that those issuers from countries with low shareholder protection hire prestigious underwriters to sponsor their equity offerings, aiming for higher valuations in the aftermarket. This is consistent with the hypothesis that if an underwriter's reputation is a mechanism of the Bonding Hypothesis, then it should generate a positive impact on firm value.

Loureiro (2010) provides evidence that there is a cost associated with this choice, in the sense that these issuers tend to be more underpriced. A global sample of IPOs of cross-listed and non-cross listed firms and a sample of private placements is used. The study finds that cross-listed firms are more likely to hire underwriters with higher reputation, especially when they come from countries with poor shareholder protection.

The underwriter reputation literature is relevant to this thesis for the following reasons. First, studies on IPO underwriter reputation have a similar objective as this thesis in analysing the reputation of the information generator and its effectiveness in reducing the impact of asymmetric information between firm insiders and outsiders. Second, a disadvantage in the IPO setting is that it is difficult to analyse the credibility of underwriters. According to Chemmanur and Fulghieri (1994), under this setting, even rigorous evaluation procedures are subject to error that could lead IPO underwriters to have difficulty differentiating between good intermediaries and those acting in their own interest to the disadvantage of investors. When the value of geological experts is considered, the process of estimating mineral deposits is highly technical, facilitating the judgement about the experts' skills with the backdrop of a robust framework with only one standard (JORC). Further, the MDSE environment is also more homogenous, resulting in less noise than in the IPO market, since firms have homogeneous business objectives and come from one industry. Third, consistent with Loureiro (2010)—who tests the Bonding Hypothesis in the underwriters' market due to clearer reputation signals — I propose the MDSE setting as an environment where reputation effects are more visible due to the high information asymmetry. The expectation is that the geological experts' reputation is associated with the information assimilation by the market.

3.5 Experts and takeovers

The informational role of experts has also been examined in relation to firms subject to the process of takeover. Although the literature in this context is not vast, the studies discussed in this section are relevant to geological experts as there are regulations in both markets demanding experts to analyse technical information and provide feedback (e.g., JORC code 2004 for the geologists setting and the *Companies (Acquisition of Shares) Bill 1980* for experts' report during takeovers). Further, both settings involve examining the value of the experts in reducing information asymmetry between insiders and outsiders of firms.

3.5.1 Eddey (1993)

Eddey (1993) examines the role of independent experts in takeovers bids using a sample of 170 independent expert's reports issued in 364 cash-based bids during the period between January 1988 and December 1991. The study is motivated by the fact that firms were required by law to provide an independent expert's report to shareholders whenever the bidder is entitled to 30% or more of the target company's shares, or the bidder and the target have one or more common directors between them. This requirement was established as a response to concerns that bidders in such cases might exploit their close relationship with the target firm to offer a lower takeover premium than they would otherwise.

Eddey (1993) finds that the bid premium offered in takeovers bids involving an expert's report was not significantly lower than the bid premium in other bids. He argues that it could be attributable to independent experts acting as recompense, therefore influencing bidders holding a superior pre-bid bargaining position. According to Eddey (1993), the greatest concern to experts is their reputation. If an expert is discredited by the market, he/she will suffer loss of future business. The author examines some dimensions of the 'fair and reasonable' criterion that experts are required to use, such as dual interpretations of the phrase. In addition, he also looks at the relations among offer price, market price and the expert's valuation of the target, the cost and length of the reports, and the influence of the expert in the bid outcome. The author shows that reports of greater length can be interpreted as a defence by the expert against the expected retaliation by the bidder whose offer the expert has rejected. The author provides evidence that a negative report contains more analysis and detail, making it longer and more costly to prepare.

Eddey (1993) explains that even though by law, an expert can be subject to penalties or litigation if his/her opinion is not formed honestly or without due care and diligence, however, it is also very difficult to successfully prosecute or litigate where matters of opinion are concerned. Thus it is not surprising that at the time the study was performed, no instance of an expert's report has been subject to judicial examination. Nevertheless, the author expected that in the future such cases might occur.

Eddey (1993) finds that the directors' recommendation to shareholders is highly correlated with the opinion of experts. Therefore, the outcome of the takeover is significantly associated with the opinions of both the expert and directors. However, the author argues that the opinion of the independent expert offers no explanatory power for the variation in bid outcomes. He attributes this phenomenon to the fact that target firm directors form their opinion after the expert has expressed his/her opinion, allowing the directors to comment on the results and present additional evidence to refute the expert's opinion. The results indicate that shareholders are generally more receptive to the directors' recommendation as opposed to the expert's opinion. Eddey (1993) concludes that although it might be expected that an expert's opinion would influence the outcome of a takeovers bid, after controlling for the recommendations of target company directors, an expert's opinion offers no further explanatory power for the variation in bid outcomes.

3.5.2 Bugeja (2005)

Bugeja (2005) tests whether the findings in Eddey (1993) can be extrapolated to all bids, irrespective of payment method. Motivated by the *Corporations Act 2001*, which mandates the preparation of an expert report in circumstances where the bidder is perceived to have a superior bargaining position, Bugeja (2005) studies the effect of independent expert reports in Australian takeovers. He examines the effects of expert reports on takeover premiums and the actions of bidding firms by re-examining and extending Eddey (1993) using a more comprehensive sample. Bugeja (2005) identifies all takeovers announcements by ASX-listed firms during the period 1990-2000, totalling 649 takeover observations. He argues that Eddey (1993) shows no difference in target firm premium in offers with and without an expert report, consistent with expert reports protecting target shareholders. According to Bugeja, although this is consistent with the expert having a role to play in obtaining a higher price for shareholders, as the number of bid revisions is not compared to those offers without an expert opinion; it is possible that other factors beyond the presence of an expert report might explain the result. Bugeja (2005) includes all bids in his sample, irrespective of payment method, and extends Eddey's (1993) results by investigating whether the provision of an expert report increases the likelihood of a price revision relative to other takeovers. In his test, he examines the difference in target firm cumulative abnormal returns (CARs) at the announcement of the offer between takeovers with and without statutory expert reports. Regression results were run separately for each of the four return windows. Bugeja's results contrast those of Eddey (1993) in that shareholders earn significantly lower takeover premiums in those bids with an expert report.

Bugeja (2005) confirms that in bids with an expert report, the probability of a revision in offer price is greater where the expert indicates that the offer is 'not fair'. Consistent with Eddey (1993), a higher frequency of bid price revision in takeovers with an expert report following a 'not fair and reasonable' opinion is observed. However, Bugeja (2005) also shows that even when the offer price is revised, target shareholders still earn significantly lower returns in takeovers with expert reports, inconsistent with experts protecting shareholders.

The literature on experts' reports during takeovers is relevant for this thesis for a number of reasons. According to Eddey (1993), litigation in the takeovers setting is unlikely because of the inherent difficulty in judging whether an expert was dishonest or simply incompetent. However, in this thesis, the geological experts' opinion is highly technical and must follow clear procedures established in the JORC code, which would diminish the likelihood of unclear opinions. In the takeover setting, the opinion of the directors competes with the opinion of the independent expert, creating experimental noise. In the case of geological experts, the effect of the reputation signal is not undermined by the existence of alternative information intermediaries.

3.6 Auditor reputation and the capital markets

In this section, I review the literature on the reputational effect of auditors in providing assurance services to client firms. The economics of auditing literature holds some relevance to this thesis due to the similarities between the structure of the geological experts market (described in Chapter 2) and the auditing market. For example, such similarities are observable in Figure 2.3, which shows the distribution of geological experts ranked by size, as defined in Equation (2.11). It depicts a similar distribution to the market for public company audits, with a clear industry leader (Hellman and Schofield), a Big 4 group, a group that could be likened to a 'second tier', and lastly a group of sole practitioners. As was discussed in Chapter 2 (Section 2.3.1), a geological expert may face potential legal liability whilst acting as a Competent Person. A geological expert is liable under the Corporations Act or can be (in tort) directly liable to the person who has suffered loss resulting from negligence. A similar obligation can be observed in the audit literature (e.g., Willenkens, Steele, Miltz, 1996; Grubbs and Ethridge, 2007).

Despite their similarities, there are unique features to each of the two markets. The market for public company audits exists within the financial setting, and is more developed and mature than the market for geological experts, with more complex and established market regulations and the presence of visible litigation history. It is also well researched in the literature. On the contrary, geological experts are involved with the assurance of non-financial resource/reserve data. The market for geological expertise is mainly governed by the requirements of the 2004 JORC code 2004. Until recently, there has been no litigation involving geological experts and this area is largely unresearched. Nevertheless, certain facets of the auditing literature assist in motivating and contextualising the experimental approach adopted in this thesis.

My review of the audit literature consists of five parts. In Section 3.6.1, I review studies on the relation between auditor quality and auditor size. In Section 3.6.2, I extend the discussion of product differentiation in the audit market by reviewing the prior work on auditor industry specialisation and auditor industry leadership. In Section 3.6.3, I review the literature on auditor switching and discuss the implications for tests of geological expert switches in this setting. In Section 3.6.4, I present the auditing by geological experts. In Section 3.6.5, I review the literature on assurance effects in the capital markets setting. It includes a discussion of the insurance hypothesis, audit quality and the earnings response coefficient, audit quality and IPO underwriter reputation, auditor switching and capital market effects, and a review of auditor brand name/industry specialisation and switching implications.

3.6.1 Auditor quality and auditor size

DeAngelo (1981) provides two key contributions to the economics of auditing literature. Her first contribution is to define audit quality as 'the market-assessed joint probability that a given auditor will both (a) discover a breach in the client's accounting system and (b) report the breach' (p. 186). DeAngelo's (1981) second key contribution is to hypothesise a positive relation between auditor size and auditor quality. She does this using an agency theory framework, arguing that size actually alters supplier incentives. Larger audit firms are argued to discourage client opportunism in the form of opportunistic earnings management since large audit firms have more clients and thus more to lose from a tarnished reputation.

In addition, DeAngelo (1981) argues that the loss of an individual client will not likely threaten the future viability and survival of a large audit firm. This suggests that larger auditors have greater incentives to guard genuine independence. This is not the case for smaller auditors, who are likely to have greater fee dependence. Thus, DeAngelo (1981) hypothesises a positive relation between auditor size and auditor quality.

DeAngelo (1981) further argues that auditors' utility stems from their role in reducing agency costs. The market has a need to assess how well an audit reduces these costs (i.e., the quality of the audit). This quality is said to be a function of both the likelihood of identifying a breach in the client's accounting system and the likelihood of the auditor reporting the breach. The likelihood of observing a breach is dependent on factors such as the auditor's technological capabilities, audit procedures and sampling. The likelihood of reporting an observed breach is a function of independence. Whilst the users of audit reports have incentives to discover audit quality, such users cannot directly observe either the audit process, or auditor-client incentives, so the costs involved in assessing quality themselves are non-trivial.

In her study, DeAngelo (1981) also suggests that, in order to reduce the need for consumer monitoring, auditors can maintain a uniform level of quality (this allows for the potential to charge higher prices due to the reduction in quality assessment costs). However, as a firm increases in size, the incentives for the auditor to provide substandard assurance are decreased due to the existence of 'quasi-rents'. DeAngelo (1981) examines infinite-horizon pricing under perfect competition and suggests that the client familiarisation costs of changing auditors will result in a price below avoidable cost (cost that will not be incurred if an activity is suspended) in the first period. She bases her assumptions on the potential for quasi-rents (where price exceeds avoidable costs) extracted by audit firms in future periods to be incentives for lowering audit quality; these incentives (relative to the associated disincentives) decrease with firm size, indicating larger firms are more independent.

To enable empirical testing of audit quality, proxies are used for the size of the auditor based on DeAngelo's hypothesised relationship of auditor size to auditor quality. Examples include the number of the auditor's clients and the percentage of audit fees obtained by an auditor as a function of the overall market (however defined). These proxies have been used in many audit fee studies (i.e., Francis, 1984; Healy and Lys, 1986; Teoh and Wong, 1993; CFT, 1995; Knechel *et al*., 2007). Much (but not all) of the empirical evidence in the economics of auditing literature demonstrates that fees charged by large audit firms exceed those charged by small auditors. Relevant key studies that examine the relationship between auditor size and audit fees include Simunic (1980), Francis (1984), Francis and Stokes (1986) and Palmrose (1986).

The first empirical audit fee study is by Simunic (1980), who articulates a supply-side model of audit fees. Fees are determined by factors that drive auditor liability loss exposure. Such factors include size, risk and client complexity. Apart from developing the first empirically testable audit fee model, Simunic (1980) provides evidence on an important contemporary issue in America at the time: whether competition existed in the market for audit services.[29] To do this, he assumes that competition prevails in the market for small audits (given that small-firm market share is much greater in the small-client segment). Simunic (1980) finds support for assertions of competition within the audit market for publicly-listed companies, based on the fact that he identifies no significant differences in audit prices between large and small US accounting firms, across both the small- and large-client segments.[30]

Simunic (1980) concludes that: (i) the maintained hypothesis of competition in the audit market for publicly-listed firms cannot be rejected; and (ii) consequently there is no empirical evidence to support assertions of monopoly audit pricing. However, the author shows that the subsample of 'small' companies using large audit firms were, on average, lower than the costs of 'small' companies using small audit firms, indicating evidence of a large audit firm's discount, attributable to scale economies. However, subsequent studies, such as Francis (1984), Palmrose (1986), and Craswell, Francis and Taylor (1995), detected a large audit firm's price premium. Tension was to remain in

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[29] In 1976, the large audit firms as a group have been accused of monopolising the market for audits by the US Congress. This fact resulted in a congressional study questioning the anti-competitive nature of the then large audit firms' market dominance.

[30] For convenience, in this thesis, I define all the Big 8/6/5/4 audit firms as 'large' and the non-Big 8/6/5/4 audit firms as 'small' auditors.

the literature between product differentiation and production efficiency as likely explanations for these divergent observations.

Subsequent audit-fee research re-examines the issue of competition in the audit market. Francis (1984) proposes a fee model adapted from Simunic (1980), replicating the tests of competition in the Australian audit market setting, albeit adopting a slightly different set of control variables to those utilised by Simunic. In contrast to Simunic (1980), Francis (1984) shows that large audit firms' prices are higher in both large and small auditee market segments. This implies that the audit services market is competitive and that there is large audit firm product differentiation in both the small- and large-client segments of the market.

Francis and Stokes (1986) attempts to reconcile the seemingly contradictory findings of Simunic (1980) and Francis (1984) regarding audit pricing by large and small accounting firms. They report a further test of the Australian market using an expanded sample in comparison to Francis (1984). Francis and Stokes find that for the large accounting firms, there is a price premium for small auditees (consistent with the earlier evidence reported in Francis (1984) regarding the existence of large audit firm product differentiation) but not for large auditees (consistent with Simunic's (1980) US study). Their result indicates that the large accounting firm product differentiation is present across all client sizes and that there are diseconomies of scale to the small auditors in the audits of large companies.

The implications of the theoretical and empirical findings concerning auditor size and auditor quality provide the basis for the hypothesis development and empirical testing in the non-financial setting of this thesis. For example, I examine the relation between size and quality of geological experts for MDSEs in a capital markets context.

Geological expert size is measured by the product of the client's size and the number of disclosures issued for that specific client scaled by the average size of possible clients, aggregated by year as defined in Equation (2.11).

3.6.2 Auditor industry specialisation

According to DeAngelo (1981), Palmrose (1986), and Craswell, Francis and Taylor (1995), industry specialisation can be seen as a further dimension of quality-differentiated audits. The role of the auditor is to provide assurance of the integrity of accounting numbers produced by the auditee's accounting technology. The demand for quality-differentiated auditing specialised in certain industries plays an important function in the agency cost/audit quality relationship. The implications of the industry specialist signal in terms of audit pricing are twofold. First, consistent with the auditor size, auditor quality literature, it is possible to assume that industry specialisation is a further extension of brand name product differentiation and will attract fee premiums. Second, industry specialisation may foster economies of scale by having a greater understanding of their clients' business environment (Eichenseher and Danos, 1981), which may lead to lower prices.

DeAngelo (1981) argues that understanding of a client and industry results in cost advantages for an incumbent firm compared to a new audit firm. Consistent with this line of argument, Danos, Eichenseher and Holt (1989) examine the economics of knowledge sharing and show that it is less costly to train one auditor in one knowledge area than to train all auditors in every knowledge area, as the specialised knowledge gets more complex. This results in an increase in the barriers to entry in the audit market due to the knowledge superiority of the specialist auditor over competitors. Early studies that examine the effect of industry specialisation find mixed results. These studies variously examine both the large and small auditors. For example, industry specialisation is acknowledged in DeAngelo (1981) as one possible reason for the selection of larger auditors by IPOs.

This study is followed by Palmrose (1986) who uses a sales-based measure to identify industry specialists. Palmrose (1986) examines private firms and did not find evidence that industry specialists receive a fee premium in full-sample tests. However, Palmrose (1986) demonstrates that the coefficients for the industry indicator variables are positive for the unregulated industries and negative for regulated industries, which suggests that in non-regulated industries the fees are higher than regulated industries.

Later, in 1990s and 2000s, studies emerge showing that large specialist audit firms charge higher audit fees compared to the non-specialists. The most well-known and highly cited is Craswell, Francis and Taylor (1995) (hereafter, CFT 1995). CFT argue that audit firms market themselves in terms of both brand name reputation and industry expertise. In other words, the fee premium reflects the willingness of client firms to pay higher fees to receive higher quality audits. CFT (1995) suggest that industry specialist auditors can be identified as any auditor with at least 10% of clients or audit fees in each industry based on the specialist definitions articulated in Craswell and Taylor (1991). They empirically examine this specialist benchmark in the Australian audit market and find that industry specialists receive a significant fee premium. The authors apply an OLS regression model with the natural log of fees as the dependent variable and find that industry specialist auditors receive fee premiums of approximately 34% over fees charged by large non-specialist auditors.

The authors show that large audit firms' brand-name audits receive a larger fee premium in non-specialist industries (34%) than in specialist industries (22%). This would imply that brand-name reputation of large auditors might be less valued in those industries where large auditor specialisations also occur. They argue for industries having specialist auditors, non-specialist large auditors are perceived to be more like the small audit firms who are also non-specialists.[31]

In more recent literature on auditor industry specialisation, Ferguson and Stokes (2002) examine auditor industry leadership. Ferguson and Stokes (2002) examine whether specialist fee premiums identified by CFT (1995) using data from 1987 persist into the years 1990, 1992, 1994 and 1998, following mergers of Arthur Young with Ernst and Whinney and Deloitte, Haskins and Sells with Touche Ross in 1989, precipitating the formation of the so-called 'Big 6'. Ferguson and Stokes (2002) find evidence of a weakening fee premium to the industry leader in 1990, 1992 and 1994. By 1998, no significant industry leadership premium remained. This suggests that auditor industry leader premium had disappeared following the earlier audit firm mergers.

In further research on auditor industry specialisation using Australian data, Ferguson, Francis and Stokes (2003) demonstrate that where a firm is a national leader, as well as a city-level leader, a fee premium is observed. Like other empirical studies,

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[31] Later studies in the behavioural auditing literature suggest industry specialisation plays an important role in determining both audit quality and accounting quality (Solomon, Shields, and Whittington, 1999). Solomon *et al.* (1999) show that an industry specialist auditor may be more effective in identifying non-error explanations for ratio variances. They show that specialist auditors have more accurate non-error frequency knowledge than non-specialists. Solomon *et al.* (1999) conduct two experiments selecting 52 members from three of the largest international accounting firms. The participants include 18 audit partners, 21 senior managers, and 13 managers, each of whom is elected by their firm as a specialist in either the financial industry or the healthcare industry. The experiments are designed to test the participants' knowledge of financial statement errors and non-errors stored in and retrieved from their memories. The findings by Solomon *et al.* support the hypothesis that auditors' industry-specific specialist knowledge is associated with audit effectiveness leading to more efficient audits.

Ferguson *et al*. (2003) assume that large-firm industry expertise can be inferred from a firm's market share or industry audit fees. The authors examine the effects of local office and national industry specialisation on audit fees for a sample of approximately 1,000 firms located in the five largest Australian cities. They utilise the same 1998 sample as Ferguson and Stokes (2002). In contrast to Ferguson and Stokes (2002), they find evidence that where a firm is a national leader, as well as a city-level leader, a fee premium is observed. The authors show that small auditors account for approximately 10% of the national market and command local market shares that range from a low of 6% to a high of 14%. Ferguson *et al*. (2003) conclude that it is only when the auditor is identified as both a national leader and city leader at the same time that higher audit fees are observed.[32]

The economics of auditing literature indicates that size and specialisation or industry leadership clearly play an important role in audit fee determination. I apply theory from the audit quality and audit pricing literatures relating to auditor size and auditor industry leadership and consider whether size and specialisation of geological assurers in the extractive industries setting are valued in the capital markets context.[33]

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[32] Ferguson, Francis and Stokes (2006) utilise the same data set as used in Ferguson and Stokes (2002) and Ferguson *et al.* (2003) and extend Ferguson *et al.* (2003) by examining the effects of city market leadership only. They apply similar models to Ferguson *et al.* (2003), with added dummy variables indicating when the auditors are either the local market leaders (or overall city leaders). They find that the coefficient estimated on the overall city leader variable is positive and significant and that the coefficient estimated for the city industry leadership variable is not significant.

[33] Subsequent auditor industry specialisation studies such as Knechel *et al*. (2003) are discussed in Section 3.8.2 along with the switching implications of auditor industry specialisation in the capital market context.

3.6.3 Auditor switches

In the empirical literature on auditor switches, Chow and Rice (1982) argue that a motivation for auditor switching is 'opinion shopping'. Opinion shopping occurs where poorly-performing firms switch auditors when they are unable to pressure their incumbent auditors into issuing a clean audit opinion. Chow and Rice (1982) propose the 'unclean audit opinions' argument: firms that received unclean audit opinions would be more likely to switch accounting firms in the following year. They conclude that auditor switching could be the result of opinion shopping.

Schwartz and Menon (1985) use a sample of 132 bankrupt companies to examine the motivation for a failing firm's propensity to change auditors. They suggest a need to control for the presence of financial distress in studies of auditor switching. They examine factors such as audit qualification, reporting disputes, management changes, audit fees and insurance needs and conclude that failing firms have a greater tendency to switch auditors than do healthier firms. Schwartz and Menon (1985) demonstrate that when a company switches auditors, it may be motivated by a desire to move to a higher quality auditor so as to provide more credible information (assurance) to investors and creditors. They also find that neither audit qualifications nor management changes are statistically associated with auditor displacement in failing firms. The authors suggest that failing firms changing auditors displayed a preference to move to a higher class of CPA firms.

The auditor-switch literature bears relevance to this thesis as, in a high information-asymmetry setting, switching to a high quality geological expert implies good news whilst switching to a low quality geological expert implies bad news (Schwarz and Menon, 1985). I examine resource attestation switches in the non-financial, mining setting using a similar framework to the auditor switching literature in the financial setting.

3.6.4 Auditing by geological experts

A geological expert may be involved in a 'review' or 'technical audit' role in relation to resource/reserve disclosures by mining firms. This section describes the responsibilities that are expected of the geological experts undertaking such reviews or audits.

Definition of technical auditor

According to Cole-Baker and Bowyer (1998), a technical auditor generally refers to a professional who examines the underlying robustness of a company as 'a going concern' and the viability of any 'expansion plans'. They argue that in the mining industry, technical audit is used to establish the underlying value of the company based on the mine lifecycle as supported by the mineral resources/reserves. Cole-Baker and Bowyer (1998) further explain that in the mining industry, the purpose of the technical audit is to examine the validity and adequacy of the data used to estimate the resources/reserves by assessing the validity of the sample collection methods and accuracy of surveying of sample locations (including down-hole surveying, sample preparation and analysis procedures as well as internal and external checks).

In other words, technical auditing in the mining setting involves independent reviews of the work presented by other geological experts in the role of a Competent

Person.[34] According to Cole-Baker and Bowyer (1998), these audits should not be seen only as a mandatory additional task but rather as an activity that can also benefit the company, especially when it comes to mine financing and interactions with lenders.

Resource auditing in the mining industry

In the mining industry, the estimation of mineral resources is a complex and subjective process. It involves techniques that yield a probabilistic indication about the company's assets (geological value) and is subject to changes as new information is disclosed. Hence, technical audits are becoming an important instrument to guarantee that the geological expert, in the role of a Competent Person, is using appropriate techniques and providing unbiased information.

The importance of auditing mineral estimates is discussed by Stephenson (2004), who argues that technical audits in the mining industry are becoming increasingly common for those preparing ore reserve estimates. Stephenson (2004) contends that since the asset that underpins a mining project's economic viability is estimated from a sampling of less than 0.001% of that asset, it is therefore critical to ensure that the estimates are undertaken to the highest standards and subjected to rigorous review. Stephenson (2004) maintains that mineral resources, and their more important derivative ore reserves, are the foundations of every mining project and hence fundamental to the success or failure of the operation. Various studies in the last 20 years have shown that failure to achieve predicted head grades remains one of the most serious threats to the economic viability of mining projects. One of the examples

[34] It is important to note that the word 'independent' used in this context is to clarify that the experts cannot audit themselves but a second expert. In other words, the geological experts in the role of 'technical auditor' and as Competent Person are different professionals.

presented in this thesis is the case of Canadian Lithium, which was discussed in Section 2.3.3.

Stephenson (2004) argues that regulatory requirements in most major mining countries oblige companies to regularly report material information to the market, including mineral resource and ore reserve estimates. He suggests that key stakeholders—such as investors, brokers, company advisers and regulators—will rely largely on the company's public releases to make critical decisions. In this thesis, the JORC code as a framework for reporting mineral estimation disclosure is examined in detail. Stephenson (2004) maintains that in the mining/exploration industry, mineral resource and ore reserve estimates are one of the most important pieces of information for which directors must ultimately take responsibility. He bases his argument on the fact that disclosure guidelines pressure directors into ensuring that public disclosure of information is full, correct and transparent.

Stephenson (2004) links reporting of resources/reserves with accounting choice and, therefore, company profitability. Choices include amortisation of exploration, evaluation and development costs, depreciation of plant and equipment, accounting for rehabilitation/restoration expenditure, impairment of assets, and any other costs which are brought to account on a 'unit-of-production' basis. The author argues that accountants and other non-technical users of ore reserve estimates would not appreciate that estimation of mine-life is dependent on the reserve disclosures, which rely entirely on a Competent Person's judgement. He points to the subjectivity involved in the process of distinguishing between *Inferred* and *Indicated* resources, depending on the Competent Person's judgement.

Stephenson (2004) further suggests that professional judgement is critical for the estimation of mineral resources and ore reserves. The author implies that it is as much an art as a science, and depends greatly on the skill, experience and judgement of the Competent Person. Since the exercise of judgement is subjective, he suggests an auditing process is one means of providing assurance to a Competent Person's judgements for the benefit of investors and other users of such information, like financial intermediaries. For example, Amos and Breaden (2001) suggest that banks are typically sceptical with regard to the estimation of resources and reserves. One reason being from the bank's perspective, the Competent Person may not be independent but might be internal to the firm and be biased in some way (such as having an emotional attachment to the project). Amos and Breaden (2001) argue that the grade predicted during the resource estimation process is often not achieved. Consequently, banks not only require a technical auditor but will also wish to appoint the technical auditor. Hence, the authors recommend that mining companies should use high-reputation geological experts in order to increase the lender's level of confidence in the project.

The literature on resource auditing in the mining sector is relevant to my thesis as it provides anecdotal evidence of the value of geological experts to investors. Amos and Breaden (2001) argue that a Competent Person's independence might be affected in cases where the geological expert is internal to the firm. I find, however, that roughly 20% of the reports contain internal geological experts and that the market for external geological experts has increased considerably since 2004, as presented in Figure 2.2 and Figure 2.4 in Chapter 2. In the absence of any prior descriptive data, the independence of geological experts might have been underestimated by Stephenson (2004) as I find that less than 1% (17) of the reports during the period 1996-2012 contain a technical auditor assuring the information released by the Competent Person, as depicted in Figure 2.2 in Chapter 2. One possible interpretation is that a Competent Person already provides sufficient professional independence, given the low rate of usage of technical auditors. I explore the value of geological experts in the role of Competent Person vis-à-vis the technical auditor further in Chapter 4.

3.6.5 Auditing and assurance effects in the capital markets setting

The insurance hypothesis

The insurance hypothesis suggests that investors place a value on audited financial statements, which is reflected in a firm's stock prices. Two papers (amongst many) that investigate this issue are Menon and Williams (1994) and Baber, Kumar and Verghese (1995). Menon and Williams (1994) hypothesise that the value assigned by investors to the right to recover potential losses from the auditor (insurance) is embedded in the stock prices of the client's securities. They investigate the insurance hypothesis by examining audit clients' stock price reactions to the announcement of the Chapter 11 bankruptcy filing by Laventhol & Horwath (L&H).

At the time of this filing, L&H was the seventh-largest accounting firm in the US. The authors consider stock prices of L&H's clients around two related events: (i) the disclosure of the auditor's (L&H's) bankruptcy; and (ii) the appointment of a successor auditor. They find evidence consistent with the insurance hypothesis in that stock prices declined on news of the L&H bankruptcy, with stronger effects observed on recent IPOs than seasoned securities. Further, Menon and Williams (1994) consider the market reaction to the announcement of the successor auditor based on the assumption that the appointment of the new auditor should resolve the uncertainties related to the future monitoring quality. When the authors control for the type of auditor in terms of size, the results suggest a more favourable market reaction when firms formerly audited by L&H chose a large auditor rather than a small auditor.

Baber, Kumar and Verghese (1995) show that L&H's bankruptcy raises concerns about the quality of their audits and that this also supports the findings of Menon and Williams (1994). Moreover, Baber *et al*. (1995) argue that archival data cannot discriminate between the two explanations. Baber *et al*. (1995) evaluate 75 clients of L&H and show that these clients earned a statistically significant, risk-adjusted return of -1.91% during the two-day trading period around the L&H bankruptcy disclosure. They suggest that the reasons why the bankruptcy had significant negative price implications for the L&H clients are twofold: first, they agree that the observed market reaction is consistent with the insurance expectations; second, the failure caused investors to re-evaluate the quality of the firm's audits, causing a negative stock price response for clients of L&H.

In more recent research, Weber, Willenborg and Zhang (2008) examine market reactions around the ComROAD AG scandal involving KPMG in Germany. They argue that market-based discipline punishes clients and auditors in cases of deviation from high-quality audit provision. The German institutional setting has long provided auditors with substantial protection from shareholder legal liability. For example, since 1931 Germany has capped auditor civil liability to shareholders. Presently the maximum liability for which an auditor can be sued is just €4 million per audit.

Consistent with auditors being more important when information asymmetry between management and investors is greater, Weber *et al*. (2008) examine the association between returns and the market-to-book ratio. They argue that the damaging effect of substandard auditing should increase with the market-to-book ratio. The authors use the German setting since the low litigiousness setting allows them to assert that the insurance explanation will not influence results. Thus, the setting allows relatively clean tests of whether auditor reputation matters. They find that KPMG's clients suffered negative abnormal returns of 3% around the ComROAD event, and that these returns are more negative for companies that are likely to have higher demand for audit quality. Further, they show that there is an increase in the number of clients that switched from KPMG in the year of the ComROAD scandal.

Whilst the insurance hypothesis is interesting, it holds little in the way of testable implications for my thesis, since there does not appear to be any anecdotal evidence of a large geological expert either failing or being sued by investors in Australia. However, recent examples, such as the Canadian Lithium case discussed in Section 2.3.3, suggest that geological experts may be exposed to a more litigious environment in the future, indicating the insurance hypothesis in this setting might become more relevant.

Audit quality and the earnings response coefficient.

Accounting information and informativeness is a theme considered by Teoh and Wong (1993). They argue that an auditor's reputation lends credibility to the earnings report. They adopt a simple analytical approach, suggesting a greater share price response to greater precision in the earnings signal, based on Holthausen and Verrecchia's (1988) model of the determinants of the magnitude of the price response to an information release. The authors test the joint hypotheses of: (i) auditor size is a proxy for auditor credibility; and (ii) the modified Holthausen and Verrecchia (1988) model is true by examining whether the earnings response coefficient (ERC) differs between large and small audit firms. They find a positive relation between the credibility of accounting information and informativeness, measured as the coefficient relating returns to earnings, i.e., the earnings response coefficient (ERC).

Teoh and Wong (1993) show that the ERCs of large audit firms' clients are significantly higher than for small audit firms' clients. This result is obtained in both a matched sample of firms paired according to industry membership and a switch sample of firms grouped according to shifts from large audit firms to small audit firms. The authors demonstrate that this result is robust to the inclusion of other explanatory factors for ERC that have been suggested by previous studies: growth and persistence, risk, firm size, and pre-disclosure information environment. Consistent with DeAngelo (1981), Teoh and Wong (1993) assume that auditor quality is an increasing function of auditor size. The presence of larger auditors is associated with more credible earnings reports in the financial setting. In this thesis, I presume that larger geological experts are associated with more credible resource/reserve disclosures in the non-financial setting.

Audit quality and IPO underwriter reputation

The information role of audits has been examined in relation to firms undertaking IPOs. There is an extensive literature on 16 reputational effects in the IPO context. For example, Willenborg (1999) conducts empirical research on development stage entity (DSE) IPOs and shows that larger, non-DSE IPOs are expected to hire a brand-name auditor but the same does not occur for DSE IPOs. Willenborg (1990) argues that companies use independent auditors to send insurance and informational signals. The size of their audit fee is an insurance signal—a larger fee implies a deeper-pocketed auditor and, therefore, a greater degree of insurance.

When the client is a larger, non-DSE company, a brand-name (high quality) auditor is an informational signal. In other words, a brand-name auditor increases investors' confidence in the accuracy of the financial statements and reveals favorable private information about firm value. Willenborg (1990) shows that in a non-DSE setting, where company activities (e.g., generating revenues or maintaining inventories) have progressed beyond the start-up phase, higher audit quality may assist uninformed investors in inferring entrepreneurial private information. Moreover, the cost of hiring a high quality auditor for large issues is low, and because higher-reputation underwriters usually support these issues, the IPO would be viewed with distrust unless a high quality auditor is chosen.

Weber and Willenborg (2003) examine different aspects of the role of auditors and audit reports in predicting post-IPO firm failure. They study auditor opinions in 'microcap' IPOs, which are small, non-venture backed IPOs marketed to individuals. Firms with favourable private information are argued as sending a positive signal to the market by engaging a higher quality auditor. The authors find that after controlling for underwriter reputation, more-prestigious auditors are more likely to issue going-concern opinions, which are strongly associated with delisting.

Brand-name auditor switching in the capital markets context

In the empirical literature on auditor switches and their effects in the capital markets, Healy and Lys (1986) argue that when two audit firms merge, clients who benefit from the large audit firm's specialised services, or its reputation, are expected to employ the larger auditor after the merger (i.e., the acquirer). On the other hand, clients that do not benefit from these services are expected to change to a small auditor following the merger. Healy and Lys (1986) examine the market reaction of clients switching from small audit firms to large firms. The authors examine a sample based on two acquisitions of small accounting firms by large accounting firms for which public information is available. The first was the 1977 merger of JK Lasser & Co. with Touche Ross & Co., and the second was the merger of SD Leidesdorf and Co. with Ernst & Ernst (later Ernst & Whinney).

The authors develop an economic model to examine attributes influencing the auditor-change decision. They find that firms that chose large audit firms are expected to have larger, more complex operations demanding more audit services. The results seem to be consistent with their predictions.

Healy and Lys (1986) find that firms with higher growth are more likely to demand higher audit quality. They show that clients that are large and have high asset-growth rates prior to the audit firm merger are likely to remain with the acquirer. Clients that are small and have low asset growth are likely to turn to another small audit firm.

In more recent auditor switch literature, Dunn, Mayhew and Morsfield (2000) study the relation between audit firm industry specialisation and client disclosure quality by examining the relation between the AIMR (Association for Investment Management and Research) scores (AIMR Disclosure Quality Awards) and auditor industry specialisation over the six-year period 1990-95. Dunn *et al*. (2000) observe that the market reaction to auditor switches is positive when client firms switch to a brand-name auditor, arguing that brand-name auditors offer better monitoring capabilities, and witness the opposite when firms switch from a brand-name auditor. The authors also document an association between auditor industry specialisation and disclosure quality for firms in unregulated industries but not in regulated industries.

Industry specialisation and auditor switching in the capital markets context

A study by Knechel, Naiker and Pacheco (2007) provides further evidence of positive stock market reactions to firms' switching from non-industry specialist to industry specialist auditors. The authors motivate their study based on the fact that industry specialisation has become increasingly relevant to the auditing profession as firms organise their practices along industry lines rather than traditional service lines (AICPA 1998; Bell *et al*. 1997). Specialised knowledge in an industry has a direct effect on an auditor's ability to assess audit risks, detect errors and misstatements, and improve earnings quality (Maletta and Wright, 1996; Owhoso *et al*., 2002; Balsam *et al*., 2003; Krishnan, 2003).

Knechel *et al*. (2007) extend the literature on auditor switching by examining whether the relative level of industry expertise possessed by the predecessor and successor auditors influences the market reaction to auditor switches. The authors apply recent data and utilise a significantly larger sample than those used in earlier studies and consider auditor switching over the period 2000-03. Their premise is that auditor quality is multidimensional and extends beyond the value inherent in a firm's brand name. They examine if industry specialisation indicates a form of service differentiation that is valued by the capital markets.

To explore investors' reaction to auditor switches, Knechel *et al*. (2007) examine the 15-day cumulative abnormal returns (CAR) around the date of the auditor switch. They then use the CARs in a cross-sectional regression analysis to explore whether the abnormal returns are a function of the type of auditor switch, after inclusion of relevant control variables.

Knechel *et al*. (2007) find that clients switching between large auditors experience significant, positive abnormal returns when the successor auditor is an industry specialist, while significant, negative abnormal returns are observed when the successor auditor is not a specialist. Their results indicate that the market does perceive audit quality differences based on industry specialisation, which is relevant to the market valuation of a company. Further, the authors observe that a switch from a Big 4 to a non-Big 4 auditor has the most negative reaction if the predecessor auditor is an industry specialist. However, when switching from a non-Big 4 to a Big 4 auditor, the expected positive effect is strongest when the successor is a non-specialist rather than a specialist. The authors suggest that future research is needed in order to understand the cause of these results and to differentiate the effect of brand name from industry specialisation. Knechel *et al*. (2007) imply that capital markets value switches to a higher quality brand-name auditor. Their findings on switches to and from brand-name and industry specialist auditors hold implications for the tests I conduct on geological expert switches in the capital markets setting.

3.7 Non-financial information and the capital markets

Amir and Lev (1996) examine the value-relevance of financial information (e.g., earnings, book values and cash flow) and non-financial information (e.g., population size of areas in which service licenses are held) in independent US cellular companies. Using a sample of 10-year panel data during the period 1984-1993 of 14 publicly-traded cellular phone companies, the authors analyse value relevance using the earnings model and the Ohlson model.

The authors report that on a stand-alone basis, financial information are irrelevant for the valuation of these firms and that only when combined with non-financial information some of the financial variables become relevant. Conversely, they find that the non-financial information in this setting is value-relevant both by itself and when combined with the financial information.

Amir and Lev (1996) then estimate the price regression in a sample of biotechnology companies listed in US and find that whilst book values are positively related, earnings are negatively related to share price. The authors suggest that, analogously to cellular phone sector, the reported earnings of biotechnology companies are likely to be irrelevant for securities pricing.

Another example of a study examining the value relevance of non-financial information is Trueman, Wong and Zhang (2001), who incorporate web usage statistics as 'other information' in valuing Internet stocks. Using a sample of 95 firms during the period of five quarters, beginning with the fourth quarter of 1998 and ending with the fourth quarter of 1999, the authors examine the roles played by analysts, past revenues, and web usage data (unique visitors, page views, and minutes spent at a firm's web sites) in the forecasting of future revenues. They show an insignificant association between bottom-line net income and market prices; however, when net income is decomposed, gross profits along with unique visitors and page views are associated with stock prices.

In the biotechnology setting, Ely, Simko, and Thomas (2003) examine if the in-process drug status of development stage biotechnology firms helps investors to assess if research and development costs indicate an expected future benefit and therefore an economic asset. The sample for this study consists of 83 start-up biotechnology companies in US with no marketable products and no drug approvals during the period between 1988 and 1998.

Ely, Simko, and Thomas (2003) apply a general valuation model and show that aggregate earnings are not significantly related to firm value, but that non-financial information, such as the number of drugs-in-progress is value-relevant, as is the net book value of assets. This result is consistent with prior studies showing that financial statement information has less value-relevance for research intensive firms (e.g., Lev and Zarowin, 1999; Stewart, 1997).

Ely, Simko, and Thomas (2003) also apply the event study method to examine the market reaction to 359 drug development announcements released to the press. They find that the market responds positively to news of the early development stage, but has no significant reaction to announcements relating to later stages in the development process.

Assurance of non-financial information has been shown to matter in other settings including the quality assurance literature. For example, Hendricks and Singhal (1997) examine the hypothesis that implementing effective total quality management (TQM) programs improves the operating performance of firms. Using a sample of 463 firms, the authors looked at operating performance measures such as profitability, assets, sales, employees' growth and cost of the companies that have won TQM awards during the period 1983 to 1993. Hendricks and Singhal (1997) find that firms winning total quality management (TQM) awards as a proxy for implementation effectiveness have better financial performance. The authors show that the direct and indirect costs associated with implementing TQMs may not result in poor performance, indicating that perhaps TQM programs provide at least some early benefits that offset these costs. The findings in this study are consistent with those in Easton and Jarrell (1998) who after examining 108 firms that began TQM implementation between 1981 and 1991 find that TQM adoption is associated with both improved financial performance along with higher stock returns.

In other studies of assurance of non-financial information, Corbett, Montes-Sancho and Kirsch (2005) consider the financial performance implications of ISO 9000 certification by manufacturing firms in the United States. The authors apply a matched firm approach consistent with Barber and Lyon, (1996), with control firms selected based on three years of observations of precertification ROA, assets and industry.

Corbet et al. (2005), using a sample of 554 firms during the period of 1990 and 1997 gaining ISO 9000 certification and the same number of control firms, find publically traded manufacturers in the United States experience significant abnormal improvements in financial performance after deciding to seek their first ISO 9000 certification,

In a more recent study, Namara and Bade-Fullen (2007) examine the market reaction to 1,277 R&D announcements released by 178 US and European bio-pharmaceutical firms during the period 1996-2003. These announcements consist of reports that identify different stages in the product development cycle, such as exploration (patenting and preclinical trials) and exploitation (human clinical trials and NDA).

The authors argue that accounting returns are not suitable to examine the impact of exploration-exploitation announcements because R&D costs are required in US and Europe to be expensed when they are incurred, rather than amortized over a longer period as an asset. Thus, short-term earnings will be depressed when there is a long-term investment in R&D. Namara and Baden-Fuller (2007) select the event study method to solve this issue, arguing that event-study approach is more appropriate because it allows the value that is created by the incremental investment in R&D to be isolated.

Namara and Baden-Fullen (2007) find that investors respond positively at every stage of R&D, but the reaction is different for small and large firms. For small firms there is a positive reaction only to the early stages of development (exploration), whilst for large firms there is a positive reaction to both exploration and exploitation announcements.

The implications of the empirical findings concerning non-financial information provide some indication that the non-financial, mineral information being examined in this thesis might also be relevant to investors. The literature on the biotechnical industry is analogous to the MDSE setting due to the predominant negative earnings resulted from the pre-production exploratory lifecycle. Also, a similar research design using event study is applied due to the lack of relevance of financial information in the biotechnical setting. There are, however, some important differences between the MDSE and biotechnical settings that make the MDSE setting unique in testing the market reaction to non-financial information. First, in the biotechnical setting it is more difficult to assess the economic value of the non-financial information disclosed to the market. For example, different drug patents may have different impact in terms of magnitude to the market and this is difficult to measure. This is not an issue in the MDSE setting, where the amount of non-financial information can be calculated using the quantity of mineral disclosed and the commodity price at the time of the disclosure. Another difference is that the non-financial disclosures are well regulated in the MDSE setting and require the presence of a professional geological expert responsible for the quality of the information released.

3.8 Hypothesis development

3.8.1 Market reaction to non-financial information

The first two hypotheses in my thesis consider the market reaction to non-financial information provided in resource/reserve disclosures. Prior research has documented a relation between the disclosure of reserve-based present value data and decreases in information asymmetry (Raman and Tripathy, 1993; Boone, 1998). In terms of prior Australian studies, Ferguson and Crockett (2003) argue that mining companies are subject to greater information asymmetry due to the specialised and highly technical nature of geological information. This evidence regarding the different information characteristics of MDSEs is consistent with Poskitt (2005), who argues that 'mining-exploration sector [MDSEs] suffers from greater information-based trading than the mining-production sector' (*p*.224). Another institutional feature is that there is typically low analyst following amongst MDSEs (Ferguson, Gross, Kean and Scott, 2011; Brown, Feigin and Ferguson, 2013).

In other studies of MDSEs, Ferguson and Scott (2011) examine the market reaction to 817 investor presentations by 326 Australian resource firms and find that these presentations are informative to the market. Moreover, in their study, when the sample is partitioned based on commodity groups, precious-metals focused firms are found to have stronger market reactions to investor presentations than firms in other groups.[35]

[35] I undertake similar partitions based on commodity type in this study.

Bird *et al*. (2011) show evidence on the market reaction to announcements by mining companies on their exploration activities.[36] Given the importance of resource/reserve quantum in mine feasibility assessment and project development, I argue that resource/reserve disclosures made by MDSEs are expected to be valued by the market. Accordingly, I hypothesise that:

> *H1: The market reacts to information contained in resource/reserve disclosures by MDSEs.*

The objective of a resource/reserve disclosure is to inform investors about the magnitude of changes in resource/reserve base of the firm. Accordingly, I predict that the market reaction is a function of the magnitude of the resource/reserve change, with greater resource/reserve changes associated with larger market reactions. Therefore, H2 is expressed as follows:

> *H2: Ceteris paribus, disclosures of greater resource/reserve changes are associated with stronger market reactions than disclosures of smaller resource/reserve changes.*

3.8.2 Reputational effect of geological experts associated with non-financial disclosures

The next hypothesis considers the importance of the reputation of geological experts in the MDSE setting, which I proxy by expert size. Brown and Burdekin (2000) examine the falls in share prices of Canadian gold mining companies following the Bre-

[36] Bird *et al*. (2011) look at mining firms without distinguishing between MDSEs and non-MDSE firms.

X Minerals scandal and show that the negative price reactions are greater for smaller gold companies than their larger counterparts. The Bre-X fraud has some similarities to examples of markets for 'lemons' and Akerlof (1970) argues that informal, unwritten guarantees are preconditions for trade and production. He generalises Gresham's law ('bad drives out good') and shows that where these guarantees are indefinite, business will suffer. Further supporting this argument is the recent evidence of high failure rates observed among MDSE projects (Ferguson, Clinch and Kean, 2011). This evidence suggests geological experts may play a role in keeping the market for junior mining companies operational.

Prior research examining audit quality in the financial context finds a positive relation between auditor size and auditor quality (DeAngelo, 1981) and that auditor size is a proxy for auditor credibility (Teoh and Wong, 1993). This relation has been widely explored in both the fee setting and capital markets context (DeAngelo, 1981; Palmrose 1986; Craswell, Francis and Taylor, 1995; Solomon *et al*., 1999; Ferguson and Stokes, 2002; Ferguson *et al*., 2003; Menon and Williams, 1994; Teoh and Wong, 1993; Weber and Willenborg, 2003). Drawing on this stream of financial auditing literature, I extend these reputational arguments to the non-financial context and argue that the size of geological experts is associated with quality, leading to the following hypothesis:

H3a: Ceteris paribus, resource/reserve disclosures that are assured by larger geological experts are associated with stronger market reactions than disclosures assured by smaller geological experts.

Consistent with prior research in the economics of auditing literature, I extend testing of the size/quality relation by considering specialisation of geological experts in the non-financial setting. Research has shown that specialised industry knowledge improves an auditor's ability to assess audit risks, detect errors and misstatements, and improve earnings quality (Maletta and Wright, 1996; Owhoso *et al.,* 2002; Balsam *et al.,* 2003; Krishnan, 2003). According to Knechel, Naiker and Pacheco (2007), the market recognises audit quality differences based on industry specialisation in terms of market reactions. Consistent with their findings of a positive stock market reaction to appointments of industry specialist auditors in the financial setting, I argue that the appointment of specialist geological experts (the proxy being specific commodity-level leaders) will result in stronger market reactions, and pose H3b as follows:

> *H3b: Ceteris paribus, resource/reserve disclosures that are assured by specialist (leading) geological experts within an individual commodity group result in larger market reactions than disclosures assured by non-specialist (non-leading) geological experts.*[37]

The last hypothesis relates to specific deposit complexity. The sample includes mineral deposits that broadly fall into six different commodity groups: 'Precious metals'; 'Base metals'; 'Bulks (bulk commodities); 'Oil and gas'; 'Solid fuel (uranium)'; and 'Other', as defined in Table 2.3. Mineral deposits are often 'polymetallic' in that there are many metals present in the mineralisation. However, base metals polymetallic deposits routinely involve the presence of more different types of metals than precious metals polymetallic deposits which, in Australia are usually gold, copper or gold, silver.

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[37] 'Bulks' refers to iron ore and coal projects.

A good example of polymetallic complexity is the Northmet base metals deposit in the Duluth Complex in Minnesota in the US, where until recently technical complexity has adversely impacted project economics mitigated project development (Duluth 2014).[38]

In contrast, for bulk commodity extraction such as coal mines, there is very little intermediate processing (only washing and blending) of the raw material prior to the shipping of the end product to the customer. In addition, the relative percentages of the minerals (coal and iron ore) in the mineralization are much greater for bulk commodities compared to hardrock deposits, so separation complexity is much lower. Accordingly, due to higher complexity and risk often associated with base metals deposits, I argue that base metals expert specialisation will be valued more than precious metals or bulks specialists. I propose the following hypothesis regarding specialist assurance and deposit complexity:

H4: Ceteris paribus, resource/reserve disclosures assured by a geological expert specialising (leading) in base metals deposits will have larger, positive reactions than disclosures assured by geological experts specialising (leading) in other commodity groups.

Prior studies, such as Healy and Lys (1986) and Knechel, Naiker and Pacheco (2007) have shown positive stock market reactions to the 'level' of audit quality (i.e., brand-name effects and industry specialisation effects). Based on this prior work on

[38] Complex geology, such as the presence of Laterites can necessitate far greater complexity in processing, which has led to a number of high profile litigation cases against mining engineers post production commencement.

auditor switches in the financial context, I examine the valuation implications of switching geological experts in the non-financial context, suggesting H5 as follows:

> *H5: Ceteris paribus, the market reacts positively (negatively) when a firm switches to a higher (lower) quality geological expert.*

CHAPTER 4

RESULTS

4.1 Introduction

In this chapter I examine the implications of JORC resource/reserve disclosures in the capital markets setting and the value of geological experts that accompany these reports. I examine the abnormal returns around a sample of 1,467 resource/reserve disclosures by 404 listed mining development-stage entities and adopt the event study method (Ball and Brown, 1968; Fama, Fisher, Jensen and Roll, 1969) to measure the economic impact of the information contained in resource/reserve disclosures using share prices. Applying the event study methodology in this context is appropriate given that event times for the ASX disclosures are clearly identifiable and a sufficient sample size can be constructed.

Ball and Brown (1968) consider the information content of earnings and evaluate stock price movements leading up to and following annual earnings announcements. They observe that most of the price reaction is completed prior to the announcement date; that is, market participants anticipate most of the information provided. The event study methodology has been widely applied in the financial economics literature subsequently. The event study approach relies upon the semi-strong form of the Efficient Market Hypothesis (EMH), which assumes that all publicly available information is incorporated in stock prices. The EMH allows analysts to evaluate new public information by analysing the reaction to the firm's stock prices. In this thesis, I use the difference between the actual stock return and the expected 'normal' return for the firm to quantify the effects of resource/reserve information and geological experts' reputation.

The remainder of this chapter is structured as follows. Section 4.2 outlines the sample and data collection process for the study. Section 4.3 presents the research design for testing the hypotheses (H1-H5) presented in Chapter 3. Section 4.4 discusses univariate and multivariate evidence on the market reaction to resource/reserve disclosures, including the effect of geological experts' reputation. Section 4.5 discusses further analysis, including tests on intraday market reactions, auditor quality and the impact of other accounting measures and other disclosure properties. Section 4.6 extends the analysis to a battery of sensitivity tests. Section 4.7 concludes the chapter.

4.2 Sample and data collection

A detailed discussion of the data collection process has been described in Chapter 2 (Section 2.4). The following is a summary of the type and source of data collected. I embark with an initial manually-collected sample of 2,061 resource/reserve disclosures, released by 414 MDSEs each of which has made at least one JORC resource/reserve disclosure over the period 1996-2012.[39,40] Bad news disclosures (a total of 190) are excluded to avoid the dilution of good news effect from the primary tests and are

[39] Typically, MDSEs commence operations with grassroots exploration of projects they either have directly applied for or have acquired from other mining entities. Following an initial discovery and more extensive drilling programs, MDSEs will seek to quantify the mineralisation. Reporting of quantified resources/reserves then takes place through the JORC framework, which specifies reporting categories of resources/reserves. Once resource delineation has taken place subject to the firm's satisfaction, economic feasibility studies can begin.

[40] Table 2.2 in Chapter 2 provides a detailed breakdown for the sample selection.

defined as resource/reserve disclosures representing a downgrade in terms of total resource or total reserve.[41,42] A total of 79 disclosures for which commodity price is not available are included in tests of H1 (which do not require commodity prices) but excluded from the primary tests of H2-H5. In addition, 325 resource/reserve disclosures used to calibrate initial resource amounts are excluded from the sample.[43] After deleting these observations (see Table 2.2 in Chapter 2), 1,546 separate disclosures made by 404 MDSEs are used in testing H1 and 1,467 disclosures made by 404 MDSEs are used in the tests of H2-H5. Daily stock prices and turnover, indexes, market capitalisation and commodity price data are obtained from Datastream. Intraday data is collected from SIRCA. GDP per capita data is obtained from the World Bank database, whilst auditing data is hand-collected from annual reports of sample firms, which are publicly available.

4.3 Research design

4.3.1 Daily analysis

H1 is tested by measuring the market reaction to resource/reserve disclosures by MDSEs using daily abnormal returns (ARs) and cumulative abnormal returns (CARs). The abnormal return (AR) is the difference between a firm's actual stock return and the

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[41] The classification method chosen for bad news disclosures is conservative, since it does not take into consideration the value of the commodity at the announcements date.

[42] By including a dummy variable *BAD_NEWS* indicating '1' when the announcement contains bad news would also imply in adding the interaction between *B4*SPEC*, *B4*SPEC*RSC* and *B4*SPEC*RSV* with *BAD_NEWS*. Since announcements containing bad news are not the focus of this thesis and the number of observations (190) is relatively small to robustly test the information impact of this group of announcements, I decide to delete these observations and build a more concise model with less variables. However, in sensitivity testing reported later in the thesis, these observations are added back in sample. Exclusion or inclusion of *BAD_NEWS* observations does not alter the tenor of results.

[43] For example, a reference point might be where a project is drilled and a resource identified in 1990, which was then followed by adverse firm-level economic conditions and a 10-year exploration hiatus. If deposit development then recommenced during the year 2000, with a resource upgrade in 2002, I pick up the original 1990 resource as a reference point.

expected return (calculated as the average return of all non-disclosing firms in the sample) and is used in order to quantify the effect of the information contained in resource/reserve disclosures.[44] The abnormal return (*AR*) for firm *i* at event date *t* is calculated as:

$$AR_{i,t} = \left[\frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}\right] - \left[\frac{R_{sr,t} - R_{sr,t-1}}{R_{sr,t-1}}\right] \quad (4.1)$$

where: $AR_{i,t}$ is the abnormal return of firm *i* at time *t*, $P_{i,t}$ is the share price of firm *i* at time *t* and $R_{sr,t}$ is the average return of all non-disclosing firms of the sample at time *t*. Cumulative abnormal returns over the period (p,q) are calculated as:

$$CAR_{i,t}(p,q) = \sum_{t=p}^{q} AR_{i,t} \quad (4.2)$$

4.3.2 Market reaction determinants

I use a 2-day buy-and-hold abnormal return (*BHAR*) measured from the closing price of the last trading day before the event date to the closing price of the first day after the event date, which measures the difference between the daily compounded actual return and the daily compounded expected return. The main advantage of using *BHAR* when dealing with possible non-synchronous trading (thin trading) is that abnormal performance measures most accurately reflect the effect of an event on an investor's portfolio (due to compounding). The effect of non-trading may not be detectable in the returns of individual securities due to the fact that daily return is not

[44] The index created and used in this study constitutes the sum of market value of all the non-disclosing firms in the same period of the resource/reserve disclosure and is illustrated in Appendix G.2. I conduct sensitivity tests using alternative index benchmarks, which are discussed in Section 4.6.5.

often significant. However, previous studies (such as Lo and MacKinlay, 1990) have shown that the effect will be more pronounced in portfolio returns. The expected buy-and-hold return is computed using the average return of all non-disclosing firms since, if a security exhibits non-synchronous trading, the standard estimate of beta is not representative of its true sensitivity to the market (Scholes and Williams, 1977; Keim, 1983).[45] The dependent variable is calculated as follows:

$$BHAR_i(0,+1) = ln[\prod_{t-0}^{t+1}(1 + R_{it}) - \prod_{t-1}^{t+1}(1 + BR_{it})] \quad (4.3)$$

where: R_i is the daily return of firm i, and BR_i is the daily return for a benchmark portfolio for firm i measured as the average return of all non-disclosing firms of the sample at time t.

Experimental variables

I construct an OLS cross-sectional regression model to predict abnormal stock returns around resource/reserve disclosures using total resource changes (*RSC*) and total reserve changes (*RSV*), both measured as scaled value changes, as the main experimental variables. This model is utilized for testing H2 and is specified as follows (subscript i is omitted):

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[45] Keim (1983) investigates the anomalous negative relation between firm size, measured by total market value of common equity, and abnormal, risk-adjusted returns using a sample of firms listed on the NYSE and AMEX. He shows that, even after applying the Scholes-Williams adjustment of beta for non-synchronous trading, excess returns are a monotonic decreasing function of firm size as measured by total market value of equity.

$$BHAR\ (0,+1) = C(1) + C(2) * RSC + C(3) * RSV + C(4) * RSC\_GRADE + C(5) * RSV\_GRADE + C(6) * LNSIZE + C(7) * COMM\_PRICE + C(8) * LNPAGES\ + C(9) * GROWTH +\ e \qquad (4.4)$$

where: RSC and RSV define the dollar value growth in mineral resources/reserves scaled by the pre-announcement market value of the firm as defined in Equation (2.2) and Equation (2.3) in Chapter 2.

In Panel B of Table 4.5, I re-specify Equation (4.4), decomposing RSC and RSV into each of the five respective JORC resource/reserve categories, as defined in Equation (2.4) and (2.5) (*Inferred*, *Indicated*, *Measured* resources*; Probable* and *Proved* reserves). The value changes associated with each individual resource/reserve categories are calculated as per the equations reported in Equations (2.6)-(2.10), defined in Chapter 2.

In Section 2.4.3 (Chapter 2), I define three different measures of quality for geological experts. First, to test H3a (larger geological experts are associated with larger market reactions than smaller geological experts), [46] I construct a Big 4 size measure for geological experts, proxied by the cumulative number of client resource and reserve disclosures weighted by the relative market value of client firms. A Big 4 group of geological experts (Hellman and Schofield, Snowden Mining, Coffey Mining and SRK Consulting) is identified.[47,48] Second, in testing H3b, I estimate specialists (leading)

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[46] DeAngelo's (1981) hypothesise a positive relation between auditor size and auditor quality and argue that size alters supplier incentives. Teoh *et al.* (1993) argue that accounting quality, proxied by size of the firm's auditor, positively influences market perception of the earnings credibility and this effect can be seen in the stock prices.
[47] Simunic (1980), Francis (1984), Francis and Stokes (1986) and Palmrose (1986) demonstrate that large auditors' fees are higher than small auditors' fees.
[48] The configuration of a Big 4 is based on the four firms occupying the top 4 positions in terms of market

geological experts based on commodity groups (i.e., precious metals, base metals, ‘bulks’, solid fuel, oil and gas and other). I then interact the size proxy (Big 4) with the specialist measure to examine Big 4-commodity leading experts (H3b).[49] The same variables are used in testing H4. The difference in testing H3 and H4 is sample related, with partitioning by commodity type undertaken in tests of H4. Third, in testing H5, I use *UPB4*, a dummy variable which equals one if the client has switched to a larger geological expert and zero otherwise. Similarly, *DNB4* measures switches to a smaller geological expert. The switch variables are measured by the geological experts’ size ranking as defined in Equation (2.11), Chapter 2.

Control variables

I control for other idiosyncratic factors that may affect market reactions to resource/reserve disclosures. Stephenson (2004) argues that failure to achieve predicted head grades remains one of the most serious threats to the economic viability of mining projects. Therefore, change in resource/reserve grade (*RSV_GRADE* and *RSC_GRADE*) is included in the model. The control for the size of the firm making the resource/reserve disclosure, I use *LNSIZE*, measured as the log of market capitalisation in the month of the disclosure. This is consistent with prior capital market studies controlling for firm size (see, for example, Collins and Kothari, 1989).[50]

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share for most of the sample period based on individual firm market shares as depicted in Figure 2.3. In additional sensitivity analysis in Section 4.6.1, I reconfigure the large expert group, dropping the smallest member of the Big 4 group and test a Big 3 measure. Note that this measure is dynamic in that I allow changes to the composition of the Big 4 or Big 3 as market share rankings change year by year.

[49] The same variables are used in testing H4. The difference in testing H4 and H3 lies in the sample, which is partitioned by commodity type in H4.

[50] Eichenseher *et al.* (1989) argue that firm size might influence the market differently in the event of auditor changes. Collins and Kothari (1989) suggest that firm size is a proxy for information availability.

Similarly, stock price changes around resource/reserve disclosures may reflect general market sentiment due to changes in the commodities market. Consistent with Moel and Tufano (2002) and Ferguson, Clinch and Kean (2011), a commodity price movement prior to the release of the resource/reserve disclosure is computed to control for commodities market sentiment. Specifically, *COMM_PRICE* is calculated as the price change for the primary deposit commodity in the 12 months prior to each respective resource/reserve disclosure. To control for the level of voluntary disclosure, I use *LNPAGES*, which is the natural log of the number of pages in each disclosure report. The variable *GROWTH* captures the importance of the news disclosed by the mining firms as defined in Section 2.4.2 of Chapter 2.

4.4 Results

4.4.1 Descriptive statistics

Table 4.1 presents descriptive statistics for the daily returns and commodity price data for the 1,467 resource/reserve disclosures included in this study. Panel A shows that the average capital expenditure as a percentage of total assets in the year prior to the mineral disclosures (*CAPEX_TA*) is 2.5%. The average one-year-lagged long-term debt as a percentage of common equity (*DEBT_EQ*) has a mean of 0.2%, and only 4% of the resource/reserve disclosures have debt in the year prior to the disclosure. This is consistent with the fact that MDSEs acquire debt mostly in later phases of the project lifecycle, such as in development phase.[51]

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[51] The sample used in this thesis consists of firms in the exploration phase as depicted in Figure 2.1 in Chapter 2.

The mean (median) commodity price change in the year prior to the mineral disclosures (*COMM_PRICE*) is 21% (17%).[52] The mean (median) 2-day window *BHAR* and *CAR* is 1.019% (1.007%) and 1.020% (1.008%), respectively. In Panels B, C and D, I report statistics on market reactions of the sample based on disclosure type. Results show that disclosures on (i) resource updates (Panel B, 1,219 observations) have a mean (median) market reaction of 3.08% (1.46%); (ii) reserve updates (Panel C, 201 observations) have a mean (median) market reaction of 3.27% (2.04%); and (iii) both resource and reserve updates (Panel D, 47 observations) have a mean (median) market reactions of 1.61% (1.01%). These results suggest that there is no material difference between resource and reserve disclosures on a descriptive level in terms of market reaction. Panel E shows that the mean (median) for the intraday abnormal return, 3-hour-window *BHAR* and *CAR* are 3.01% (1.02 %), 3.16% (1.32%) and 3.17% (1.34%), respectively. The remaining variables used in the multivariate model in this chapter are described in detail in Section 2.4.4 (Chapter 2).

The correlation matrix presented in Table 4.2 indicates a significant, negative correlation between *RSC* and *RSV* of -0.107 ($p<0.001$) in Panel A. This is consistent with larger changes in resource are associated with smaller changes in reserves. *RSC* is also negatively correlated with client size (*SIZE*), indicating that higher resource disclosures are made by smaller MDSE firms in early stages of development. Panel B indicates a high correlation among various categories of resource/reserve changes according to the JORC classification: the resource categories of *IND* and *INF* with *RSC*

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[52] This is not surprising given the sample period (apart from the three year period of 1999-2001) coincided with the mining boom in Australia. By way of example, the gold price (London PM fix) was $271 dollars per ounce when it bottomed in 2001. By the end of 2010, it was $1,668 dollars per ounce.

and the reserve categories of *PRV* and *PRB* with *RSV*. These results support the construction of Panel A and Panel B as presented on Table 4.5 and examining their *F*-statistic after nesting the regression in blocks of variables.

4.4.2 Market reaction to resource/reserve disclosures

To test H1 (whether there is a positive market reaction to resource/reserve disclosures by MDSEs), daily abnormal returns (ARs) and cumulative abnormal returns (CARs) are calculated for the sample of 1,546 resource/reserve disclosures announced by 414 companies.[53] Figure 4.1 presents graphically the daily raw returns for an extended 21-day window, centred on event day 0. There is a positive and significant market reaction on the announcement date (t = 0), with a mean (median) abnormal return of 3.03% (1.5%), significant at p<0.000.[54,55] During the extended 21-day window, there is no other date with similar price effect. CARs over the 21-day window before and after the announcement date (t = 0) are presented graphically in Figure 4.2, indicating an increasing and positive pattern over the 21-day period. Table 4.3 and Table 4.4 depict the significance of the daily abnormal returns (Table 4.3) and cumulative abnormal returns (Table 4.4) over the extended window (-10, 0, 10).[56] The

[53] Observations for projects without available commodity prices (e.g., rare earths and mineral sands) are included in this sample since the commodity price is not required for the test of H1, which increases the sample by 79 observations.

[54] Median abnormal returns are 1.5% on the announcement date (t = 0), Z-score = -21.935, significant at p<0.001 by applying a paired Wilcoxon test (Corrado, 2011).

[55] Table 4.3 suggests a significant positive effect on days -2 and -3 that may be due to the action of option traders since the date of disclosures might be predictable in some cases. .

[56] Consistent with Ferguson and Scott (2011), the nature of the test conducted in Table 4.4 is to examine whether different CAR windows over the announcement day are significantly positively different from 0. The significant abnormal return on event day 0 provides confidence that the longer CAR window results are not driven by correlation of returns. Furthermore, the pre-announcement windows are steadily significant and larger than the post-announcement CAR windows, reflecting descriptive statistics portrayed in Figure 4.1.

‘per cent positive’ statistic peaks at 64% on the disclosure event date (t = 0). Table 4.3 presents Student t-tests on whether daily AR is different from 0. AR is calculated as in Eq. (1); Event day ‘0’ represents the day of the resource/reserve disclosure. The t-stat is based on the Student t-test, ‘N’ is the number of observations. Two-tailed tests of significance are reported as follows: *** less than 0.01, ** less than 0.05, and * less than 0.10. These descriptive results are consistent with H1, indicating that the market reacts to information contained in resource/reserve disclosures by MDSEs.

4.4.3 Determinants of market reaction to resource/reserve disclosures

The test for H2 examines whether disclosures of a greater resource/reserve change are associated with a stronger market reaction (see Section 3.8, Chapter 3). I estimate an OLS regression of *BHAR*s over the 2-day (0, +1) window. Table 4.5 reports tests across the full sample of ‘good news’ resource/reserve changes, with results for the *BHAR* regression (Panel A) indicating that the model achieves an F-statistic of 4.72, significant at $p<0.000$. The model has an adjusted R-squared of 0.027. In Panel A, the coefficient for *RSC* (change in resource) is 0.0001, positive and significant at $p<0.022$, whilst the coefficient for *RSV* (change in reserve) is 0.0019 and significant at $p<0.014$. This indicates that changes in share prices around resource/reserve disclosures are driven by the size of total resource/reserve changes, consistent with the predictions of H2. In terms of other significant control variables, the proxy for firm size (*LNSIZE*) has a negative coefficient of -0.006, significant at $p<0.000$. Due to the significant correlation between *RSC* and *RSV*, I test the group effect of the two variables using F-statistics. I find similar results as the OLS model, with a significant F-statistic of 5.21.

In Panel B, I decompose the model into individual JORC categories and observe that returns are driven by the change in resources classified as *Inferred* resources (*INF*, with a positive coefficient of 0.0001, significant at $p<0.055$) or *Probable* reserves (*PRB*, with a positive coefficient of 0.0025, significant at $p<0.054$). These are both interesting and intuitive results. At the broader level (Panel A), it appears that both total resource and reserve changes generate greater positive market reactions. However, once broken down into the JORC categories, these respective results are in fact driven by the lower confidence resource and reserve categories (*Inferred* and *Probable*). Resource and reserve changes in other JORC categories are not significant. Intuitively, these results suggest that changes in the higher confidence resource categories (*Indicated* and *Measured* resources and *Proved* reserves) are typically associated with more mature deposits, where overall deposit size is well known by the market and hence any future changes in deposit quantum are more easily predictable. On the other hand, the lower confidence *Inferred* resource and *Probable* reserve changes may be more strongly associated with measures of future growth in resources/reserves. Due to the significant correlation between the JORC categories as depicted in Panel B of Table 4.2, I test the group effect of the variables using *F*-statistics. I find similar results as the OLS model, with a significant *F*-statistic of 2.76.

The test of H3a considers whether larger geological assurers (the Big 4) accompanying resource/reserve disclosures are associated with stronger market reactions. The size of each geological expert is calculated per year, based on the number of disclosures and size of the geological expert's clients as defined in Equation (2.11), Chapter 2. In Panel A of Table 4.6, I include the variable Big 4 (*B4*) and its interaction with the variables representing resource (*RSC*) and reserve (*RSV*) changes. The interaction between *B4* geological expert and resource/reserve change (*B4*RSC* and *B4*RSV*) are the test variables for H3a, with the coefficients measuring the impact on returns of the interaction between the magnitude of resource/reserve change with Big 4 geological expertise. Panel A depicts the interaction term of *B4*RSC* with a positive coefficient of 0.00011, marginally significant at $p<0.136$ ($p=0.068$ one-tailed), suggesting a weak evidence that larger geological experts are valued by the market for resource changes, but not reserve changes.[57,58]

The test of H3b considers geological expert specialisation (commodity leadership) effects. In Panel B of Table 4.6, I include the variable *SPEC,* which indicates whether the geological expert holds the largest share of client projects within an individual commodity group (i.e., precious metals, base metals, solid fuels or bulks leaders). The interactions between *SPEC* and resource/reserve changes (*SPEC*RSC* and *SPEC*RSV*) measure the impact on returns driven by the joint effect of the magnitude of resource/reserve upgrade and the presence of a commodity leader. Panel B shows a weakly positive result, with a coefficient of 0.0002 for *SPEC*RSC*, significant at $p<0.16$ ($p=0.080$, one-tailed). Once again, this indicates weak evidence that, other things equal, a specialist expert results in stronger market reactions.[59] However, a tighter test of specialist geological expertise is where I confine the specialist commodity leader definition to the Big 4 experts (*B4*SPEC*RSC*). Results of this test are reported in Panel C of Table 4.6, which shows that *B4*SPEC*RSC* is positive with a coefficient

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[57] All reported tests in the thesis are on a two-tailed basis unless otherwise stated.

[58] The group effect of *RSC* and *RSV* is examined using *F*-statistics. I find results similar to the OLS model, with a significant *F*-statistic of 5.28 for *RSV* and *RSV* but not significant for the interactions.

[59] The group effect of *RSC* and *RSV* is examined using *F*-statistics. I find results similar to the OLS model, with a significant *F*-statistic of 5.11 for *RSV* and *RSV* but not significant for the interactions.

of 0.0003, significant at $p<0.05$. This suggests that when the geological expert is a commodity leader belonging to the Big 4 group, a larger market reaction is observed. Using an alternative approach, I nest the regression in blocks of variables and examine their *F*-statistic. I consider two groups: the first with the variables *RSC* and *RSV* only; the second includes their interactions with *B4*SPEC*. I find similar results to the OLS model, with a significant *F*-statistic of 5.45 ($p<0.000$) for the *RSC* and *RSV* group and 2.48 ($p<0.053$) for the group with interaction terms.

Hypothesis H4 investigates the effect of commodity-specific knowledge of geological experts on the market reaction to reserve/reserve disclosures. In Table 4.7 (Panel A), I report the specialist interaction term *B4*SPEC*RSC* for base metals deposits and observe, consistent with H4, that the coefficient on *B4*SPEC*RSC* is positive and significant at $p<0.06$. The precious metals and bulk commodities coefficients are insignificant at conventional levels, suggesting the results are driven by the Big 4 commodity leader in base metals.[60] For the reduced sample of base metals containing good news, the model is not significant, with an *F*-statistic at $p<0.152$. In further analysis, I increase the sample size from 339 to 399 observations by including 60 resource and reserve downgrades (or bad news) and I find an improvement in the *F*-statistic, which becomes significant at the $p<0.08$ level (Appendix H.5).[61,62]

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[60] The group effect of *RSC* and *RSV* is examined using *F*-statistics. I only find significant group effect for Panel A.

[61] The same test is not applicable to the 'Oil and gas' group due to the small sample size (88 observations) and the lack of Big 4 geological experts present in this group, as discussed in Section 2.4.3 (Chapter 2). Sample size (229 observations) is also problematic for testing geological experts reputation in the 'Solid fuel' group and in the 'Other metals' group (20 observations).

[62] The results indicate that the *B4*SPEC*RSC* is still significant and positive after including bad news, suggesting higher reputation geological experts help in mitigating the effects of bad news.

The last hypothesis (H5) examines the valuation implications of switching geological experts (technical attesters) with different levels of reputation. In Table 4.8, the coefficient for the variable *UPB4* (-0.056) is negative and significant at $p<0.082$. Anecdotal evidence presented in Chapter 2 and Chapter 3 indicates that higher reputation geological experts have incentives to be more rigorous in disclosing resource/reserve information.[63] Thus, the total amount of resources/reserves disclosed when switching to these experts is likely to be lower than would be otherwise.[64] The result may be indicative of conservatism. Next, I interact both *UPB4* and *DNB4* with total resource changes (*RSC*) and total reserve changes (*RSV*). I find that the coefficient on *UPB4*RSC* is positive (0.0002) and significant at $p<0.009$, while *DNB4*RSV* is not significant. Thus, switching to a larger (B4) geological expert increases the market reaction to resource/reserve change, a finding consistent with the financial switching literature (e.g, Knechel *et al*., 2007).[65]

4.5 Further analysis

4.5.1 Intraday analysis

I consider the use of intraday tests in further analysis, providing additional evidence on the market reaction to resource/reserve disclosures and the geological experts that accompany these reports. I examine a 3-hour duration spanning one hour before and one hour after the hour in which a resource/reserve change is announced to the market. Intraday analysis can be conducted on resource/reserve disclosures because each ASX

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[63] Such evidence includes, and is not limited to, the liability of the Competent Person and the positive relation between size and quality vis-à-vis prior economics of auditing literature in the financial context.
[64] The market creates expectations about the mineral quantum based on drilling reports disclosed prior to the resource/reserve disclosure.
[65] The group effect of *RSC* and *RSV* is examined using *F*-statistics. I find similar results to the OLS model, with a significant *F*-statistic of 5.34 for *RSV* and *RSV* group and significant for the *UPB4* interactions (*F*-statistic of 4.10) but not significant for the *DNB4* interactions.

announcement has a precise time stamp. Thus, I run tests for abnormal returns, volumes and bid-ask spreads using trade-by-trade data.

To perform analysis in an intraday setting, some methodological issues need to be considered. For example, in disclosures announced outside of normal trading hours, the event period is treated as the first hour of the next trading day (i.e., between 10am to 11am). Most resource disclosures are released inside trading hours (illustrated in Figure 4.3). On the ASX, stocks are scheduled to open at different moments between 10:00 am and 10:10 am, depending on the starting alphabet of their ASX code. Once the schedule time is set, the stocks open within ± 15 seconds of this scheduled time, with the exact opening time randomly generated by the ASX for each stock every day.

Another issue is that each firm may exhibit its own intraday trading pattern. Following Brown *et al*. (1999), I control for intraday patterns in market characteristics using the same time period as the event time over the control window (e.g., 1pm to 2pm over day p to q). Liquidity and bid-ask spreads are recalculated at the hourly level and intraday buy-and-hold abnormal return is calculated as:

$$BHAR_i(-1,+1) = ln[\prod_{t-1}^{t+1}(1 + R_{it})] \qquad (4.5)$$

where: R_i is the hourly buy-and-hold return of firm i. I use a 3-hour buy-and-hold abnormal return (*BHAR*), measured from the closing price of the second last trading hour before the event hour to the closing price of the first hour after the event hour.

Brown, Chua and Mitchell (2002) argue that greater liquidity reduces information asymmetry and lowers uncertainty, thus encouraging investors to use a finer price grid. Using an intraday analysis, Brown *et al*. (2006) show a significant change in order and price revisions of the release of price-sensitive announcements. Brown *et al*. (2006)

argue that this result is due to a decrease in information asymmetry following the private information disclosed. Thus, I examine the order flow and other characteristics of trading behaviour. SIRCA provides data in a second-by-second format; this means that I am able to compute the hour from the minute the resource/reserve information was disclosed, as in Brown *et al*. (2013). Once again, I control for intraday patterns by using the same time period as the event time over the control window (Brown *et al*., 2006; Brown *et al*., 2013). The supplementary intraday order-book flow and other trading measures analysis are defined as follows:

$ONN_{i,j}$ is the number of on-market trades for firm i at hour j. It indicates the number of on-market trades. This variable is used to calculate the trading frequency during the event period measured as the number of trades per hour that a given stock has experienced during the event.

$ONVOL_{i,j}$ is the volume of on-market trading for firm i at hour j. This variable measures the on-market volume traded and serves as another proxy for measuring the effect of the announcement in reducing information asymmetry.

$ACTN_{i,j}$ is the number of actions (i.e., trades, new limit orders, amends and deletes) in the limit order-book for firm i at hour j. The number of actions in the limit order-book captures the attention paid by the market to a certain security.

$LIMACTN_{i,j}$ is the number of actions excluding trades in the limit order-book for firm i at hour j. According to Brown, Walsh and Yuen (1997), there is evidence that order flow and the existing limit order-book interact with stock return in the short run. In particular, a temporal imbalance between buy and sell orders arriving at a market increases the likelihood that informed traders are attempting to pre-empt good or bad news, thus prices and further orders react accordingly. This measure is relevant when dealing with non-synchronous returns, because it provides information even if there is no frequent trading. I define imbalance (IMBi,j) as follows:

$$IMB_{i,j} = \frac{BIN_{i,j}}{BIN_{i,j}+SIN_{i,j}}, \qquad (4.6)$$

where: $BIN_{i,j}$ and $SIN_{i,j}$ are the number of buyer and seller initiated trades for firm i at hour j, respectively.[66] Thus, $IMB_{i,j}$ measures the trade imbalance for firm i at hour j.

In the tests conducted in this section, the objective is to examine whether each metric's value is higher during the event period than the average expected value during the benchmark period. Tests for abnormal values of each metric, M, during the event period were conducted as follows.

Given that a disclosure d has a corresponding event period t_d and disclosure stock s_d, let T_d be the day of period t_d. Each disclosure d is assigned a set of control periods C_d consisting of $\{ c_{d,tr} \ \forall \ d \in [-60, -6] \}$ where $c_{d,tr}$ is the period at the same time of day as t_d on trading day $T_d + tr$ (that is, tr trading days in relation to T_d). Let $M(t, s)$ denote the value for the metric M during period t for stock s. Let $Fr(d, M)$ be the set of fractiles of $M(t_d)$ within the control sample $\{ M(c_{d,d}, s_d) \ \forall \ d \}$. Similar to Brown, Kwan and Wee (2006), I examine whether for each disclosure d, the set of fractiles, $Fr(d, M)$, is different from the expected value of 0.5 using the Fisher-Pitman permutation test.

4.5.1.1 Intraday market reaction

Table 4.9 presents tests examining whether there is a market reaction at the hourly level around resource/reserve disclosures. Abnormal returns, liquidity and bid-ask

[66] Note that, at market opening, overlapping limit orders are resolved according to an automatic algorithm. These trades are neither buyer nor seller initiated.

spreads are tested in Panels A, B and C, respectively. The intraday data has fewer observations than the main results due to a greater number of errors in the intraday databases.

Panel A shows a significant intraday abnormal return in the hour following the release of resource/reserve disclosures for both the *t*-test ($p<0.000$) and the non-parametric Wilcoxon test ($p<0.000$). Further, there is also strong evidence of increase in liquidity ($p<0.000$) at the hourly level around the disclosure of resource/reserve information as indicated in Panel B. Panel C shows a significant decrease of 13% in the bid-ask spread in the hour after the disclosure. The result indicates strong evidence of a market reaction around the release of resource/reserve disclosures at the hourly level. I conclude that the information content of resource/reserve is promptly absorbed by the market, resulting in a reduction in information asymmetry.

In Table 4.10, I repeat the analysis in Table 4.6, considering whether larger geological assurers (the Big 4) are associated with a stronger market reaction at the hourly level around the release of resource/reserve disclosures. It provides further evidence regarding the tests of H3 using a 3-hour buy-and-hold abnormal return (*BHAR*). The sample size (1,324) for these tests is smaller than the main results (1,467) due to greater number of errors in the intraday databases. Table 4.10 (Panel A) depicts an insignificant coefficient for *B4*RSC*, suggesting larger geological experts are not valued by the market for resource changes on an intraday level.

In Panel B (Table 4.10), I include the variable *SPEC*, which indicates whether the geological expert holds the largest share of client projects within an individual commodity group (i.e., precious metals, base metals, solid fuels or bulks leaders). Panel B shows a positive coefficient for *SPEC*RSC* (0.00022), significant at $p<0.026$. This result provides stronger evidence than the primary results (in Table 4.6) that a specialist leader is associated with stronger market reactions.[67,68] Stronger results (than those for daily analysis in Table 4.6) are also reported when I confine the specialist commodity leader definition to the Big 4 (*B4*SPEC*RSC*). Panel C shows that *B4*SPEC*RSC* is positive with a coefficient of 0.0003 and significant at $p<0.000$, providing further evidence that when the geological expert is a commodity leader belonging to the Big 4 group, a larger market reaction is observed.[69,70,71] Interestingly, the coefficient for *B4*SPEC*RSV* (-0.00275) is negative and significant at $p<0.068$. This result, however, is not robust because it is driven by only 14 observations.[72,73]

4.5.1.2 Intraday flow and other trading measures

Table 4.11 presents the order-book reaction at the intraday level around the release of resource/reserve disclosure events. The results for the hour immediately before and after the disclosure hour are reported in Panels A and B, respectively. Panel A shows marginal results with respect to on-market trading (*ONN*) and volume of on-market trading (*ONVOL*), with insignificant t-statistics but significant when using the non-

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[67] The group effect of *RSC* and *RSV* is examined using F-statistics. I find results similar to the OLS model, with a significant F-statistic of 6.57 for *RSV* and *RSV* group and significant for the interactions with an F-statistic of 2.80.

[68] Table 4.6 reports a marginally positive coefficient for *SPEC*RSC* (0.0002 with $p<0.16$).

[69] Table 4.6 reports a significant, positive coefficient for *B4*SPEC*RSC* (0.0003 with $p<0.054$).

[70] The group effect of *RSC* and *RSV* is examined using F-statistics. I find results similar to the OLS model, with a significant F-statistic of 6.56 for *RSV* and *RSV* group and significant for the interactions with an F-statistic of 10.48.

[71] In order to assess whether the results are driven by the reduced sample size, I repeat the primary analysis using a 3-day buy-and-hold abnormal return as reported in Appendix K. The results in the reduced sample are similar to those reported for the primary results in Table 4.6. I conclude that the results reported in the intraday analysis are not driven by the reduced sample.

[72] From the 14 observations, only two are the main drivers of the significant, negative results. I repeat the tests after deleting these observations and find that the coefficient for *B4*SPEC*RSV* (-0.001807) becomes marginally significant at $p<0.134$.

[73] I find similar results when repeating this test using a 2-hour buy-and-hold intraday dependent variable, as reported in Appendix J.

parametric Wilcoxon test. The number of actions in the limit order-book (*ACTN* and *LIMACTN*) is significant, showing that the market responds to the release of resource/reserve disclosures.

An abnormal reaction in the hour immediately following the resource/reserve disclosure is shown in Panel B. I find significantly higher trading in terms of number of trades (*ONN*) and volume (*ONVAL*) using both parametric and non-parametric tests. This means the market witnesses increased trading frequency and reductions in information asymmetry after the disclosure of a resource/reserve disclosure. Moreover, an abnormal order-book reaction in terms of actions is observed, both including (*ACTN*) and excluding trades (*LIMACTN*). These results indicate a prompt market reaction following a resource/reserve disclosure. A possible explanation for the insignificant result for the trade imbalance measure (*IMB*) is that resource/reserve disclosures result in lower information asymmetry, higher trading, lower bid-ask spread, and thus a balance of buyer- and seller-initiated trading.[74]

The differences between the reactions in the hour immediately before and after the hour of the resource/reserve disclosure are examined in Panel C. In the hour after the resource/reserve disclosure, a higher level of order-book actions and trading than in the hour before the announcement is observed. In summary, Table 4.11 indicates a significant order flow and investors' trading reaction following a resource/reserve disclosure.

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[74] The lower bid-ask spread and higher liquidity subsequent to a resource/reserve disclosure is discussed earlier in Section 4.5.1.

4.5.2 Effect of capital expenditure and debt

I examine the effect of one-year lagged capital expenditure as a percentage of total assets (*LNCAPEX_TA*) and long-term debt as a percentage of common equity (*LNDEBT_EQ*) on the market reactions to resource/reserve disclosures. Table 4.13 – Panel A, shows that the coefficient for *LNCAPEX_TA* (-0.00888) is negative and significant at $p<0.011$. A possible explanation for these results is that investors are more likely to anticipate the information about resource/reserve disclosures from those firms with higher past capital expenditure, thus having a lower market reaction on these disclosures. There is no significant effect from *LNDEBT_EQ* on the market reaction to resource/reserve disclosures presented in Panel B. This may be due to the lower number of observations (4%) of firms with debt. After controlling for debt and capital expenditure, I find results qualitatively similar to key results reported in Table 4.6, for *B4*SPEC*RSC* (0.00038, $p<0.059$).

4.5.3 Value of technical auditor

To investigate the value of geological experts in the role of technical auditors, I re-run the analysis in Table 4.6 by including the dummy variable *TECHAUD* which equals 1 if the resource/reserve disclosure has been audited by a geological expert and 0 otherwise. Results are reported in Appendix M and show that the variable *TECHAUD* is not significant, indicating that the role of geological expert in an audit capacity derives no incremental value. Regardless of the results presented in the multivariate model, there are only 17 observations of reports audited by geological experts in my whole sample (less than 1% of total). As discussed in Chapter 2, one possible interpretation is that a Competent Person already provides sufficient professional assurance to investors and thus not justifying the costs of an extra assurance provided by a technical auditor.

4.5.4 Positioning of geological expert's name in disclosure report

Following Carter and Manaster (1996), I examine whether the positioning or prominence of the geological expert's name in a resource/reserve disclosure report alters my results in any way. I re-run the analysis as in Table 4.6 (Panel C) by including the dummy variable *BODY* which equals 1 if the geological expert's name appears in the report's body and 0 otherwise. Results are reported in Appendix F.6 which shows that the variable *BODY* is not significant, indicating the positioning of the expert's name in the disclosure report does not impact my results.

4.6 Sensitivity tests

4.6.1 Alternative measures of geological expert's proxy for size

I examine individual brand effect of each of the top 5-ranked geological experts (Hellman and Schofield; Snowden Mining; SRK Consulting; Coffey Mining; and Golder Associates) as reported in Appendix E.1. To do so, I repeat the primary analysis in Table 4.6 after substituting the variable *SPEC* for a dummy variable indicating the presence of each individual geological expert's brand. I find no significant individual brand effect, indicating the commodity leader results are not driven by any particular expert.[75]

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[75] In Panel A, the coefficient on *LEAD*RSV* is negative (-0.01289) and significant at $p<0.000$. This result is however based on only four observations.

In Appendix E.2, I reconfigure the large expert group by dropping the smallest members of the Big 4 group and testing a Big 2 and a Big 3 effect on the market. Panel A.1 investigates the Big 2 effect on the market reaction and finds no significant coefficient for *BN*RSC*. In Panel A.2, I confine the specialist commodity leader definition (*SPEC*) to the Big 2 (*BN*SPEC*RSC*) and find a positive coefficient of 0.00012, significant at $p<0.038$. Using a Big 3 measure, Panel B.1 shows a positive coefficient of 0.00013 for *BN*RSC*, marginally significant at $p<0.177$ ($p=0.088$ one-tailed). When I confine the specialist commodity leader definition (*SPEC*) to the Big 3 (*BN*SPEC*RSC*), it shows a positive coefficient of 0.0004, significant at $p<0.059$. The weakest results are obtained when I extend the definition of a leader to incorporate a Big 5 measure. Panel C.1 shows no significant coefficient for *BN*RSC*. In Panel C.2, I find a positive coefficient of 0.00030 for *B5*RSC*, marginally significant at $p<0.114$ ($p=0.057$ one-tailed). The results indicate the definition of leading geological experts does impact on the results.

I conduct further analysis on alternative definitions of a specialist based on (1) the size of clients assured by the specialists (2) the number of disclosures. Results indicate that using the first approach based on the client size, the results are similar to those appearing in Table 4.6. For example, in Appendix C.1, Panel A, the *B4*SPEC*RSC* interaction term has a coefficient of .0004, significant at $p<.062$. Once again this is driven by the Base Metals sector in Panel B, where the co-efficient on the interaction term is significant at $p<.01$. When the specialist definition is configured based on the number of disclosures assured by the consulting geologist (Appendix C.2), the *B4*SPEC*RSC* interaction is positive, but not significant in the test across the full sample, or across any individual commodity cluster. In sum, like many studies of auditor industry specialization, my results are sensitive to the definition of specialist assurer.

4.6.2 Choice of alternative event windows

I test the robustness of my results by repeating the analysis in Table 4.6 using a 1-day event window. As Appendix F.1 shows, the coefficient for geological expert *B4*SPEC*RSC* is 0.00034, significant at $p<0.081$, and consistent with key results in Table 4.6. Alternatively, when a 3-day and 5-day event window are used, all primary results remain with the exception of the coefficient for *B4*SPEC*RSC* (0.00034, $p<0.12$ for 3-day) and (0.00036, $p<0.12$ for 5-day), which are both significant on a one-tailed basis only. Lastly, using a 10-day event window, the model becomes noisy and thus results are no longer significant, probably due to noise.

4.6.3 Quantile regression

Following Choi *et al*. (2008), I perform a median quantile regression to examine the impact of extreme observations on the results reported in Table 4.6 The results, reported in Appendix F.2, indicate positive and significant coefficients for *RSC* (0.00005, $p<0.001$), *RSV* (0.00189, $p<0.002$) and *B4*SPEC*RSC* (0.00016, $p<0.001$), suggesting my results are a little stronger using this approach.

4.6.4 Multicollinearity

I calculate the variance inflation factors (VIF) on the primary model in Table 4.6 to measure the possible presence of multicollinearity. The average VIFs are 1.12, and range from 1.01 to 1.1 amongst the variables, suggesting no significant multicollinearity is present. In other tests, I re-run the primary tests with reduced-form specifications, keeping only the experimental variables *RSC*, *RSV*, *B4*SPEC* and interaction terms necessary to test H2 and H3a. Results presented in Appendix F.3 show no meaningful change to the primary results reported in Table 4.5 and Table 4.6. When applying a reduced-form specification approach, positive and significant coefficients for *RSC* (0.00005, $p<0.033$), *RSV* (0.00140, $p<0.072$) and *B4*SPEC*RSC* (0.0003, $p<0.052$) are observed.

4.6.5 Choice of performance benchmark

I conduct sensitivity tests using four alternative benchmark indices in Appendix G.1. I repeat the analysis in Table 4.6 calculating abnormal returns using the following four alternative indices: (1) ASX S&P 300 Metals and Mining Index; (2) Dow Jones Australia Mining Index; (3) Australia Datastream Mining Index; and (4) ASX All Ordinaries Index.[76, 77] For all such sensitivity tests, the primary results remain unchanged. In other analysis presented in Appendix F.4, I test for alternative measures of the dependent variable. In Panel A, I repeat the analysis in Table 4.5 using a 2-day window *CAR*s as opposed to *BHAR*s and report similar results for the coefficient on *RSC* (0.00006, significant at $p<0.045$) and *RSV* (0.00006, significant at $p<0.024$). In Panel B, I repeat the analysis of H3b in Table 4.6 and find the coefficient for *B4*SPEC*RSC* (0.0003) positive and significant at $p<0.05$ using *CARs* as opposed to *BHARs*.

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[76] Due to the lack of data before the year of 2000 for ASX S&P 300 Metals and Mining, I use the FTSE Australia Mining Index as a substitute for the years of 1996 to 2000.

[77] Appendix G.2 and G.3 graphically illustrates both the primary index used in this thesis (the average of market value for all non-disclosing firms) and the alternative indices respectively. The graphs show that the index created for this thesis and the conventional indices for mining firms are qualitatively similar.

4.6.6 Country growth characteristics

I consider the impact of project domicile characteristics (Appendix F.5) on my results by including a separate variable (*GDP_RANK*) for the decile ranking based on the gross domestic product per capita (as defined in Section 2.4.2) of the country of project domicile.[78] After including this variable, I find that the coefficient on *GDP_RANK* is positive, as would be expected, but not significant.

4.6.7 Heteroskedascity test

Following Stock and Watson (2008), I repeat the analysis in Table 4.5 and Table 4.6 after clustering standard errors by year. The result of this test, presented in Appendix F.7, is similar to the primary results, with positive and significant coefficients for the variables *RSC* (0.00006, significant at $p<0.025$) and *RSV* (0.00191, significant at $p<0.049$) for the main test in Table 4.5 and for the interaction term *B4*SPEC*RSC* (0.0003, significant at $p<0.043$), similar to the primary test of H3b in Table 4.6.

4.6.8 Alternative specification for timing of disclosure

I examine an alternative specification for the model in Table 4.5 and Table 4.6 by controlling for disclosure timing, as reported in Appendix F.8. I include a dummy variable *FIRST_DISC*, to reflect the sequencing of resource/reserve disclosures, which is coded 1 for the first resource/reserve disclosure and 0 for subsequent disclosures. Panel A indicates that the coefficient for *FIRST_DISC* is negative (-0.01) and

[78] Countries with low GDP per capita are ranked in the bottom decile and countries with high GDP per capita are ranked in the top decile.

significant at $p<0.034$ for the main test in Table 4.5, suggesting initial resource disclosures are disappointments. When included in the model in Panel B, the coefficient for *B4*SPEC*RSC* (0.0003, significant at $p<0.056$) is similar to the primary test of H3b in Table 4.6.

4.6.9 Sample partitioning

I consider whether revisions to the JORC code (1998 and 2004) may influence my results. After excluding 13 disclosures made before 1998, I find results qualitatively similar to the key result in Table 4.6 for the interaction term *B4*SPEC*RSC* (0.0003, $p<0.056$) as reported in Appendix H.1. I then exclude all observations prior to 2004, reducing the sample to 1,372 disclosures. After doing so, the coefficient on *B4*SPEC*RSC* (0.0003, $p<0.051$) remains unchanged. Thus, alternative partitions under differing JORC code revisions make no difference to the results. I consider the possible impact of the 2008 global financial crisis (GFC) (Appendix H.2) by excluding observations during the GFC period. The coefficients for *RSC* (0.00007, $p<0.016$) and *RSV* (0.00184, $p<0.026$) are unchanged in terms of tests in Table 4.5, whilst *B4*SPEC*RSC* (0.0003, $p<0.056$) remains positive and significant.

I examine the effect of the dilution of good news effect by including resource and reserve downgrades or bad news events in my sample. This results in an increased sample of 1,657 observations. Once again, after re-running the specialist test, the interaction term *B4*SPEC*RSC* has a coefficient of 0.00037, significant at $p<0.061$ (as reported in Appendix H.3), which is similar to the primary test reported in Table 4.6.

I also examine the 'Base metals' classification by repeating Table 4.7 analysis after classifying base metals constituents into LME spot traded base metals (excluding tungsten and vanadium) and all base metals. Classifying based on LME presence does not alter my results with coefficient for *B4*SPEC*RSC* (0.0007, significant at $p<0.000$) in configuration 1 and *B4*SPEC*RSC* (0.0007, significant at $p<0.000$) in configuration 2 as depicted in Appendix P.

4.6.10 MDSE definition

The definition of an MDSE is consistent with that adopted in prior literature in that the company has product revenues which are less than 5% of its market capitalisation. My sample includes one firm Fortescue (FMG) that commences production, but does not meet the 5% revenue threshold because it is still in the ramp-up phase, effecting one resource/reserve change. Initially I include this early-stage producer in the analysis, but then drop it from the sample for robustness. After doing so, the coefficient on *B4*SPEC*RSC* (0.0003, $p<0.056$) is unchanged, as reported in Appendix H.4.

4.6.11 Non-trading firms

Prior research has shown that daily returns approach could generate unreliable results due to spurious autocorrelations induced by non-synchronous trading (Atchison, Butler and Simonds, 1987). To consider this issue, I replicate the analysis in Table 4.6 excluding a total of 64 observations with zero turnover on the event day. The results reported in Appendix H.6 (Panel A) indicate positive and significant coefficients for *RSC* (0.00006, $p<0.028$) and *RSV* (0.00184, $p<0.021$). Panel B shows that the coefficient for *B4*SPEC*RSC* (0.00037) is positive and significant at $p<0.081$, suggesting my results are qualitatively similar to the primary results and are not affected by non-synchronous trading bias.

4.6.12 Foreign projects

In other tests, I consider the impact of project domicile by including a separate dummy variable for offshore projects. After including this offshore dummy, I find that the coefficient on *B4*SPEC*RSC* (0.00038, $p<0.054$) is still positive and significant as reported in Appendix I. The coefficient for the variable *FOREIGN* (0.0021, $p<0.688$) is positive but not significant.

4.6.13 Selection bias test

It is widely accepted in principle that clients self-select auditors (Chaney, Jeter and Shivakumar 2004). This self-selection bias might be present in the market for geological experts. To address this issue, I use a two-stage Heckman model, consistent with prior economics of auditing literature (Ireland and Lennox 2001; Chaney, Jeter and Shivakumar 2004; Francis, Lennox and Wang, 2010; Lawrence, Minutti-Meza and Zhang, 2011).

I examine whether differences in proxies for a geological expert's quality between Big 4 specialist leaders (*B4*SPEC*) and non-Big 4 specialist leaders could be a reflection of their respective clients' characteristics. To investigate the effects of potential sample selection bias associated with larger experts who are specialist commodity leaders (*B4*SPEC*), I run the two-step Heckman (1979) correction model. First, I fit a probit choice model of the firms with Big 4 specialist commodity leaders (*B4*SPEC*), and then control for section bias by including the inverse Mills' ratio from the choice model in the following regression fitted to disclosures with those experts:

$$R = \beta_0 + \beta_1 MILLS + \varepsilon \qquad (4.7)$$

where: *MILLS* is the inverse Mills' ratio and the constant term should be indicative of the returns while taking into account selection bias.

The choice model is described as follows:

$$(BIG4 * SPEC) = C(1) + C(2) * RSC + C(3) * RSV + C(4) * RSC\_GRADE + C(5) * RSV\_GRADE + C(6) * LNSIZE + C(7) * COMM\_PRICE + C(8) * LNPAGES + C(9) * GROWTH + C(10) * GDP\_RANK + C(11) * LNCAPEX\_TA + C(12) * LNDEBT\_EQ + C(13) * FIRST\_DISC + e \quad (4.8)$$

Appendix N.1 shows the results of the probit choice model with 90.12% of the observations correctly classified. The pseudo R-squared of the model is 4.0%, indicating that it has at least some discriminatory power. *LNSIZE* (0.09) is positive and significant at $p<0.015$, consistent with the expectations that bigger firms would be able to afford better quality geological experts. Size is chosen because it can be excluded from the second-stage model, since the amount of resource/reserve change (*RSC* and *RSV*) can also proxy for size.[79] The coefficient on *COMM_PRICE* (0.2810) is positive and significant at $p<0.076$, indicating that firms are more likely to engage higher-quality geological experts when industry sentiment (proxied by higher commodity prices) is high. The coefficient on *GROWTH* (0.1056) is positive, but not significant. The sign of the coefficients on *COMM_PRICE* and *GROWTH* are consistent with Healy and Lys (1986), who argue that firms with higher growth are more likely to demand higher-reputation auditors. In order to control for differences in lifecycle, I include

[79] Lennox et al. (2012) highlight the importance for validly excluding the independent variables from the main variable.

FIRST_DISC to reflect the sequencing of resource/reserve disclosures. The coefficient on *FIRST_DISC* is found to be negative but not significant.

To control for the country characteristics where the project is domiciled, I include the variable *GDP_RANK* as a ranking based on the *GDP_PC* deciles of the 186 countries included in the sample.[80] The coefficient on *GDP_RANK* (-0.0436) is negative and marginally significant at $p<0.11$ ($p=0.055$ one-tailed), consistent with Akerlof's argument that there is considerable evidence that quality variation is greater in undeveloped than in developed countries. Thus, MDSEs with projects in undeveloped countries (i.e., lower *GDP* per capita on the lower deciles) would require higher-reputation geological experts. However, this relationship could result from bigger-brand geological experts operating on the majority of international projects. To test this conjecture, I create two dummy variables (*GDP_LOW* and *GDP_HIGH*) that equal to 1 if the *GDP_PC* is in the two lowest/highest deciles and then I exclude observations of projects in Australia. As reported in Appendix N.2, the coefficient on *GDP_LOW* (0.53818) is positive and significant at $p<0.052$ (Panel A) while the coefficient on *GDP_HIGH* (-1.06119) is positive and significant at $p<0.086$ (Panel B). This indicates that projects in poorer (undeveloped) countries demand higher reputation from geological experts than projects domiciled in richer (developed) countries.

Panel B presents the results of the Heckman correction regression. The constant term is negative and has a value that approximates the value of the buy-and-hold abnormal returns from previous analysis in Table 4.6. The inverse Mills' ratio is not statistically significant. Following Lennox *et al*. (2012), who highlight the issue of

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[80] *GDP_PC* is the average gross domestic product per capita for each country during my sample period, as discussed earlier in Chapter 2.

multicollinearity when using the selection model, I calculate the variance inflation factors (VIF) on the choice model to assess the possible presence of multicollinearity. The average VIFs are 1.07, and range from 1.0 to 1.22 among the variables, suggesting no significant multicollinearity is present. Thus, the Heckman correction results provide some evidence that the primary results in this thesis are not driven by self-selection bias.

4.6.14 Alternative data source

I test the robustness of my results using an alternative source of stock price data obtained from SIRCA. I repeat the analysis in Table 4.5 and Table 4.6, and report the results in Appendix F.9. In terms of the tests in Panel A of Table 4.5, the coefficient on *RSC* (0.00007, $p<0.007$) is unchanged, while the coefficient on *RSV* (0.00133, $p<0.139$) is similar but less significant. Results in Panel B are qualitatively the same as in Table 4.6, with the coefficient on *B4*SPEC*RSC* (0.0004, $p<0.053$) remaining positive and significant.

4.6.15 Cash flow effect

I examine the effect of cash flow by including the variable *CASHBURN* in the model. The variable is defined as the ratio measured by the amount of cash at the end of the period divided by the net operating cash flow as follows:

$$CASHBURN = \frac{Cash\ at\ the\ End\ of\ the\ Period}{Net\ Operating\ Cash\ Flow * -1}$$

The variable represents the number of periods (years) necessary to consume all the current cash based on the cash used in the current period to pay for its operations. There are a small number of firms in the sample that have some positive cash flow and are therefore excluded from this test. I repeat the analysis in Table 4.5 and Table 4.6 after excluding a total of 129 observations where the net operating cash is positive. For both tests, I find a positive coefficient for the variable *CASHBURN* (as might be expected), but not significant as reported in Appendix F.10. I repeat this test using an alternative measure for CASHBURN by accounting for the net investing cash flow. I re-calculate the *CASHBURN* ratio by adding net investment cash flow to the denominator as follows:

$$CASHBURN = \frac{Cash\ at\ the\ End\ of\ the\ Period}{(Net\ Operating\ Cash\ Flow + Net\ Investing\ Cash\ Flow) * -1}$$

The result of this test presented in Appendix F.11 shows a positive and significant coefficient on *CASHBURN* (0.00565, significant at $p<0.068$) while the coefficients on *RSC* (0.00006, significant at $p<0.061$) and *RSV* (0.00226, significant at $p<0.028$) remain similar to the main test in Table 4.5. This result is consistent with those in Panel B, where the coefficient on *CASHBURN* (0.00480) is positive and significant at $p<0.101$ and the coefficient on *B4*SPEC*RSC* (0.00037, significant at $p<0.065$) remain similar to the primary test of H3b in Table 4.6. This result indicates that firms with a lower cash burn rate (i.e., more cash available) have a higher market reaction to their resource/reserve disclosures than firms with a higher cash burn rate (i.e., less cash available).

4.6.16 Firm age effect

I consider the impact of firm age (Appendix F.12) by including a separate variable (*FIRM_AGE*) measuring the number of days between the resource/reserve disclosure and the firm's listing date on the ASX. After including this variable, I find that the coefficient on *FIRM_AGE* is negative, as would be expected, but is not significant.

4.6.17 Project equity adjustments

I re-run primary results in Table 4.6, this time adjusting Equations 2.1-2.3 for project equity (Appendix O). There are a total of 236 observations belonging to Joint Ventures. Of those, 158 hold more than 50% project equity and 73 below 50%. Appendix O.1 depicts the distribution of Joint Venture interests. Effectively this calibrates the value of the resource or reserve change by the company's project interest, which is particularly important for joint ventures. When calibrating resource and reserve change by project equity, the *B4*SPEC*RSC* test variable strengthens slightly and has a coefficient of 0.0004, significant at $p<0.031$ as reported in Appendix O.2.

4.6.18 Abnormal volume turnover

I conduct further tests examining the effects of specialist assurance reconfiguring the dependant variable in (4.4) as abnormal trading volume over 2-day and 10-day event windows following the resource disclosures as depicted in Appendix F.13. In each case the primary test variable *B4*SPEC*RSC* is negatively signed, but is not significant.

4.7 Conclusions

In this chapter, the impact of resource/reserve disclosures on firm value and the reputational value of geological experts assuring these reports is examined in a capital market context. Based on a hand-collected resource/reserve data organised around specific mineral projects and tracked over the resource development lifecycle of each deposit, a multivariate model is specified, controlling for deposit properties, firm-level economic properties and disclosure characteristics. This chapter finds that resource/reserve disclosures are significant market events followed by a positive market return at both daily and hourly levels. It shows evidence of a positive return on the day of the resource/reserve disclosure, suggesting that the market prices resource definition events. A further intuitive result is that larger resource changes are found to be associated with higher abnormal returns. When decomposing the model by JORC categories, the multivariate results are primarily driven by the lowest confidence (*Inferred*) resource and (*Probable*) reserve category, suggesting changes in these categories may better reflect future deposit growth expectations. It also documents an increase in liquidity and a reduction in the bid-ask at the hourly level. Moreover, it presents evidence of market reaction at the hourly level in terms of order-book measures, indicating that the information content of resource/reserve disclosures is quickly impounded by the market resulting in a reduction in information asymmetry.

Further, the size of geological experts that accompany such reports is significant in the cross-sectional returns prediction model, with the strongest evidence found for specialist or commodity-leading geological experts. The analysis in this chapter indicates that these commodity-leader results are driven by deposit complexity or base metals resource/reserve changes. It also shows that, consistent with Akerlof (1970), projects in undeveloped countries have higher requirement for geological experts' reputation. In terms of limitations, I note the tests of expert commodity leadership are sensitive to the definition of the group of large experts. However, I also note that this is not dissimilar to the audit literature, with many studies of audit fees reporting findings sensitive to the definition of specialists. In summary, this chapter provides the first evidence demonstrating that changes in share prices around resource/reserve disclosures are driven by both the amount of mineral disclosed and the size (quality) of the expert associated with the market disclosure.

4.8 Chapter 4 figures and tables

Figure 4.1: Daily abnormal returns over the 21-day (-10,0,10) window

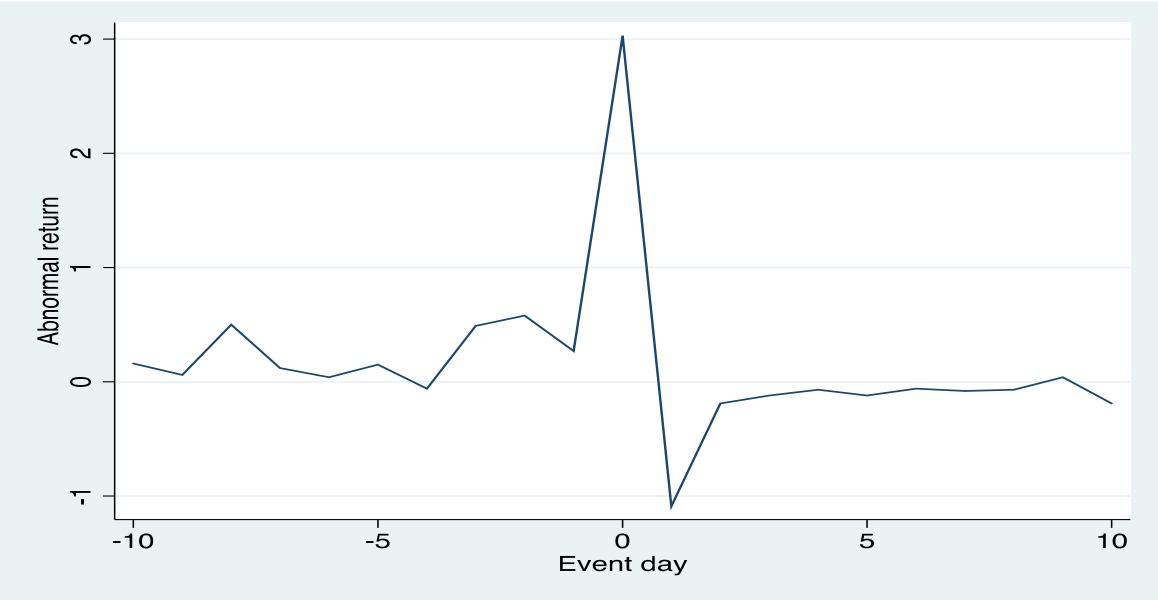

Figure 4.2: Cumulative abnormal return over the 21-day (-10,0,10) window

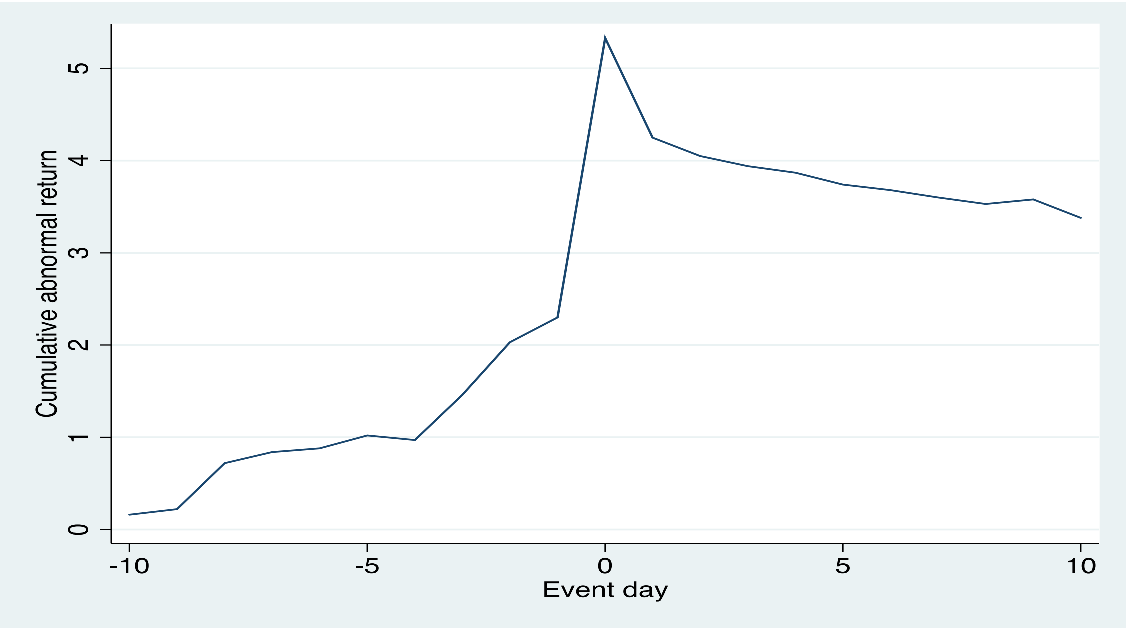

Figure 4.3: Timing of resource and reserve disclosures

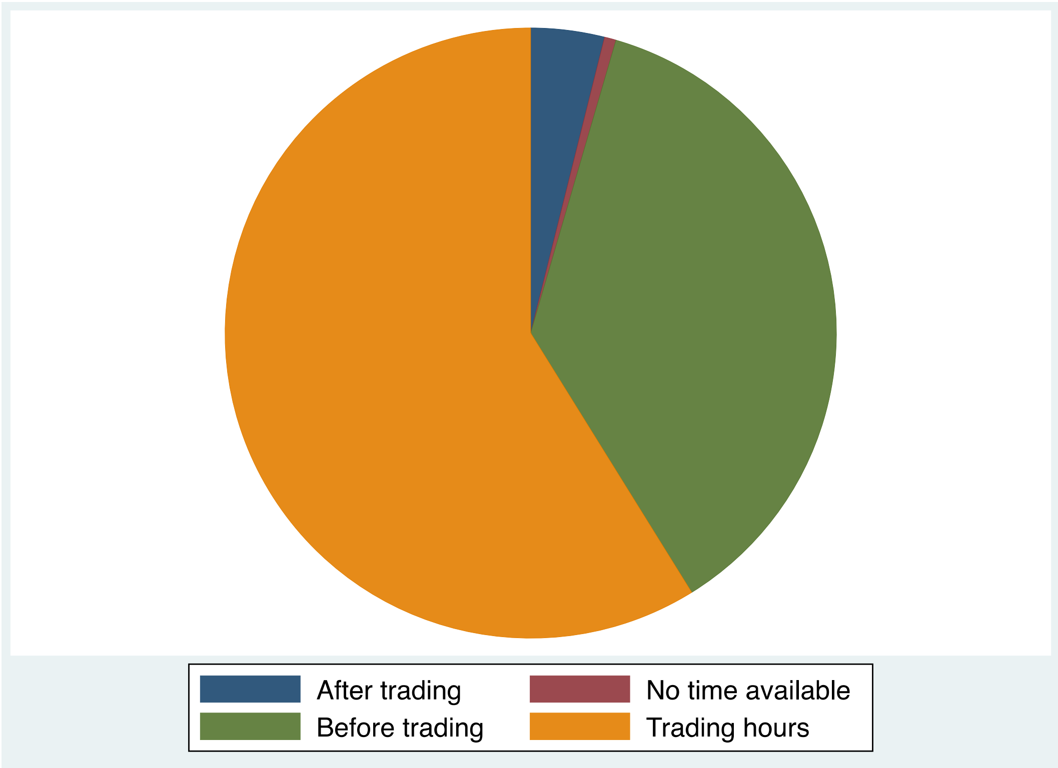

Table 4.1: Descriptive statistics for market and commodity price variables

Panel A – All commodities

	Mean	Median	Std. Dev.	Min	Max	Obs.	Non-Zero Obs.	% Non-Zero Obs.
CAPEX_TA	2.5761	0.0000	36.9192	0.0000	1375	1467	483	33%
LNCAPEX_TA	0.4229	0.0000	0.7668	0.0000	7.2269	1467	483	33%
DEBT_EQ	0.2281	0.0000	2.3619	0.0000	48	1467	60	4%
LNDEBT_EQ	0.0503	0.0000	0.3145	0.0000	3.8918	1467	60	4%
COMM_PRICE	0.2167	0.1734	0.3797	-0.5779	1.6742	1467	1467	100%
BHAR2	1.0197	1.0070	0.1073	0.4799	2.2682	1467	1467	100%
CAR2	1.0200	1.0080	0.1075	0.4539	2.2684	1467	1467	100%
AR	1.0306	1.0153	0.0966	0.5128	2.2749	1467	1467	100%
LNBHAR2	0.0144	0.0070	0.1000	-0.7343	0.8190	1467	1467	100%
LNCAR2	0.0119	0.0052	0.1007	-0.7624	0.8189	1467	1467	100%
LNAR	0.0262	0.0153	0.0879	-0.6678	0.8219	1467	1467	100%

Panel B – Resource only disclosures

	Mean	Median	Std. Dev.	Min	Max	Obs.	Non-Zero Obs.	% Non-Zero Obs.
BHAR2	1.019379	1.0056	0.1115226	0.479854	2.26815	1467	1219	83%
CAR2	1.019975	1.0070	0.1206199	0.442303	2.26842	1467	1219	83%
AR	1.030888	1.0146	0.1002617	0.512854	2.27492	1467	1219	83%

Panel C – Reserves only disclosures

	Mean	Median	Std. Dev.	Min	Max	Obs.	Non-Zero Obs.	% Non-Zero Obs.
BHAR2	1.024397	1.0179	0.0808343	0.823582	1.40412	1467	201	14%
CAR2	1.024162	1.0183	0.0080087	0.815924	1.40895	1467	201	14%
AR	1.032757	1.0204	0.0761293	0.827399	1.41041	1467	201	14%

Panel D – Resource and reserves disclosures

	Mean	Median	Std. Dev.	Min	Max	Obs.	Non-Zero Obs.	% Non-Zero Obs.
BHAR2	1.006716	0.9987	0.0960322	0.779233	1.31658	1467	47	3%
CAR2	1.003208	0.9985	0.9378700	0.771766	1.30171	1467	47	3%
AR	1.016118	1.0111	0.0781102	0.782943	1.26487	1467	47	3%

Panel E – Intraday resource and reserve analysis

	Mean	Median	Std. Dev.	Min	Max	Obs.	Non-Zero Obs.	% Non-Zero Obs.
INT_AB	1.0301	1.0102	0.0809	-0.3402	0.8148	1324	1324	100%
INT_BHAR3	1.0316	1.0132	0.0822	0.6597	1.8148	1324	1324	100%
INT_CAR3	1.0317	0.0134	0.0823	-0.3666	1.8148	1324	1324	100%
LNINT_AB	0.0269	0.0102	0.0727	-0.4159	0.5959	1324	1324	100%
LNINT_BHAR3	0.0283	0.0131	0.0743	-0.4159	0.5959	1324	1324	100%
LNINT_CAR3	0.0284	0.0133	0.0745	-0.4567	0.5959	1324	1324	100%

Variable Definitions:

CAPEX_TA = One-year lagged capital expenditure as percentage of total assets.
LNCAPEX_TA = Log of one-year lagged capital expenditure as percentage of total assets.
DEBT_EQ = One-year lagged long-term debt as percentage of common equity.
LNDEBT_EQ = Log of one-year lagged debt as percentage of common equity.
COMM_PRICE = Price change for the primary deposit commodity in the 12 months prior to each respective resource or reserve disclosure.
CAR2 = 2-day cumulative abnormal return.
BHAR2 = 2-day buy-and-hold abnormal return.
AR = Abnormal return on the event day
LNCAR2 = Log of 2-day cumulative abnormal return.
LNBHAR2 = Log of 2-day buy-and-hold abnormal return.
LNAR = Log of abnormal return on the event day.
INT_AB = Abnormal return on the event hour.
INT_BHAR3 = 3-hour buy-and-hold abnormal return.
INT_CAR3 = 3-hour cumulative abnormal return.
LNINT_AB = Log of abnormal return on the event hour.
LNINT_BHAR3 = Log of 3-hour buy-and-hold abnormal return.
LNINT_CAR3 = Log of 3-hour cumulative abnormal return.

Table 4.2: Correlation matrix

Panel A - Pairwise Pearson correlation coefficients of experimental and control variables

	RSC	RSV	GRADE_RSC	GRADE_RSV	SIZE	COMM_PRICE	PAGES	BHAR2	CAR2	Growth	B4	SPEC	B4*SPEC
RSC	1.000												
RSV	-0.107***	1.000											
GRADE_RSC	0.033	-0.054**	1.000										
GRADE_RSV	0.042	0.058**	0.016	1.000									
SIZE	-0.072***	0.032	-0.015	-0.018	1.000								
COMM_PRICE	-0.065**	-0.016	-0.024	-0.024	0.073***	1.000							
PAGES	0.161***	-0.069***	0.01	0.008	-0.021	-0.050*	1.000						
BHAR2	0.115***	0.030	0.037	0.022	0.007	0.008	0.020	1.000					
CAR2	0.121***	0.029	-0.009	0.023	-0.017	0.003	-0.013	0.996***	1.000				
GROWTH	-0.080***	-0.074***	0.084***	-0.002	0.011	-0.006	-0.074***	0.041	0.035	1.000			
B4	0.015	-0.107***	-0.047*	0.003	0.016	0.092	0.034	0.010	0.009	0.034	1.000		
SPEC	-0.047*	0.067**	-0.043	0.025	0.017	0.055***	-0.060**	0.040	0.004	0.044*	0.583***	1.000	
B4*SPEC	-0.047*	-0.047*	-0.042	0.012	0.017	0.078*	-0.028	0.039	0.039	0.059**	0.618***	0.900***	1.000

Panel B – Pairwise Pearson Correlation coefficients of resource/reserve changes among individual JORC categories

	RSC	RSV	MEA	IND	INF	PRV	PRB
RSC	1						
RSV	-0.107***	1					
MEA	0.132***	-0.062**	1				
IND	0.474***	-0.071***	0.248***	1			
INF	0.915***	-0.121***	-0.014	0.234***	1		
PRV	-0.106***	0.671***	-0.046*	-0.097***	-0.104***	1	
PRB	-0.103***	0.930***	-0.075***	-0.071***	-0.114***	0.569***	1

***, ** and * indicate significance at 0.01, 0.05 and 0.1 levels.

Table 4.3: Market-adjusted mean abnormal returns (daily)

Event Day	AR	*t*-stat	N	Count Positive	% Positive AR
-10	0.16	1.231	1546	711	46%
-9	0.06	0.399	1546	719	47%
-8	0.50	1.058	1546	702	45%
-7	0.12	0.893	1546	712	46%
-6	0.04	0.274	1546	671	43%
-5	0.15	0.973	1546	713	46%
-4	-0.06	-0.399	1546	696	45%
-3	0.49	3.115***	1546	717	46%
-2	0.58	2.660***	1546	711	46%
-1	0.27	1.838*	1546	724	47%
0	3.03	12.249***	1546	985	64%
1	-1.09	-6.936***	1546	579	37%
2	-0.19	-1.392	1546	669	43%
3	-0.12	-0.824	1546	677	44%
4	-0.07	-0.458	1546	664	43%
5	-0.12	-0.896	1546	701	45%
6	-0.06	-0.446	1546	670	43%
7	-0.08	-0.530	1546	704	46%
8	-0.07	-0.482	1546	695	45%
9	0.04	0.251	1546	669	43%
10	-0.19	-1.379	1546	668	43%

Table 4.3 presents Student *t*-tests on whether daily AR is different from 0. AR is calculated as in Eq. (1); Event day '0' represents the day of the resource/reserve disclosure. The *t*-stat is based on the Student *t*-test, 'N' is the number of observations. Two-tailed tests of significance are reported as follows: *** less than 0.01, ** less than 0.05, and * less than 0.10

Table 4.4: Significance tests on market-adjusted cumulative abnormal returns

Event Day	CAR	*t*-test	*p*-value	N
-10 to 10	3.39%	4.784	0.000	1535***
-5 to 5	2.86%	6.455	0.000	1535***
-3 to 3	2.97%	7.393	0.000	1535***
-1 to 1	2.21%	7.450	0.000	1535***
-10 to -3	1.46%	2.651	0.008	1535**
-10 to -6	0.88%	1.702	0.089	1535*
-5 to -1	1.42%	4.516	0.000	1535***
3 to 10	-0.67%	-2.073	0.038	1535**
1 to 5	-1.59%	-5.683	0.000	1535***
6 to 10	-0.36%	-1.284	0.200	1535

Table 4.4 presents Student *t*-tests of *CAR*s being different from 0. *CAR* is calculated as defined in (1) and (2); the *t*-stat is the result of the Student *t*-test, with 'N' being the number of observations. Two-tailed tests of significance are reported: *** less than 0.01, ** less than 0.05, and * less than 0.10

Table 4.5: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price and disclosure levels

Panel	A – Eq. 3.4				B – Eq. 2.4 and Eq. 2.5				
B	Variable	Coef.	*P>t*	*F*-stat	*B*	Variable	Coef.	*P>t*	*F*-stat
1	C	0.0738	0.421		1	C	0.0334	0.000***	
2	RSC (RESOURCES)	0.0001	0.022**	5.21***	2	MEA (Measured)	0.0002	0.768	
3	RSV (RESERVES)	0.0019	0.014**		3	IND (Indicated)	0.0002	0.173	
4	RSC_GRADE	0.0051	0.877		4	INF (*Inferred*)	0.0001	0.055*	2.76**
5	RSV_GRADE	0.1025	0.230		5	PRV (Proved)	0.0019	0.720	
6	LNSIZE	-0.0069	0.000***		6	PRB (Probable)	0.0025	0.054*	
7	COMM_PRICE	0.0077	0.304		7	LNSIZE	-0.0068	0.000***	
8	LNPAGES	-0.0030	0.312		8	COMM_PRICE	0.0072	0.344	
9	GROWTH	0.0144	0.004***		9	LNPAGES	-0.0033	0.268	
					10	GROWTH	0.0140	0.006***	
	Obs.	1467				Obs.	1467		
	F-statistic	4.72				*F*-statistic	4.24		
	Prob(*F*-statistic)	0.000				Prob(*F*-statistic)	0.000		
	Ajd. *R*-squared	0.027				Ajd. *R*-squared	0.028		

In Table 4.5, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; and * less than 0.10. *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Table 4.6: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects

Panel		A – Size			B - Specialization			C – Size and specialization		
B	Variable	Coef.	*P>t*	*F*-stat	Coef.	*P>t*	*F*-stat	Coef.	*P>t*	*F*-stat
1	C	-0.08622	0.335		-0.07461	0.415		-0.08165	0.367	
2	RSC (RESOURCES)	0.00004	0.171	5.28***	0.00004	0.070**	5.11***	0.00004	0.084*	5.45***
3	RSV (RESERVES)	0.00157	0.050**		0.00152	0.066**		0.00176	0.026**	
4	RSC_GRADE	0.00524	0.876		0.00733	0.825		0.00871	0.794	
5	RSV_GRADE	0.11662	0.161		0.10135	0.234		0.10762	0.200	
6	LNSIZE	-0.00692	0.000***		-0.00695	0.000***		-0.00691	0.000***	
7	COMM_PRICE	0.00751	0.319		0.00718	0.332		0.00605	0.404	
8	LNPAGES	-0.00301	0.313		-0.00298	0.321		-0.00317	0.288	
9	GROWTH	0.01418	0.005***		0.01445	0.004***		0.01413	0.005***	
10	B4	-0.00685	0.374							
11	B4*RSC	0.00011	0.136	1.88						
12	B4*RSV	0.00323	0.152							
13	SPEC				0.00023	0.978				
14	SPEC*RSC				0.00023	0.163	1.32			
15	SPEC*RSV				0.00196	0.317				
16	B4*SPEC							-0.00247	0.780	
17	B4*SPEC*RSC							0.00038	0.054*	2.48*
18	B4*SPEC*RSV							0.00239	0.290	
	Obs.	1467			1467			1467		
	F-statistic	3.64			3.72			4.05		
	Prob(*F*-statistic)	0.000			0.000			0.000		
	Ajd. *R*-squared	0.033			0.038			0.047		

In Table 4.6, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; and * less than 0.10. *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Table 4.7: Ordinary Least Squares regression of 2-day buy-and-hold returns on resource/reserve categories, size, commodity price, disclosure levels and reputation effects by commodity type

Panel		**A – Base Metals**			**B – Precious Metals**			**C – Bulks**		
B	Variable	Coef.	*P*>*t*	*F*-stat	Coef.	*P*>*t*	*F*-stat	Coef.	*P*>*t*	*F*-stat
1	C	0.0162	0.920		-0.1349	0.310		-0.9910	0.002***	
2	RSC (RESOURCES)	0.0001	0.131	2.22	0.0002	0.065*	2.02	0.0000	0.631	0.25
3	RSV (RESERVES)	0.0014	0.295		0.0020	0.453		-0.0001	0.942	
4	RSC_GRADE	-0.0227	0.762		0.0228	0.561		-0.0375	0.773	
5	RSV_GRADE	0.0440	0.739		0.1388	0.283		1.0738	0.000***	
6	LNSIZE	-0.0060	0.204		-0.0087	0.003***		-0.0066	0.068*	
7	COMM_PRICE	0.0198	0.078*		-0.0068	0.792		0.0004	0.968	
8	LNPAGES	-0.0128	0.032**		0.0038	0.286		-0.0052	0.505	
9	GROWTH	0.0229	0.047**		0.0105	0.195		0.0201	0.039**	
10	B4*SPEC	-0.0443	0.207		0.0163	0.174		-0.0129	0.466	
11	B4*SPEC*RSC	0.0007	0.061*	1.77	-0.0002	0.448	1.55	0.0004	0.135	1.96
12	B4*SPEC*RSV	0.0050	0.264		0.0041	0.180		0.0054	0.128	
	Obs.	339			555			360		
	F-statistic	1.44			8.15			3.96		
	Prob(*F*-statistic)	0.152			0.000			0.000		
	Ajd. *R*-squared	0.140			0.032			0.040		

In Table 4.7, two-tailed test of significance are reported: *** less than 0.01; ** less than 0.05; and * less than 0.10. *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Table 4.8: Ordinary Least Squares regression of 2-day buy-and-hold returns on resource/reserve categories, size, commodity price, disclosure levels and switching from and to Big 4

B	Variable	Coef.	*P>t*	*F*-stat
1	C	-0.0395	0.683	
2	RSC (RESERVES)	0.0001	0.040**	5.34***
3	RSV (RESOURCES)	0.0019	0.018**	
4	RSC_GRADE	0.0085	0.797	
5	RSV_GRADE	0.0644	0.473	
6	LNSIZE	-0.0068	0.000***	
7	COMM_PRICE	0.0072	0.341	
8	LNPAGES	-0.0030	0.313	
9	GROWTH	0.0148	0.004***	
10	B4	0.0058	0.403	
11	UPB4	-0.0560	0.082*	
12	UPB4*RSC	0.0002	0.009***	4.10**
13	UPB4*RSV	0.0043	0.401	
14	DNB4	0.0037	0.805	
15	DNB4*RSC	0.0000	0.739	0.31
16	DNB4*RSV	0.0010	0.598	
	Obs.	1467		
	F-statistic	3.94		
	Prob(*F*-statistic)	0.000		
	Ajd. *R*-squared	0.0335		

In Table 4.8, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; and * less than 0.10. *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Table 4.9: Intraday market reaction to resource and reserve disclosures using abnormal return, liquidity and bid-ask spread measures

Panel A – Abnormal return

Event hour	Student				Wilcoxon	
	N	Mean	*t*-stat	*P>t*	z-stat	*P>t*
-1	1324	0.5027679	0.262		-0.378	
0	1324	0.5044099	0.4159		-0.321	
1	1324	0.5428216	4.0941	***	3.696	***

Panel B – Liquidity

Event hour	Student				Wilcoxon	
	N	Mean	*t*-stat	*P>t*	z-stat	*P>t*
-1	1324	0.7551652	29.9408	***	23.979	***
0	1324	0.7661367	31.3622	***	24.427	***
1	1324	0.7473927	28.4224	***	23.33	***

Panel C – Bid-ask spread

Event hour	Student				Wilcoxon	
	N	Mean	*t*-stat	*P>t*	z-stat	*P>t*
-1	874	0.5375728	3.7510	***	3.754	***
1	1155	0.4610214	-4.2903	***	-4.244	***

Table 4.9 presents modified Student *t*-tests and paired Wilcoxon rank tests on the hourly market reaction around resource/reserve disclosures. Panels A, B and C present tests on abnormal return, turnover and bid-ask spread, respectively. Two-tailed test of significance: *** = less than 0.001, ** = less than 0 .01 and * = less than 0.05.

Table 4.10: Ordinary Least Squares regression of 3-hour buy-and-hold returns on resource/reserve categories, size, commodity price, disclosure levels and disclosure levels and reputation effects

Panel		**A – Size**			**B - Specialisation**			**C – Size and specialisation**		
B	Variable	Coef.	*P>t*	*F*-stat	Coef.	*P>t*	*F*-stat	Coef.	*P>t*	*F*-stat
1	C	-0.17245	0.085*		-0.16259	0.076*		-0.15160	0.081*	
2	RSC (RESOURCES)	0.00006	0.012**	6.53***	0.00005	0.013**	6.57***	0.00005	0.017**	6.56***
3	RSV (RESERVES)	0.00081	0.131		0.00147	0.056*		0.00138	0.044**	
4	RSC_GRADE	0.02841	0.294		0.03048	0.260		0.03191	0.239	
5	RSV_GRADE	0.18765	0.052*		0.17555	0.044**		0.16278	0.047**	
6	LNSIZE	-0.00656	0.000***		-0.00652	0.000***		-0.00649	0.000***	
7	COMM_PRICE	0.01426	0.010***		0.01361	0.013**		0.01292	0.017**	
8	LNPAGES	0.00003	0.993		-0.00059	0.876		-0.00046	0.902	
9	GROWTH	0.01329	0.001***		0.01352	0.000***		0.01340	0.001***	
10	B4	-0.00850	0.104							
11	B4*RSC	0.00003	0.546	0.55						
12	B4*RSV	0.00371	0.385							
13	SPEC				-0.00854	0.159				
14	SPEC*RSC				0.00022	0.026**				
15	SPEC*RSV				-0.00071	0.596	2.80*			
16	B4*SPEC							-0.00837	0.172	
17	B4*SPEC*RSC							0.00031	0.000***	10.48***
18	B4*SPEC*RSV							-0.00275	0.068*	
	Obs.	1324			1324			1324		
	F-statistic	5.1			5.48			7.12		
	Prob(*F*-statistic)	0.000			0.000			0.000		
	Ajd. *R*-squared	0.054			0.0635			0.0718		

In Table 4.10, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; and * less than 0.10. *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Table 4.11: Intraday market reaction to resource/reserve disclosures using intraday flow and other trading measures

Panel A: The hour immediately before resource/reserve disclosure

		Student			Wilcoxon	
Variable	**N**	**Mean**	**t-stat**	*P>t*	**z-stat**	*P>t*
ONN	1324	0.499	-0.198		-3.606	***
ONVOL	1324	0.498	-0.276		-3.631	***
ACTN	1324	0.607	12.537	***	12.303	***
LIMACTN	1324	0.613	13.316	***	13.005	***
IMB	1274	0.515	1.879	*	1.815	*

Panel B: The hour immediately after resource/reserve disclosure

		Student			Wilcoxon	
Variable	**N**	**Mean**	**t-stat**	*P>t*	**z-stat**	*P>t*
ONN	1324	0.766	35.799	***	25.620	***
ONVOL	1324	0.759	35.630	***	25.453	***
ACTN	1324	0.797	42.248	***	27.204	***
LIMACTN	1324	0.799	42.640	***	27.314	***
IMB	1280	0.515	1.554		1.291	

Panel C: Differences between the hour immediately before and after the resource/reserve disclosure (After-Before)

		Student			Wilcoxon	
Variable	**N**	**Mean**	**t-stat**	*P>t*	**z-stat**	*P>t*
ONN	1324	0.272	27.766	***	23.985	***
ONVOL	1324	0.260	27.529	***	23.787	***
ACTN	1324	0.190	17.196	***	17.479	***
LIMACTN	1324	0.186	16.843	***	17.290	***
IMB	1274	0.000	0.035		-0.416	

Table 4.11 presents modified Student *t*-tests and paired Wilcoxon rank tests on the intraday flow and other trading measures around resource/reserve disclosures. Panels A and B present tests on the hour immediately before and after the disclosure, respectively. Panel C tests differences between the hour immediately before and after the release of the resource/reserve information. Variables are defined as: ONN is the number of on-market trades; ONVOL is the volume of on-market trading; ACTN is the number of actions in the limit order-book; LIMACTN is the number of actions excluding trades in the limit order-book and IMB is the trade imbalance. Two-tailed test of significance: *** = less than 0.001, ** = less than 0 .01 and * = less than 0.05.

Table 4.12: Ordinary Least Squares regression of 2-day buy-and-hold returns on resource/reserve categories, size, commodity price, disclosure levels and audit quality

Panel		**A – Big N**		**B - Leader Big N**		**C – Second Leader Big N**		**C – Leader non-Big N**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.08111	0.369	-0.09078	0.323	-0.09013	0.315	-0.08187	0.365
2	RSC (RESOURCES)	0.00004	0.087*	0.00004	0.098*	0.00004	0.082*	0.00004	0.087*
3	RSV (RESERVES)	0.00175	0.026**	0.00174	0.027**	0.00175	0.027**	0.00176	0.026**
4	RSC_GRADE	0.00855	0.797	0.00777	0.815	0.00943	0.777	0.00881	0.790
5	RSV_GRADE	0.10744	0.201	0.11829	0.166	0.11460	0.169	0.10777	0.201
6	LNSIZE	-0.00687	0.000***	-0.00683	0.000***	-0.00713	0.000***	-0.00690	0.000***
7	COMM_PRICE	0.00608	0.402	0.00634	0.383	0.00607	0.402	0.00607	0.403
8	LNPAGES	-0.00317	0.289	-0.00303	0.311	-0.00306	0.306	-0.00316	0.288
9	GROWTH	0.01412	0.005***	0.01408	0.005***	0.01441	0.004***	0.01413	0.005***
10	B4*SPEC	-0.00245	0.782	-0.00195	0.826	-0.00162	0.854	-0.00248	0.780
11	B4*SPEC*RSC	0.00038	0.055*	0.00038	0.055*	0.00038	0.054*	0.00038	0.054*
12	B4*SPEC*RSV	0.00239	0.295	0.00245	0.283	0.00234	0.284	0.00239	0.291
13	BIG N	-0.00078	0.884						
14	KPMG			-0.00820	0.267				
15	EY					0.00964	0.204		
16	BDO							-0.00074	0.925
	Obs.	1467		1467		1467		1467	
	F-statistic	3.83		3.84		3.79		3.94	
	Prob(*F*-statistic)	0.000		0.000		0.000		0.000	
	Ajd. *R*-squared	0.0465		0.0473		0.0476		0.0465	

In Table 4.12, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; and * less than 0.10. *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Table 4.13: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels, reputation effects, capital expenditure and debt on resource and reserve disclosures

Panel		**A – CAPEX_TA**		**B – DEBT_EQ**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.06759	0.457	-0.09870	0.282
2	RSC (RESOURCES)	0.00004	0.103	0.00004	0.082*
3	RSV (RESERVES)	0.00167	0.034**	0.00167	0.035**
4	RSC_GRADE	0.00629	0.849	0.00988	0.765
5	RSV_GRADE	0.10532	0.213	0.12224	0.152
6	LNSIZE	-0.00823	0.000***	-0.00667	0.000***
7	COMM_PRICE	0.00810	0.264	0.00528	0.471
8	LNPAGES	-0.00352	0.249	-0.00319	0.275
9	GROWTH	0.01427	0.004***	0.01434	0.004***
10	B4_SPEC	-0.00223	0.802	-0.00233	0.792
11	B4_SPEC*RSC	0.00038	0.059*	0.00038	0.054*
12	B4_SPEC*RSV	0.00237	0.293	0.00251	0.269
13	LNCAPEX_TA	-0.00888	0.011**		
14	LNDEBT_EQ			0.01033	0.331
	Obs.	1467		1467	
	F-statistic	4.01		3.81	
	Prob(*F*-statistic)	0.000		0.000	
	Ajd. *R*-squared	0.0423		0.0476	

In Table 4.13, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10. *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

CHAPTER 5

SUMMARY AND CONCLUSIONS

5.1 Summary

This study examines the market reactions to resource/reserve disclosures by Australian MDSEs and the reputational effect of geological experts that assure these reports. To execute this study, I developed a database by hand-collecting project-level resource/reserve disclosure data. This database allows me to describe the market structure of the geological experts in Australia and specify a multivariate model to examine the impact of resource/reserve update magnitude on share price, as well as investigate the reputational effect of geological experts assuring these reports. I show evidence of positive abnormal return on the day of the resource/reserve disclosure and that larger resource changes are found to be associated with higher abnormal returns. I also find that the lowest confidence JORC classifications for resource (*Inferred*) and reserve (*Probable*) category are the drivers of the multivariate result, possibly for indicating future deposit growth expectations.

Additionally, the market structure for geological experts indicates the presence of a market leader, a Big 4 group, a second tier group and sole practitioner geological experts. Using a cross-sectional returns prediction model, I find weak evidence that the market values the assurance of large geological experts, with the strongest evidence found for specialist or commodity leading geological experts. Further, the analysis indicates that these mixed results are driven by deposit complexity.

Not dissimilar to the limitations in the audit literature, I note the tests of expert commodity leadership are sensitive to the definition of the group of large experts. In summary, this study contributes to the non-financial disclosure/assurance literature by showing that changes in share prices around resource/reserve disclosures are driven by both the quantity of mineral disclosed and the size (quality) of the expert associated with the market disclosure. These results may provide further motivation for testing reputation effects in other non-financial settings.

5.2 Contributions and implications

I contribute to the prior literature by broadening the existing focus of the reserve valuation literature from the oil and gas sector in the US. I conduct the first study ever to appropriately distinguish resource/reserve changes under the JORC reporting framework by tracking a firm's resource/reserve endowments over each individual mining project's lifecycle from inception to project development. This thesis is also the first study ever to consider the impact of resource /reserve changes in terms of different primary commodities across mineral deposits and to provide evidence of the reputational impact of geologist experts. I find the first evidence demonstrating that changes in share prices around resource/reserve disclosures are driven by the size of the resource/reserve changes and that these changes, depending on their respective JORC categories, are valued differently by the market.

This thesis is also the first study to provide a description of the market structure of geological experts that accompany resource/reserve disclosures in Australia. I find the presence of a market leader, a Big 4, a second tier and sole practitioner geological experts. This market structure has similarities to the market structure of financial audits by public accounting firms. In this thesis, I find weak evidence that the market values geological expertise associated with resource/reserve disclosures, with higher returns associated with larger experts who are specialist commodity leaders. Further, the analysis indicates that these mixed results are driven by deposit complexity, suggesting that the specialist reputation matters more where deposit complexity or risk is higher.

Overall, I provide weak evidence demonstrating that changes in share prices around non-financial disclosures are driven by specialist assurers, results suggesting that non-financial assurance matters little in the absence of litigation risk.

5.3 Potential limitations

Despite the large sample of MDSEs in Australia, one potential limitation is the lack of data on reserve disclosures. Reserves are more likely to be classified during later phases of a project's lifecycle, such as development. This means that when reserves are disclosed, often there is an overlap between exploration and production and therefore such firms cannot be classified as MDSEs.[81] The sample used in this thesis constitutes firms in the exploration and early development phase only, who are more likely to disclosure resources. Thus this thesis is limited in providing exhaustive results regarding the impact of reserve disclosures, since sample constituents are non-production firms.

Another limitation is that the tests of expert commodity leadership are sensitive to the definition of the group of large experts. In addition, my results are sensitive to

[81] The definition of an MDSE is consistent with that adopted in prior literature in that the company has product revenues less than 5% of its market capitalisation.

alternative definitions of a specialist. However, I note this is not dissimilar to the audit literature, with many studies of audit fees reporting findings sensitive to the definition of specialists (e.g., Craswell, Francis and Taylor, 1995).

Another caveat in this setting is the possible presence of non-synchronous trading. If excess returns are a monotonic decreasing function of firm size (Keim, 1983), then noise would have a significant effect on the OLS results found for small client firms that is the setting of this thesis. Consequently, thin-trading might bias my results downwards. Consistent with McInish *et al*. (1992), small firms are characterised by higher bid-ask spread than large firms. Appendix L.1 shows that the mean difference between these two groups in my sample is of 0.049 (354%) and significant at $p<0.000$. Appendix L.2 illustrates the bid-ask spread difference across all deciles of firms, showing that the highest decile (largest firms) has a bid-ask spread 12 times (0.125 to 0.009) lower than the bottom decile. Such differences in bid-ask spread might be an indication of investors having fewer consensuses on the price change for small firms which, together with non-synchronous trading, could result in greater noise in tests using longer windows in this setting. Such an observation is consistent with stronger results observed as the event window decreases from 10-hour to 3-hour buy-and-hold abnormal return (Section 4.4.2, Section 4.5.1.1 and Section 4.6.2).

5.4 Suggestions for future research

The value of geological experts' reputation is expected to benefit investors and other users of such information, such as financial intermediaries. Given the value of geological experts is demonstrated in this thesis, it would be interesting to extend this analysis to other users, such as banks. The anecdotal evidence that geological experts' reputation might be valuable to banks can be seen in Amos and Breaden (2001), who argue that banks are typically sceptical with respect to the estimation of resources and reserves. Mining companies usually use equity financing before developing the mine. In other words, during the first two stages (exploration and evaluation) of mining projects, equity financing is the only means of funding for MDSEs. In addition, disclosures with minerals classified as resources are more frequent than reserves in these stages.[82] These companies rely on equity financing to fund start-up and early operating costs of new projects before the mines begin to generate revenue from selling their minerals to the market. When these firms enter the development stage (usually after a bank feasibility study), the bank financing becomes more important for them. It is therefore surprising that higher-reputation geological experts accompanying bank feasibility studies would facilitate greater access to debt financing (Ferguson, Feigin and Kean, 2013).

A further outcome of using a sample based on advanced phases of development is to analyse the impact of geological experts that accompany the disclosure of reserves. As discussed in the limitation of this study, the sample used in this thesis (exploration firms) is more likely to disclosure information about resources, while reserves are expected to be disclosed in further phases, such as development or production. Thus, it would be interesting in future research to examine the impact of geological experts accompanying reserve disclosures with a larger sample.

The challenges associated with self-selection bias in this setting are also an area worth exploring in future research. I provide the first suggestion for the determinants involved in choosing higher-reputation geological experts. The discussion of a

[82] Note that the sample used in this thesis constitutes firms in the exploration phase, where firms are more likely to disclose resource changes.

convincing implementation to identify exogenous independent variables from the first stage model is also a topic in vogue in the accounting literature (Lennox *et al.*, 2012). Further work on tests examining self-selection in this setting could provide additional insight into the broader accounting literature.

As shown in Chapter 2, Akerlof (1970) argues that most skilled labour carries some certification indicating the attainment of certain levels of proficiency. Certifications, such as high school diploma, PhD, and even the Nobel Prize (to some degree), serve the function of building the 'brand names' of differentiated education and labour markets. Given that the geological experts' qualifications and name are revealed in the resource and reserve disclosure, it would be interesting to organise the reputation ranking at the partner level.

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APPENDICES

Appendix A: Abbreviation of geological experts' name used in this thesis

Geological Expert	Abbreviation
AMC Consultants Pty Ltd	AMC
BFP Consultants Pty Ltd	BFP
Boyer Exploration & Resource Management PTY LTD	Boyer
Camden Geoserve Pty Ltd	Camden
Coffey Mining Ltd (Coffey International Ltd)	Coffey
CSA Global Pty *Ltd*	CSA
Cube Consulting Pty Ltd	Cube
Ecopetrol SRL	Ecopetrol
Exploration Lionore Mining Australia Pty Ltd	Lionore
Finore Mining Inc.	FinOre
Forrest A Garb and Associates	FGA
Forrest A Garb and Associates Inc	F.G.&A.
Gaffney, Cline and Associates Pty Ltd	GCA
Geomine Consulting Namibia CC	Geomine
GeoVal Consult Pty Ltd	Geoval
Golder Associates Pty Ltd	Golder
GRD Minproc Pty Ltd	GRD
Hackchester Pty Ltd	Hackch.
Hellman and Schofield Pty Ltd	H&S
Henry Consultancies Pty Ltd	Henry
Hoye Pty Ltd	Hoye
JB Mining Services Pty Ltd	JB
Lee Keeling and Associates Inc	LKA
Maxwell Geoservices Pty Ltd	Maxwell

McDonald Speijers Pty Ltd	Speijers
McKeown Mining Pty Ltd	McKe.
MHA Petroleum Consultants LLC	MHA
Micromine Consulting Services Pty Ltd	MCS
Mike Barr Services Pty Ltd	Mike Barr
Netherland, Sewell & Assoc (NSAI) Inc	NSAI
Newexco Services Pty Ltd	Newe.
Newnham Exploration and Mining Services Pty Ltd	Newn.
Orelogy Group Pty Ltd	Orelogy
Quantitative Group Pty Ltd	QuantGr
Ravensgate Pty Ltd	Raven.
Resource Evaluations Pty Ltd	ResVal
Resource Service Group Pty Ltd	Rsc Svc
RSG Global Ltd	RSG
Runge Ltd	Runge
Salva Resources Pty Ltd	Salva
Senergy Pty Ltd	Senergy
Signet Pty Ltd	Signet
Snowden group LLC	Snowden
Sole practicioner	Sole
SRK Consulting Pty Ltd	SRK
WGM Consulting Engineers LLC	WGM
Widenbar and Associates Inc	Widenbar
William M. Cobb & Associates Pty Ltd	WMA
Xenith Consulting Pty Ltd	Xenith

Appendix B: Resource and reserve disclosure examples

Appendix B.1: Example of disclosure 1 – Crusader 8th August 2010

crusader

Crusader Resources Ltd

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West Perth WA 6005 Australia
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Fax +61 8 9320 7501
www.crusaderresources.com
ABN 94 106 641 963

25th August 2010 ASX Release

Maiden Mineral Resource Estimate for Borborema Gold Project of 13.88Mt for 728kozs @ 1.63 g/t.

HIGHLIGHTS;

- **Independent Mineral Resource estimate for Borborema Gold Project returns a total Indicated plus Inferred Resource of;**
  - **728koz @ 1.63 g/t Au (at 0.5 g/t cut off) or**
  - **596koz @ 2.45 g/t Au (at 1g/t cut off).**
- **Gold mineralisation exhibits strong continuity along strike and down dip.**
- **Thicknesses up to 30m (true width) and shallow dip ~35° indicate potential open pit development.**
- **Significant potential highlighted to increase the mineral resource, with a down dip Exploration Target[1] indentified. Priority drill targets along strike will also be tested.**
- **Aggressive drilling program to lift resource above 1 million ounces set to begin.**

Crusader Resources Ltd's (ASX: CAS) 100% owned Borborema gold project in Brazil contains an independently estimated JORC compliant Indicated and Inferred Resource of 728koz of gold based on a total of 13.88 million tonnes of ore at a grade of 1.63 grams/tonne gold using a 0.5 g/t cut off grade.

The maiden resource was compiled by respected international consulting group, Coffey Mining (Brazil).

Coffey Mining estimated total Indicated plus Inferred Resources (using a 0.5 g/t cut off) as 13.88 Mt @ 1.63 g/t for 728koz of gold. At a higher cut off grade (1.0 g/t) the estimate is 7.6Mt for 596koz @ 2.45 g/t (See Table 1 and Table 2).

The mineral resource is based on drilling along 1,310 metres of strike on a shear zone, of which the remaining 4 kilometres is poorly explored.

Crusader will soon commence drilling the project targeting the down dip and along strike potential of the mineralisation. Information on planned drilling and exploration activities will be distributed shortly.

Commenting on the Mineral Resource estimate, Crusader's Managing Director, Rob Smakman said;

"The Mineral Resource estimated by Coffey validates Crusader's decision to acquire this project, and clearly shows the potential to significantly improve the size of the resource. We have a goal of increasing the resource to greater than 1 million ounces, which could support a 100,000oz pa production rate. The resource is (so far) only constrained by the drilling.

This project is fantastically situated for development. It is located on a sealed highway, has access to plenty of water and power, and is only 140 kilometres from the coast and a State capital. It is also located in a district where mining has been a way of life.

Crusader has expanded the in-country team, we have drill rigs on the way to commence the next phase of work, and we are looking forward to delivering a resource expansion leading to a scoping study that will define the route to development."

Table 1
Borborema Project
Mineral Resource (August 2010)
Ordinary Kriged Estimate (0.5g/t Au cut off)
25mE x 25mN x 4mRL Parent Cell.

Category		**Indicated**			**Inferred**			**Total**		
	Cut off	Tonnes (Mt)	Au g/t	Contained Gold (kOz)	Tonnes (Mt)	Au g/t	Contained Gold (kOz)	Tonnes (Mt)	Au g/t	Contained Gold (kOz)
Oxide	0.5				2.01	0.90	58	2.01	0.90	58
Fresh	0.5	2.51	2.37	191	9.35	1.59	479	11.86	1.76	670
Sub Totals		2.51	2.37	191	11.36	1.47	537	13.9	1.63	728
					Total at 0.5 g/t cut off			**13.90**	**1.63**	**728**

Table 2
Borborema Project
Mineral Resource (August 2010)
Ordinary Kriged Estimate (1.0gt//t Au cut off)
25mE x 25mN x 4mRL Parent Cell.

Category		**Indicated**			**Inferred**			**Total**		
	Cut off g/t	Tonnes (Mt)	Grade Au g/t	Contained Gold (kOz)	Tonnes (Mt)	Grade Au g/t	Contained Gold (kOz)	Tonnes (Mt)	Grade Au g/t	Contained Gold (kOz)
Oxide	1.0				0.36	1.80	20	0.36	1.80	20
Fresh	1.0	2.10	2.71	182	5.14	2.37	391	7.24	2.47	573
Sub Totals		2.10	2.71	182	5.50	2.33	411	7.60	2.44	596
					Total at 1.0 g/t cut off			**7.60**	**2.44**	**596**

Note; Rounding errors may occur in the tables above.

The resource estimate is based principally on cores from diamond drilling completed by Caraiba Mineracao Ltda. (Caraiba) in 2006. As announced previously by Crusader, Caraiba did not complete sampling of all the drill core. Crusader has undertaken a detailed program of core sampling and logging to complete the geological interpretation, and compiled historical reverse circulation and diamond

drilling data in interpreting the mineralisation. The Mineral Resource estimation methodology is summarised in Appendix 1.

Mineralisation at Borborema consists of quartz-sulphide veining hosted in a shear zone which dips to the east at an angle of ~35°. The mineralisation occurs as multiple zones, ranging up to 30 metres in thickness. Metallurgical testing completed by Crusader indicates non-refractory ore with recoveries between 93% and 95% under conventional CIL processing.

Coffey has, in addition to the Mineral Resource estimate, outlined an Exploration Target down-dip of the deepest drilling to a maximum vertical depth of 180 metres. This Exploration Target is between 5 million tonnes and 10 million tonnes at average grades between 1.0g/t and 2.0 g/t gold. (see previous footnote regarding "Exploration Target".)

Crusader recently purchased the Borborema property outright from a group of private investors following a six month due diligence period (see ASX release 5 August 2010). The Project includes the freehold title over the project, mine buildings, and the mineral rights over three granted mining leases (~3,000Ha). The purchase price, based on the current resource estimate and exchange rate, is equivalent to ~$3 Aud/oz.

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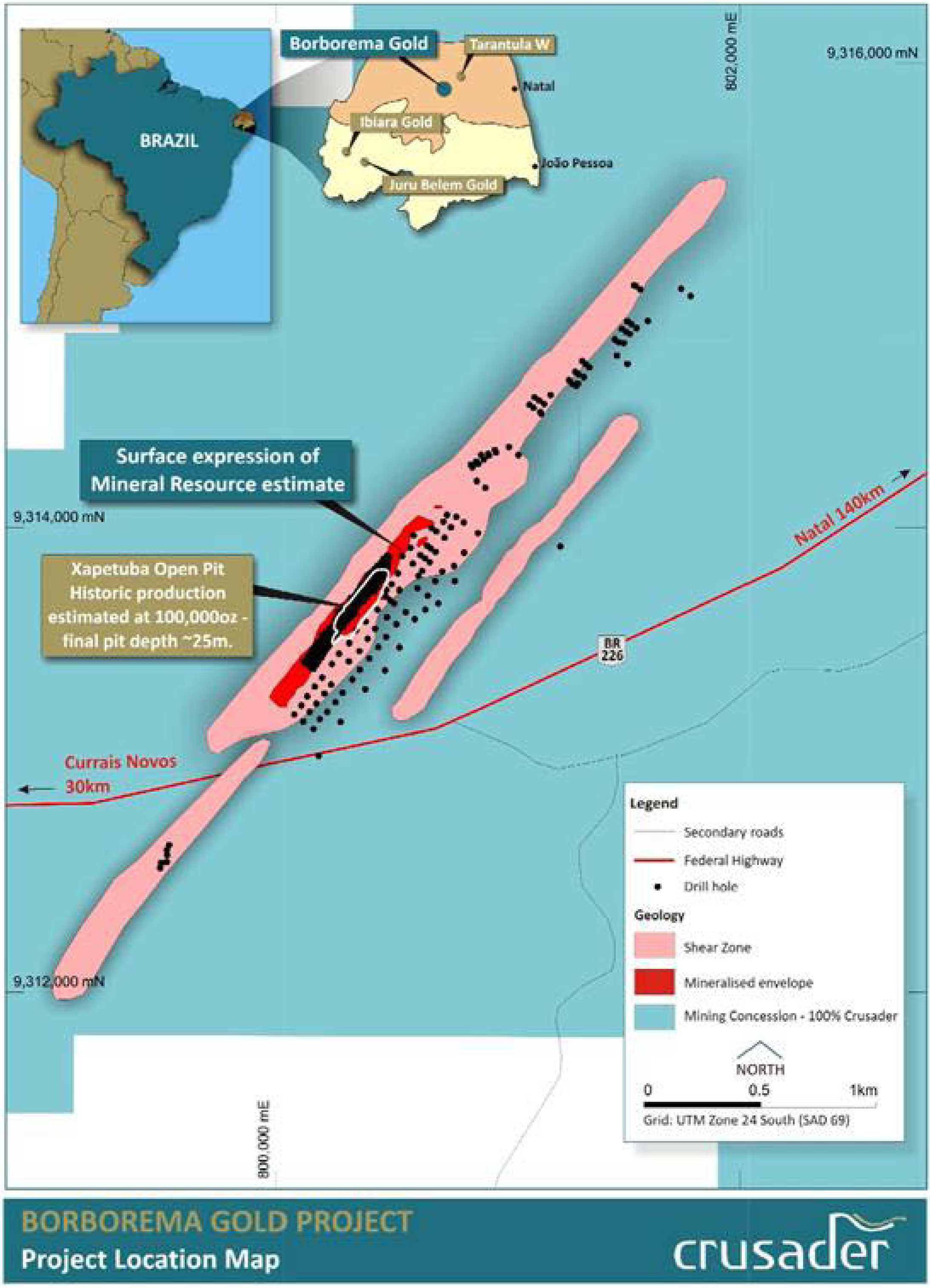
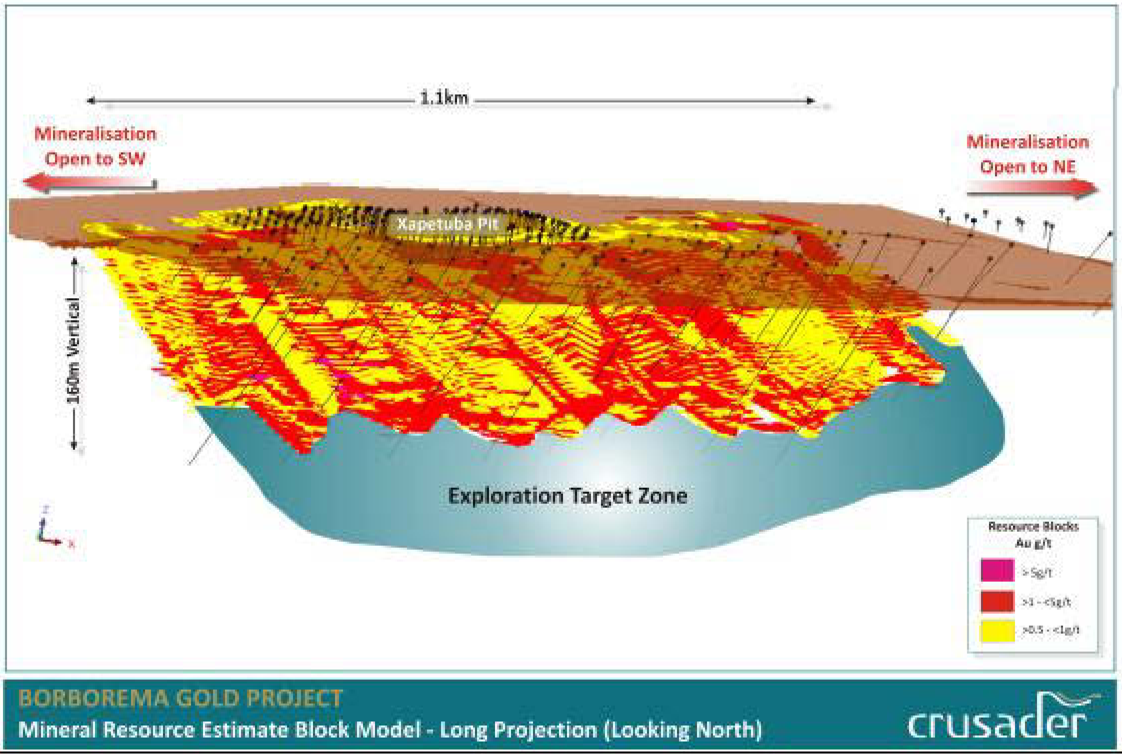
(Disclaimer)
The information in this report that relates to Exploration Results is based on information compiled or reviewed by Mr. Robert Smakman, who is a Member of The Australasian Institute of Mining and Metallurgy and is a fulltime employee of the company. Mr. Smakman has sufficient experience in the type of deposits under consideration and the activities being undertaken to qualify as a Competent Person as defined in the December 2004 Edition of the Australasian Code for reporting of Exploration Results, Mineral Resources and Ore Reserves and consents to the inclusion in the report of the matters based on his information in the form

and context in which it appears. Mr Smakman accepts responsibility for the accuracy of the statements disclosed in this report.

The information in this report that relates to Mineral Resources is based on and accurately reflects, information compiled by Mr Bernardo Viana who is a full time employee of Coffey Mining Pty Ltd and a Member of the Australian Institute of Geoscientists. Mr Viana has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the 2004 edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. Mr Viana consents to the inclusion in the report of the matters based on the information in the form and context in which it appears.


Borborema Gold
Tarantula W
Natal
Ibiara Gold
João Pessoa
Juru Belem Gold
BRAZIL
802,000 mE
9,316,000 mN
Surface expression of
Mineral Resource estimate
9,314,000 mN
Xapetuba Open Pit
Historic production
estimated at 100,000oz -
final pit depth ~25m.
Natal 140km
BR
226
Currais Novos
30km
Legend
Secondary roads
Federal Highway
Drill hole
Geology
Shear Zone
Mineralised envelope
Mining Concession - 100% Crusader
NORTH
0
0.5
1km
Grid: UTM Zone 24 South (SAD 69)
9,312,000 mN
800,000 mE
BORBOREMA GOLD PROJECT
Project Location Map
crusader



About Crusader

Crusader Resources Ltd (ASX: CAS) is a minerals exploration company focussed on the identification, acquisition and development of projects in Brazil and Australia. The Company has a diverse portfolio of projects including iron ore, gold, uranium, tungsten and tin. Crusader applies leading edge exploration skills to the discovery of new assets and continues to utilise its strong networks in Brazil, Australia and around the world to identify new opportunities.

Crusader is set to become Australia's latest iron ore production company when production begins at the Posse Iron project (100%). The project is located in the Iron Quadrilateral region of Minas Gerais state, Brazil and will be a low capital cost project with no infrastructure bottlenecks and simple logistics. Posse contains an Indicated Mineral Resource of 4.83Mt at 47.39% Fe and an Inferred Mineral Resource of 31.18Mt at 42.89% Fe. (Refer to announcement made 11 May 2009).

Crusader has two gold projects in Brazil, Borborema and Juru Belem. The Borborema gold project was the most important gold mine in the NE of Brazil with historical production of ~250,000 ounces. Crusader is working to expand the resources at Borborema.

Crusader also has an extensive portfolio of gold, tin, indium and tungsten projects within Brazil.

In Australia, Crusader has a portfolio of projects prospective for uranium, gold and nickel.

The Lake Throssell uranium project is 100% Crusader owned. The company holds highly prospective leases for over more than 2,500 km2 located 200km to the north east of

Laverton in Western Australia. Exploration is set to begin in late 2010 after successful negotiations were held with the native title holders. Crusader Resources Ltd has 73,926,372 ordinary shares on issue.

Notes relating to the Borborema Gold Resource Estimate.

Geology

The dominant rock types hosting the gold mineralisation are the biotite schists of the Seridó Formation, the uppermost unit of the sequence of supercrustal rocks that comprise the Seridó Group (1.8 – 2.4 Ga). At the project scale, these biotite-schists can be divided into two main groups:

- biotite-garnet-sillimanite-schist, with a foliation striking N40E and dipping on average at 45º to the south-east. It is within this lithology that gold mineralization occurs, principally associated with grey – white quartz veins of millimetre- to centimetre scale;

- biotite-garnet-cordierite-schist, which has a foliation orientation similar to that above, but which shows no evidence of gold mineralization.

In the central part of the project area there exists a zone of intense trans-current shearing that is concordant with the foliation. This zone is up to 200m thick in places and has a total length in excess of 4.5 km. Within the zone are thin bands which commonly host sulphides – pyrite and pyrrhotite predominantly, with subordinate chalcopyrite and sphalerite – and which host the higher concentrations of gold mineralization. The rock surrounding this shear zone also hosts gold mineralization, albeit in lower concentrations.

Data Density

Within the area covered by the resource estimate, the drill density averages 60m x 60m of diamond drilling. In some areas, drill density is lower and non quantitative information has been referenced in order to build the geological model. This other information includes historical RC and diamond drilling and surface trench sampling.

Geological Interpretation

The mineralisation is confined entirely within the schist unit along a regional shear structure. Coffey Mining has interpreted a number of stacked mineralised domains using a high grade (greater than 1g/t Au) cut off along with a low grade envelope (between 0.5g/t and 1g/t Au) and the oxide material that has been used to constrain the block modelling process.

Drilling Technique

The drill hole data used for this estimate was based on surface diamond drilling completed in 2006/7 by Servitec Sondagem Ltda. Core diameter is HQ (63.5mm) and NQ (47.6mm).

Accuracy of Location of Sampling Points

All drill collars were surveyed by licensed land surveyors using the SAD 69 UTM zone 24 datum. Drill holes were routinely surveyed down hole using an Eastman single shot camera.

Sampling Techniques

Diamond drill core was cut in half and half core sampled and submitted for assaying. The minimum sample interval was 0.5 metre to a maximum of 5 metres. The average sample interval was 1m. Sample intervals were constrained by metre intervals but at times, geological boundaries were chosen- as defined by lithology, alteration or structure.

Drill Core Recovery

Drill core recovery averaged 95%.

Bulk Density

2,387 bulk density measurements were taken by Crusader field staff using the Immersion technique. Results from the mineralised unit were averaged and used as the value for density (2.75 g/cm3).

Quality of Assay Data

Sample preparation was done by ALS Chemex lab in Brazil and assaying of samples by ALS Chemex in Chile. The fire assay method used by the laboratory was Au- AA26. A 50 gram charge was analysed by AAS with a detection limit of 0.01 ppm Au.

Quality of Data Description

Caraiba drilling was checked by Crusader field geologists. The 25 holes cut and sampled by Crusader were re-logged by Crusader field geologists. Features relating to lithology, alteration type, alteration intensity, vein type, vein intensity as well as structural features are captured and stored in an offsite, electronic database. Drill core is also photographed wet and dry. Magnetic susceptibility data was collected on metre intervals. Basic geotechnical logging was also routinely undertaken.

Estimation Techniques

Geological interpretation of the mineralisation was compiled by Crusader geologists on cross
sections. These 2 dimensional wireframes were digitised and 3-d shapes were compiled by Coffey mining staff. The grade interpolation method was Ordinary Kriging based on drillhole data and geological interpretations provided Crusader.

Top Cuts

Statistical methods were used to determine the top cut to be applied to the gold assays. Coffey Mining opted on an 8g/t Au top cut based on their statistical review.

Metallurgical Considerations

Metallurgical testing has been done on a selection of the fresh material. The testing returned between 93-95% overall recoveries using common techniques.

Appendix B.2: Example of disclosure 2 – Crusader 18th November 2010

crusader

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18th November 2010 — ASX Release

Borborema Gold Project- Indicated Resources upgraded by 240%.

HIGHLIGHTS;

- **Re-estimation of the Mineral Resource for Borborema Gold Project returns a total Indicated plus Inferred of;**
  - **839kozs @ 1.70 g/t Au (at 0.5 g/t cut off) or**
  - **731kozs @ 2.28 g/t Au (at 1g/t cut off).**
- **Indicated resources have increased from 191 kozs in August to 653 kozs.**
- **Re-estimate has been completed by Coffey Mining in response to internal checks highlighting technical issues with the original estimate- specifically with resource classification.**
- **New Mineral Resource estimate does not include results of the current drilling underway at Borborema. Over 6,000m of the planned 10,000m has been drilled and is progressing through the sampling and assay process.**
- **Drilling continues on site with results planned to be announced during November/December. A further update on the Mineral Resource will be completed in the first quarter of 2011.**

Crusader Resources Limited (ASX:CAS) has received an updated JORC compliant Mineral Resource estimate for the Borborema gold project in Brazil which has increased the contained ounces by 15% (from 728k ozs to 839 kozs), the grade by 4% (from 1.63 g/t to 1.70g/t at a 0.5 g/t cut-off) and the amount included in the Indicated category by 242% from 191 kozs to 653 kozs).

The new estimate was completed by Coffey Mining after its internal reviews revealed resource classification issues with the August 2010 estimate. Some of the estimate parameters have also been changed in the current work- in response to the new geological interpretation being applied from logging of the drilling underway at Borborema.

Crusader was advised by Coffey after the market had closed on Friday 12 November that Coffey's review was likely to result in a material increase in the Borborema Mineral Resource. As a result of the advice, Crusader sought a trading halt prior to the market opening on Monday 15 November.

Commenting on the updated Mineral Resource estimate, Crusader's Managing Director, Rob Smakman said;

"The Mineral Resource re-estimate by Coffey is another validation of the project. The increase in the quality of the resource ounces into indicated means that conversion to reserve ounces could be

achievable much quicker at Borborema. With the drilling program now well underway and results starting to flow in a few weeks, the resource can only continue to grow."

Crusader will release results and use them to do a further updated resource in the first quarter of 2011."

Table 1 Borborema Project Mineral Resource (August 2010) Ordinary Kriged Estimate (0.5g/t Au cut off) 10mE x 20mN x 10mRL Parent Cell.										
Category		**Indicated**			**Inferred**			**Total**		
	Cut off	Tonnes (Mt)	Au g/t	Contained Gold (kOz)	Tonnes (Mt)	Au g/t	Contained Gold (kOz)	Tonnes (Mt)	Au g/t	Contained Gold (kOz)
Oxide	0.5	0.52	1.58	26	-	-	-	0.52	1.58	26
Fresh	0.5	11.64	1.67	627	3.23	1.79	186	14.87	1.70	813
Sub Totals		**12.16**	**1.67**	**653**	**3.23**	**1.79**	**186**	**15.39**	**1.70**	**839**
					Total at 0.5 g/t cut off			**15.39**	**1.70**	**839**

Table 2 Borborema Project Mineral Resource (August 2010) Ordinary Kriged Estimate (1.0gt//t Au cut off) 10mE x 20mN x 10mRL Parent Cell.										
Category		**Indicated**			**Inferred**			**Total**		
	Cut off g/t	Tonnes (Mt)	Grade Au g/t	Contained Gold (kOz)	Tonnes (Mt)	Grade Au g/t	Contained Gold (kOz)	Tonnes (Mt)	Grade Au g/t	Contained Gold (kOz)
Oxide	1.0	.30	2.28	22	-	-	-	0.30	2.28	22
Fresh	1.0	7.44	2.27	543	2.22	2.32	166	9.66	2.28	709
Sub Totals		**7.74**	**2.27**	**565**	**2.22**	**2.32**	**166**	**9.96**	**2.28**	**731**
					Total at 1.0 g/t cut off			**9.96**	**2.28**	**731**

Note; Rounding errors may occur in the tables above.

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(Disclaimer)

The information in this report that relates to Exploration Results is based on information compiled or reviewed by Mr. Robert Smakman, who is a Member of The Australasian Institute of Mining and Metallurgy and is a full-time employee of the company. Mr. Smakman has sufficient experience in the type of deposits under consideration and the activities being undertaken to qualify as a Competent Person as defined in the December 2004 Edition of the Australasian Code for reporting of Exploration Results, Mineral Resources and Ore Reserves and consents to the inclusion in the report of the matters based on his information in the form and context in which it appears. Mr Smakman accepts responsibility for the accuracy of the statements disclosed in this report.

The information in this report that relates to Mineral Resources is based on and accurately reflects, information compiled by Mr Ian Dreyer who is a full time employee of Coffey Mining Pty Ltd and a Member of The Australasian Institute of Mining and Metallurgy. Mr Dreyer has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the 2004 edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. Mr Dreyer consents to the inclusion in the report of the matters based on the information in the form and context in which it appears.

About Crusader

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Crusader has two gold projects in Brazil, Borborema and Jurú-Belem. The Borborema gold project is the most important gold project in the NE of Brazil with historical production of ~300,000 ounces. In November 2010, Crusader updated the JORC compliant resource estimate at Borborema (at a 0.5g/t cut-off) of 12.16Mt @ 1.67g/t for 653 kozs Indicated and 3.23Mt @ 1.79 g/t for 186 kozs Inferred for a combined Indicated and Inferred resource estimate of 15.39Mt @ 1.70g/t for 839 kozs.. Crusader is currently aggressively exploring the Borborema project.

Crusader also has an extensive portfolio of gold, tin, indium, REE and tungsten projects within Brazil.

In Australia, Crusader owns 100% of the Lake Throssell uranium project, a highly prospective project covering more than 2,500 km^2 and located 200km to the north east of Laverton in Western Australia. Exploration is set to begin in early 2011 after successful negotiations were held with the native title holders.

Crusader Resources Ltd has 76,283,514 ordinary shares on issue.

Notes relating to the Borborema Gold Resource Estimate.

Geology

The dominant rock types hosting the gold mineralisation are the biotite schists of the Seridó Formation, the uppermost unit of the sequence of supercrustal rocks that comprise the Seridó Group (1.8 – 2.4 Ga). At the project scale, these biotite-schists can be divided into two main groups:

- biotite-garnet-sillimanite-schist, with a foliation striking N40E and dipping on average at 45º to the south-east. It is within this lithology that gold mineralization occurs, principally associated with grey – white quartz veins of millimetre- to centimetre scale;
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In the central part of the project area there exists a zone of intense trans-current shearing that is concordant with the foliation. This zone is up to 200m thick in places and has a total length in excess of 4.5 km. Within the zone are thin bands which commonly host sulphides – pyrite and pyrrhotite predominantly, with subordinate chalcopyrite and sphalerite – and which host the higher concentrations of gold mineralization. The rock surrounding this shear zone also hosts gold mineralization, albeit in lower concentrations.

Data Density

Within the area covered by the resource estimate, the drill density averages 60m x 60m of diamond drilling. In some areas, drill density is lower and non quantitative information has been referenced in order to build the geological model. This other information includes historical RC and diamond drilling and surface trench sampling.

Geological Interpretation

The mineralisation is confined entirely within the schist unit along a regional shear structure. Coffey Mining has interpreted a number of stacked mineralised domains using a high grade (greater than 1g/t Au) cut off along with a low grade envelope (between 0.5g/t and 1g/t Au) and the oxide material that has been used to constrain the block modelling process.

Drilling Technique

The drill hole data used for this estimate was based on surface diamond drilling completed in 2006/7 by Servitec Sondagem Ltda. Core diameter is HQ (63.5mm) and NQ (47.6mm).

Accuracy of Location of Sampling Points

All drill collars were surveyed by licensed land surveyors using the SAD 69 UTM zone 24 datum. Drill holes were routinely surveyed down hole using an Eastman single shot camera.

Sampling Techniques

Diamond drill core was cut in half and half core sampled and submitted for assaying.
The minimum sample interval was 0.5 metre to a maximum of 5 metres. The average sample interval was 1m. Sample intervals were constrained by metre intervals but at times, geological boundaries were chosen- as defined by lithology, alteration or structure.

Drill Core Recovery

Drill core recovery averaged 95%.

Bulk Density
2,387 bulk density measurements were taken by Crusader field staff using the Immersion technique. Results from the mineralised unit were averaged and used as the value for density (2.75 g/cm^3).

Quality of Assay Data
Sample preparation was done by ALS Chemex lab in Brazil and assaying of samples by ALS Chemex in Chile. The fire assay method used by the laboratory was Au- AA26. A 50 gram charge was analysed by AAS with a detection limit of 0.01 ppm Au.

Quality of Data Description
Caraiba drilling was checked by Crusader field geologists. The 25 holes cut and sampled by Crusader were re-logged by Crusader field geologists. Features relating to lithology, alteration type, alteration intensity, vein type, vein intensity as well as structural features are captured and stored in an off-site, electronic database. Drill core is also photographed wet and dry. Magnetic susceptibility data was collected on metre intervals. Basic geotechnical logging was also routinely undertaken.

Estimation Techniques
Geological interpretation of the mineralisation was compiled by Crusader geologists on cross sections. These 2 dimensional wireframes were digitised and 3-d shapes were compiled by Coffey mining staff.
The grade interpolation method was Ordinary Kriging based on drillhole data and geological interpretations provided Crusader.

Top Cuts
Statistical methods were used to determine the top cut to be applied to the gold assays. Coffey Mining opted on an 8g/t Au top cut based on their statistical review.

Metallurgical Considerations
Metallurgical testing has been done on a selection of the fresh material. The testing returned between 93-95% overall recoveries using common techniques.

Pioneer RESOURCES LIMITED

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15 August 2011

ASX/Media Announcement

Pioneer posts maiden resource of 185,600oz Au at Mt Jewell Project

- **Estimate at this stage includes Hughes & Tregurtha deposits only, defined to JORC Mineral Resource standard - further updates will be provided**
- **Mining studies for Hughes & Tregurtha to now be accelerated, including:**
  - **Economic - identify priority areas for resource category upgrade drilling and trial mining options**
  - **Core drilling - provide high-quality samples for metallurgical test work and pit wall stability data**
  - **Environmental - baseline studies to plan for future rehabilitation**
- **Exploration drilling planned to resume by the end of September 2011. Targets at Mt Jewell include Airstrip, Criterion, Wild Dog and Hughes West; and the first Pioneer holes into the exciting new Juglah Dome Gold Project.**

Pioneer Resources Limited (ASX: PIO) is pleased to report a maiden JORC reportable in-situ Mineral Resource estimate of 3.78 million tonne at a grade of 1.53g/t Au for 185,600oz Au for its Mt Jewell Project, located 55km north of Kalgoorlie, WA. Of this total, 131,600oz Au or 71% is categorised as Measured or Indicated Mineral Resource. This information is shown in more detail in Tables 1 and 2.

A higher grade subset comprises 1.3 million tonne at 2.39g/t for 99,500oz Au. The Company's initial mining studies will focus on this higher grade material and more shallow parts of the in-situ Mineral Resource. The estimate announced today represents the first step in Pioneer's strategy to build a 500,000oz inventory, which the Company believes could then underpin a stand-alone mining operation at Mt Jewell, providing for a minimum seven-year operating life.

"I consider that this initial Mineral Resource is an excellent achievement in a relatively short period of time, and is the direct result of our strong commitment to gold exploration and belief in Mt Jewell. We now have a very important platform from which to grow the business and we intend to follow up a number of new targets with aggressive drilling programs over the next year to build upon this foundation," Pioneer's Managing Director David Crook said.

The Mineral Resource was estimated by independent consultants CSA Global using data from 22,000m of resource definition drilling undertaken by Pioneer since the first gold discovery was made at Tregurtha in September 2009.

The Mt Jewell Project is considered to be an open pit proposition with conventional carbon-in-leach extraction of gold. The location of the project benefits from nearby established mining infrastructure due to its close proximity to Kalgoorlie, and there are several major operating gold treatment facilities within a 75km radius, including those at Paddington, Kanowna Belle, Kalgoorlie and Coolgardie.

The Tregurtha and Hughes gold deposits are new, greenfields discoveries made by Pioneer in 2009. The Company's substantial commitment to gold exploration since then has resulted in the identification of a suite of other prospects and anomalies, which will be the subject of on-going active exploration with the objective of making further discoveries. The Mt Jewell Gold Project is a major holding comprising more than 750km2 of tenements.

The Tregurtha and Hughes deposits are located along a NNW-trending shear in the south-west corner of the Rainbow Dam Granodiorite. The Rainbow Dam Granodiorite is a tear drop shaped body bound to the east by the Ringlock Dam greenstone belt and to the west by the Scotia Greenstone Belt. Further west is the nearby Scotia Dam Granodiorite, which hosts the Golden Cities and Federal Gold Mines.

Parameters

The Mineral Resource estimate is based on 88 reverse circulation ("RC") holes in Hughes and 78 RC holes in Tregurtha. The drilling is primarily on 20x20m and 40x40m drilling patterns, expanding to a 50x50m patterns at depth.

The wireframes for lodes are modelled on geological interpretation. The mineralisation within these lodes has been delineated using lithology and a minimum gold grade of 0.5g/t. A 1m composite data set for individual lodes was used for variography analysis and estimation. For continuity purposes, adjacent drill holes and sections were used to refine the geological relationship and to reduce the saw-tooth effect to the modelling.

A block model was created using 10.0mE × 10.0mN × 1.0mRL parent blocks. Ordinary Kriging was used to estimate 3D blocks. Quantitative Kriging Neighbourhood Analysis was used to optimise parameters for the Kriging search strategies.

The headline Mineral Resource of 185,600oz Au for the Tregurtha and Hughes Deposits has been reported for 3D blocks above a lower cut-of grade of 0.8g/t Au, subdivided by weathering zones to provide for density variations.

A summary of the in-situ Mineral Resource, reported by incremental lower grade cut-offs, is shown in Table 1. Table 2 subdivides the headline Mineral Resource by category.

Table 1 In Situ Mineral Resource by Lower Cut-off Grade							
Cutoff	Tregurtha		Hughes		Total		
Grade	Tonnes	Au	Tonnes	Au	Tonnes	Grade	Au
(g/t)		(g/t)		(g/t)		(g/t)	(oz)
0.0	3,824,000	1.01	2,033,000	1.54	5,857,000	1.19	224,800
0.5	3,334,000	1.10	1,949,000	1.59	5,283,000	1.28	217,500
0.6	2,967,000	1.17	1,877,000	1.63	4,844,000	1.35	210,000
0.7	2,555,000	1.25	1,772,000	1.69	4,327,000	1.43	199,000
0.8	**2,138,000**	**1.35**	**1,639,000**	**1.77**	**3,777,000**	**1.53**	**185,600**
0.9	1,738,000	1.46	1,497,000	1.85	3,235,000	1.64	170,600
1.0	1,395,000	1.59	1,359,000	1.95	2,754,000	1.77	156,500
1.1	1,115,000	1.72	1,218,000	2.05	2,333,000	1.89	141,900
1.2	901,000	1.86	1,092,000	2.15	1,993,000	2.02	129,400
1.3	744,000	1.99	969,000	2.27	1,713,000	2.15	118,300
1.4	611,000	2.13	870,000	2.37	1,481,000	2.27	108,100
1.5	**518,000**	**2.25**	**778,000**	**2.48**	**1,296,000**	**2.39**	**99,500**
2.0	244,000	2.85	432,000	3.08	676,000	3.00	65,100

Table 2 Mineral Resource by Resource Category (0.8g/t Lower Cut-off Grade)							
	Hughes		Tregurtha		Total		
Category	Tonnes	Au	Tonnes	Au	Tonnes	Grade	Au
		(g/t)		(g/t)		(g/t)	(oz)
Measured	317,000	1.50	328,000	2.71	645,000	2.12	43,900
Indicated	969,000	1.32	906,000	1.60	1,875,000	1.46	87,700
Inferred	852,000	1.33	405,000	1.38	1,257,000	1.35	54,400
Total	**2,138,000**	**1.35**	**1,639,000**	**1.77**	**3,777,000**	**1.53**	**185,600**

Note: Totals might not add due to the timing of equation rounding. The CSA Mineral Resource was estimated within constraining wireframe solids based on a nominal lower cut-off grade of 0.5g/t Au. Ordinary Kriging technique with high grade treatment (to reduce the influence of some very high grade samples) was used. The resource is quoted from blocks above the specified gold cut-off grade.

Yours faithfully

Production Note:
Signature removed prior to publication.

Managing Director

Released by :	Further information:
Paul Armstrong Read Corporate Telephone:	Mr David Crook Pioneer Resources Limited Telephone:

Responsible Parties

Responsible Parties in respect of the information within this release (which includes the report that the information is derived from) as it relates to geology and mineralization:

Based on the databases provided by Pioneer, CSA has produced the Mineral Resource estimates for Hughes and Tregurtha deposit, These Mineral Resources have been classified and reported in accordance with The 2004

Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code). Resource classification is based on the geological confidence and interpretation, data QAQC, drill spacing and geostatistical measures. It is CSA's opinion that the current Mineral Resource models provide robust global estimates of the in situ mineralisation of Au in the project.

CSA Global Pty Ltd (CSA)

CSA Global Pty Ltd (CSA) is an Australian-owned company providing geological and mining consulting services to the mineral resource sector. The organisation is well resourced with an established office in Perth, Western Australia and has undertaken work for a number of substantial international mining houses. CSA comprise a team of technical professionals dedicated to providing excellence of service in their field of expertise. The CSA's independence is ensured by the fact that it holds no equity in any project. This permits the CSA to provide its clients with conflict-free and objective recommendations on crucial judgment issues. The CSA have a demonstrated track record in undertaking independent assessments of resources and reserves, project evaluations and audits, Competent Persons Reports, independent audits and independent feasibility evaluations to bankable standards on behalf of exploration and mining companies and financial institutions worldwide. This report was prepared by consultants sourced from the CSA office in Perth (Australia). These consultants are specialists in the fields of Economic Geology, Project Analysis and Due Diligence, and Resource Evaluation.

Dr Bielin Shi (PhD, MSc, MAusIMM, MAIG) – Principal Geologist CSA

Dr Shi of CSA is a geologist with high level experience in economic and mining geology, resource estimation and applied geostatistics. The information in this announcement that relates to Mineral Resources is based on information compiled by Dr Shi, who is a member of the Australasian Institute of Mining and Metallurgy (AusIMM) and the Australian Institute of Geoscientists (AIG). Dr Shi is a Competent Person as defined by the JORC Code (2004 Edition) and consents to the inclusion in this announcement of matters based on his information in the form and context in which it appears. . He conducted the field-based assessment of Pioneer' Mount Jewel Project and is the primary author for this report.

Warranties

Pioneer has represented in writing to CSA that full disclosure has been made of all material information and that, to the best of their knowledge and understanding, such information is complete, accurate and true.

Reliance to other experts

CSA has based this resource estimate report on information provided by Pioneer. This report relies on other experts for the description of project tenure, regional geology and environmental considerations. The report includes third party technical reports and relevant published and unpublished third party information. CSA has made all reasonable endeavours, including a review of the Pioneer data, to confirm the authenticity and completeness of the technical data on which this report is based, however CSA cannot guarantee the authenticity or completeness of such third party information.

The report author is not qualified to comment on any legal, environmental, political or other issues relating to the status of the Hughes and Tregurtha tenements, or for any marketing and mining considerations related to the economic viability of the Hughes and Tregurtha mineralisation.

About Pioneer Resources Limited

Pioneer Resources Limited (ASX: PIO) is a specialist exploration company searching for gold and base metals in the Kalgoorlie District of Western Australia. The Company strives to create shareholder value by combining work on advanced projects with active project generation from within the Company's 100%-owned and joint venture tenement portfolio.

A summary of the Company's activities is presented in a fact sheet and other reports available from the Company's web site at www.PIOresources.com.au.

Appendix C: Alternative definitions of a specialist

Appendix C.1 - Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects based on client size

Panel		**A - All metals**		**B – Base Metals**		**C – Precious Metals**		**D – Bulk Metals**	
B	Variable	Coef.	P>t	Coef.	P>t	Coef.	P>t	Coef.	P>t
1	C	-0.07510	0.396	0.04029	0.806	-0.12866	0.441	-0.87309	0.085*
2	RSC (RESOURCES)	0.00004	0.010***	0.00006	0.063*	0.00024	0.094*	0.00002	0.366
3	RSV (RESERVES)	0.00201	0.037**	0.00151	0.443	0.00219	0.393	0.00061	0.648
4	RSC_GRADE	0.00730	0.793	-0.02611	0.753	0.02275	0.533	-0.04091	0.745
5	RSV_GRADE	0.10288	0.134	0.02451	0.880	0.13322	0.387	0.95864	0.049**
6	LNSIZE	-0.00699	0.003***	-0.00614	0.163	-0.00863	0.013**	-0.00701	0.135
7	COMM_PRICE	0.00594	0.305	0.01782	0.086*	-0.00645	0.754	0.00176	0.733
8	LNPAGES	-0.00320	0.316	-0.01319	0.067*	0.00350	0.418	-0.00466	0.686
9	GROWTH	0.01475	0.016**	0.02450	0.051*	0.01041	0.246	0.02163	0.090*
10	B4*SPEC	-0.00332	0.597	-0.03379	0.225	0.01241	0.295	-0.00299	0.839
11	B4*SPEC*RSC	0.00037	0.062*	0.00077	0.000***	-0.00016	0.334	0.00009	0.398
12	B4*SPEC*RSV	-0.00218	0.205	0.00374	0.300	-0.01009	0.095*	-0.00140	0.678
	Obs.	1467		339		555		360	
	F-statistic	38.37		.		4.02		.	
	Prob(F-statistic)	0.000		.		0.006		.	
	R-squared	0.043		0.146		0.030		0.032	

In Appendix C.1; Two-tailed test of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors clustered by year correcting for heteroskedasticity.

Appendix C.2 - Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects based on number of announcements

Panel		A - All metals		B – Base Metals		C – Precious Metals		D – Bulk Metals	
B	Variable	Coef.	P>t	Coef.	P>t	Coef.	P>t	Coef.	P>t
1	C	-0.07071	0.443	0.07176	0.659	-0.13745	0.410	-0.99115	0.043**
2	RSC (RESOURCES)	0.00006	0.028**	0.00012	0.085*	0.00024	0.095*	0.00002	0.378
3	RSV (RESERVES)	0.00184	0.032**	0.00144	0.475	0.00205	0.439	-0.00007	0.940
4	RSC_GRADE	0.00594	0.837	-0.02570	0.770	0.02365	0.520	-0.03733	0.768
5	RSV_GRADE	0.09839	0.164	-0.01755	0.916	0.14040	0.362	1.07392	0.030**
6	LNSIZE	-0.00699	0.003***	-0.00486	0.303	-0.00865	0.014**	-0.00662	0.128
7	COMM_PRICE	0.00745	0.288	0.02619	0.074*	-0.00627	0.750	0.00037	0.940
8	LNPAGES	-0.00302	0.346	-0.01186	0.088*	0.00375	0.387	-0.00528	0.639
9	GROWTH	0.01423	0.018**	0.02085	0.095*	0.01040	0.244	0.02004	0.079*
10	B4*SPEC	0.00691	0.383	0.00443	0.772	0.01500	0.188	-0.01220	0.435
11	B4*SPEC*RSC	-0.00002	0.763	-0.00013	0.219	-0.00016	0.356	0.00038	0.159
12	B4*SPEC*RSV	0.00247	0.431	0.00116	0.546	0.00135	0.770	0.00536	0.215
	Obs.	1467		339		555		360	
	F-statistic	106.43		4.03		4.74		.	
	Prob(F-statistic)	0.000		0.006		0.003		.	
	R-squared	0.029		0.063		0.031		0.040	

In Appendix C.2; Two-tailed test of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors clustered by year correcting for heteroskedasticity.

Appendix D: Description of data collected

Report Data	
Date	The date that the report was published. This is the identification of the reports
Time (AM/PM):	The exact time the report was published.
Project Name	Tracks the project for which the resource and reserve updates are being disclosed by a certain company.
Project location	Where the project is located.
Pages	Number of pages in the report.
Header	The name of the report; important to define the focus of the report through the development of a pattern.
Stand Alone	Binary data, showing if the resource/reserve announcement was published standalone or as a part of a bigger scope report—i.e., annual/quarterly report. Assuming that more relevant information would be emphasized due to its significance, this flag may imply higher market reactions.
Technical Report	Checks whether the report is part of a technical report or not.
Resource/Reserve Change:	Total change in resources/reserves.
Mineral Data	
Primary Commodity	Show which is the primary commodity (the lead product) explored in the mine.
By-Product Commodity	Show which is the second commodity explored in the mine.
Reserve Data	
Tonnage	The total representation of the mineral reserve in tons without considering the grade/density of metal
Grade	Show how much mineral is being extracted per rock.

Metal	Net value of metal that can be extracted from the mine.
Type	If it is a Proved/Probable/Total type.
Cut Off	The cut-off grade is that grade of material below which mining is uneconomical. Calculating the cut-off grade involves a mini-feasibility study in which all the known and potential costs of the project are accounted for. This is consistent with the 3rd kind of reports, which consists of feasibility reports investigating the economics of extracting such occurrences with a view to project development.
Resource Data	
Tonnage	The total representation of the mineral resource in tons without considering the grade/density of metal.
Grade	Show how much mineral is being extracted per rock.
Metal	Net value of metal that can be extracted from the mine.
Type	If it is a Measured/Indicated/Inferred/Total type.
Cut Off	The cut-off grade is that grade of material below which mining is uneconomical. Calculating the cut-off grade involves a mini-feasibility study in which all the known and potential costs of the project are accounted for. This is consistent with the 3rd kind of reports, which consists of feasibility reports investigating the economics of extracting such occurrences with a view to project development.
Geological expert	
Expert Name	The name of the expert in charge of examining the mineral information.
Qualification	The qualification of the expert.
Organisation	Which firm does the expert work for?
Internal/External	Examine the expert's independence by checking if the expert is an internal employer or an external expert.

MDSE data	
Company Name	The name of the exploration firm.
Informativeness	
Focus	Show the intention of the report by exploring the focus of the announcement.
Oxide/Sulphide	Checks whether the report provides extra technical information. Just a few reports provide such information that is very relevant to the evaluation of the ore. Therefore, this data is interesting to examine whether the market reacts to a higher quality information report.
Geological expert Location	Check where the name of the expert is positioned. For example, if the name is intentionally hidden in the footnote due to a low-quality geological expert or is evident in the body of the report trying to take advantage of the geological expert's brand.

Appendix E: Alternative measures for geological expert's proxy of size

Appendix E.1 – Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects using individual brand effects based on commodity leaders

Panel		**A – H&S**		**B -Snowden**		**C – SRK**		**D – Coffey**		**E – Golder**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.06857	0.446	-0.06895	0.455	-0.07316	0.426	-0.07048	0.443	-0.06980	0.452
2	RSC (RESOURCES)	0.00006	0.034**	0.00006	0.026**	0.00006	0.025**	0.00006	0.022**	0.00005	0.055*
3	RSV (RESERVES)	0.00187	0.016**	0.00176	0.024**	0.00188	0.017**	0.00187	0.011**	0.00191	0.015**
4	RSC_GRADE	0.00314	0.926	0.00491	0.882	0.00358	0.915	0.00333	0.920	0.00102	0.976
5	RSV_GRADE	0.10042	0.228	0.09810	0.255	0.10312	0.227	0.10104	0.237	0.10426	0.229
6	LNSIZE	-0.00678	0.000***	-0.00689	0.000***	-0.00680	0.000***	-0.00697	0.000***	-0.00691	0.000***
7	COMM_PRICE	0.00771	0.306	0.00745	0.323	0.00781	0.300	0.00833	0.269	0.00620	0.399
8	LNPAGES	-0.00329	0.278	-0.00314	0.295	-0.00297	0.321	-0.00333	0.270	-0.00331	0.272
9	GROWTH	0.01445	0.004***	0.01427	0.005***	0.01457	0.004***	0.01446	0.004**	0.01407	0.006***
10	LEAD	-0.01159	0.331	0.00531	0.753	-0.00432	0.798	0.01951	0.277	-0.01542	0.330
11	LEAD*RSC	0.00001	0.807	-0.00003	0.733	-0.00003	0.641	-0.00006	0.548	0.00037	0.178
12	LEAD*RSV	-0.01289	0.000***	0.00314	0.410	0.00098	0.682	0.00230	0.801	0.00085	0.815
	Obs.	1467		1467		1467		1467		1467	
	F-statistic	7.13		3.5		3.64		3.51		3.41	
	Prob(*F*-statistic)	0.000		0.000		0.000		0.000		0.000	
	Ajd. *R*-squared	0.0297		0.0285		0.0282		0.0293		0.0399	

In Appendix E.1, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix E.2 – Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects using Big 2, Big 3, Big 4 and Big 5 alternative measures

Panel		A.1 – Big 2		A.2 – Big 2*SPEC		B.1 – Big 3		B.2 - Big 3*SPEC		C.1 – Big 5		C.2 – Big 5*SPEC	
B	Variable	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.07393	0.420	-0.07472	0.420	-0.08433	0.346	-0.08142	0.368	-0.07837	0.388	-0.07924	0.383
2	RSC (RESOURCES)	0.00006	0.026**	0.00006	0.032**	0.00004	0.111	0.00004	0.080*	0.00004	0.127	0.00004	0.076**
3	RSV (RESERVES)	0.00173	0.025**	0.00181	0.020**	0.00164	0.037**	0.00176	0.025**	0.00172	0.034**	0.00177	0.026**
4	RSC_GRADE	0.00451	0.893	0.00663	0.842	0.00516	0.878	0.00917	0.783	0.00571	0.866	0.00776	0.816
5	RSV_GRADE	0.10418	0.223	0.10202	0.239	0.11409	0.172	0.10712	0.203	0.10773	0.204	0.10602	0.209
6	LNSIZE	-0.00685	0.000***	-0.00699	0.000***	-0.00688	0.000***	-0.00692	0.000***	-0.00689	0.000***	-0.00694	0.000***
7	COMM_PRICE	0.00783	0.298	0.00739	0.327	0.00708	0.342	0.00586	0.418	0.00738	0.327	0.00678	0.355
8	LNPAGES	-0.00311	0.299	-0.00298	0.319	-0.00294	0.326	-0.00325	0.277	-0.00300	0.314	-0.00315	0.292
9	GROWTH	0.01426	0.005***	0.01424	0.005***	0.01468	0.004***	0.01400	0.005***	0.01448	0.004***	0.01427	0.005***
10	BN	-0.00492	0.600			-0.00663	0.429			-0.00422	0.561		
11	BN*RSC	-0.00003	0.525			0.00013	0.177			0.00006	0.323		
12	BN*RSV	0.00336	0.500			0.00317	0.217			0.00118	0.628		
13	BN*SPEC			0.00422	0.599			-0.00076	0.931			-0.00067	0.938
14	BN*SPEC*RSC			0.00012	0.038**			0.00040	0.059***			0.00030	0.114
15	BN*SPEC*RSV			0.00409	0.322			0.00221	0.325			0.00199	0.372
	Obs.	1467		1467		1467		1467		1467		1467	
	F-statistic	3.45		4.78		3.57		4.09		3.44		3.87	
	Prob(*F*-statistic)	0.000		0.000		0.000		0.000		0.000		0.000	
	Ajd. *R*-squared	0.0287		0.03		0.0329		0.0471		0.0296		0.0414	

In Appendix E.2, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F: Alternative model specifications

Appendix F.1: Ordinary Least Squares regression of (1, 3, 5, 10)-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects using alternative event window

Panel		**A – Event day AR**		**B -3-day BHAR**		**C -5-day BHAR**		**D – 10-day BHAR**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.04709	0.576	-0.09068	0.401	-0.33270	0.096	-0.07099	0.748
2	RSC (RESOURCES)	0.00004	0.117	0.00004	0.098*	0.00003	0.210	0.00002	0.583
3	RSV (RESERVES)	0.00108	0.142	0.00161	0.058*	0.00156	0.128	0.00112	0.412
4	RSC_GRADE	0.00087	0.976	0.05067	0.174	0.04548	0.327	0.03420	0.508
5	RSV_GRADE	0.08290	0.293	0.07605	0.454	0.32756	0.090	0.07211	0.736
6	LNSIZE	-0.00423	0.012**	-0.00719	0.000***	-0.00886	0.000***	-0.00728	0.006***
7	COMM_PRICE	0.01001	0.090*	0.00751	0.321	0.00222	0.817	-0.00109	0.925
8	LNPAGES	-0.00263	0.349	-0.00237	0.467	0.00001	0.997	0.00098	0.807
9	GROWTH	0.00942	0.029**	0.01642	0.003***	0.01851	0.005***	0.00744	0.338
10	B4*SPEC	-0.00007	0.993	-0.00342	0.709	-0.00472	0.676	0.00282	0.825
11	B4*SPEC*RSC	0.00034	0.081*	0.00034	0.103	0.00036	0.120	0.00035	0.182
12	B4*SPEC*RSV	0.00106	0.571	0.00274	0.044**	-0.00134	0.695	0.00122	0.736
	Obs.	1467		1467		1467		1467	
	F-statistic	2.26		6.21		3.2		1.35	
	Prob(*F*-statistic)	0.010		0.000		0.000		0.189	
	Ajd. *R*-squared	0.0399		0.0378		0.0334		0.0159	

In Appendix F.1, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.2: Quantile non-parametric regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects

B	Variable	Coef.	*P>t*
1	C	-0.05434	0.684
2	RSC (RESOURCES)	0.00005	0.001***
3	RSV (RESERVES)	0.00189	0.002***
4	RSC_GRADE	-0.01413	0.531
5	RSV_GRADE	0.07674	0.560
6	LNSIZE	-0.00109	0.378
7	COMM_PRICE	-0.00080	0.871
8	LNPAGES	-0.00159	0.492
9	GROWTH	0.00463	0.228
10	B4*SPEC	-0.00228	0.741
11	B4*SPEC*RSC	0.00016	0.001***
12	B4*SPEC*RSV	0.00116	0.625
	Obs.	1467	
	Raw sum of deviations	98.009	
	Min sum of deviations	96.573	
	Pseudo R-squared	0.0147	

In Appendix F.2, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.3: Alternative reduced form Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories and reputation effects

B	Variable	Coef.	*P>t*
1	C	0.00818	0.009***
2	RSC (RESOURCES)	0.00005	0.033**
3	RSV (RESERVES)	0.00140	0.072*
4	B4*SPEC	-0.00430	0.632
5	B4*SPEC*RSC	0.00039	0.052*
6	B4*SPEC*RSV	0.00248	0.294
	Obs.	1467	
	F-statistic	3.2	
	Prob(*F*-statistic)	0.007	
	Ajd. *R*-squared	0.0306	

In Appendix F.3, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.4: Ordinary Least Squares regression of 2-day cumulative abnormal return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects

Panel		**A - Table 4.5 (Panel A)**		**B - Table 4.6 (Panel C)**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.06940	0.451	-0.07635	0.402
2	RSC (RESOURCES)	0.00006	0.024**	0.00004	0.089*
3	RSV (RESERVES)	0.00192	0.013***	0.00179	0.024**
4	RSC_GRADE	0.00367	0.913	0.00738	0.827
5	RSV_GRADE	0.10327	0.227	0.10728	0.204
6	LNSIZE	-0.00770	0.000***	-0.00776	0.000***
7	COMM_PRICE	0.00731	0.333	0.00561	0.441
8	LNPAGES	-0.00285	0.343	-0.00299	0.319
9	GROWTH	0.01381	0.006***	0.01357	0.007***
10	B3_SPEC			-0.00157	0.860
11	B3_SPEC*RSC			0.00038	0.053*
12	B3_SPEC*RSV			0.00212	0.333
	Obs.	1467		1467	
	F-statistic	5.21		4.45	
	Prob(*F*-statistic)	0.000		0.000	
	Ajd. *R*-squared	0.030		0.049	

In Appendix F.4, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.5: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels, reputation effects and gross domestic product

Panel		**A - Table 4.5 (Panel A)**		**B - Table 4.6 (Panel C)**	
B	Variable	Coef.	P>t	Coef.	P>t
1	C	-0.07649	0.407	-0.08318	0.360
2	RSC (RESOURCES)	0.00006	0.022**	0.00004	0.084*
3	RSV (RESERVES)	0.00190	0.014**	0.00175	0.026**
4	RSC_GRADE	0.00497	0.881	0.00863	0.796
5	RSV_GRADE	0.10322	0.229	0.10802	0.200
6	LNSIZE	-0.00677	0.000***	-0.00686	0.000***
7	COMM_PRICE	0.00761	0.310	0.00598	0.410
8	LNPAGES	-0.00298	0.321	-0.00315	0.293
9	GROWTH	0.01429	0.005***	0.01409	0.005***
10	B4*SPEC			-0.00235	0.791
11	B4*SPEC*RSC			0.00038	0.054*
12	B4*SPEC*RSV			0.00241	0.289
13	GDP_RANK	0.00000	0.695	0.00000	0.818
	Obs.	1467		1467	
	F-statistic	4.19		3.71	
	Prob(F-statistic)	0.000		0.000	
	Ajd. *R*-squared	0.027		0.046	

In Appendix F.5, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.6: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels, reputation effects and geological expert disclosure location

B	Variable	Coef.	P>t
1	C	-0.08106	0.369
2	RSC (RESOURCES)	0.00004	0.090*
3	RSV (RESERVES)	0.00172	0.034**
4	RSC_GRADE	0.00908	0.787
5	RSV_GRADE	0.10614	0.206
6	LNSIZE	-0.00690	0.000***
7	COMM_PRICE	0.00601	0.408
8	LNPAGES	-0.00332	0.273
9	GROWTH	0.01413	0.005***
10	B4	-0.00293	0.745
11	B4*RSC	0.00038	0.054*
12	B4*RSV	0.00242	0.286
13	BODY	0.00142	0.787
	Obs.	1467	
	F-statistic	3.75	
	Prob(F-statistic)	0.000	
	Ajd. *R*-squared	0.0466	

In Table Appendix F.6, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.7: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects clustered by year

Panel		**A - Table 4.5 (Panel A)**		**B - Table 4.6 (Panel C)**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.07376	0.408	-0.08165	0.340
2	RSC (RESOURCES)	0.00006	0.025**	0.00004	0.020**
3	RSV (RESERVES)	0.00191	0.049**	0.00176	0.035**
4	RSC_GRADE	0.00513	0.859	0.00871	0.747
5	RSV_GRADE	0.10249	0.134	0.10762	0.105
6	LNSIZE	-0.00686	0.004***	-0.00691	0.004***
7	COMM_PRICE	0.00772	0.282	0.00605	0.298
8	LNPAGES	-0.00303	0.341	-0.00317	0.320
9	GROWTH	0.01436	0.019**	0.01413	0.015**
10	B4*SPEC			-0.00247	0.784
11	B4*SPEC*RSC			0.00038	0.043**
12	B4*SPEC*RSV			0.00239	0.267
	Obs.	1467		1467	
	F-statistic	20.39		39.77	
	Prob(*F*-statistic)	0.000		0.000	
	Ajd. *R*-squared	0.0278		0.0465	

In Appendix F.7, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using year cluster standard errors correcting for heteroskedasticity.

Appendix F.8 Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects with disclosure timing control

Panel		**A - Table 4.5 (Panel A)**		**B - Table 4.6 (Panel C)**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.08622	0.352	-0.09486	0.299
2	RSC (RESOURCES)	0.00007	0.013**	0.00005	0.056*
3	RSV (RESERVES)	0.00193	0.013**	0.00177	0.026**
4	RSC_GRADE	0.00956	0.776	0.01315	0.696
5	RSV_GRADE	0.11424	0.184	0.12021	0.156
6	LNSIZE	-0.00671	0.000***	-0.00674	0.000***
7	COMM_PRICE	0.00732	0.332	0.00566	0.436
8	LNPAGES	-0.00249	0.411	-0.00263	0.384
9	GROWTH	0.00921	0.101	0.00890	0.114
10	FIRST_DISC	-0.01566	0.034**	-0.01593	0.028**
11	B4*SPEC			-0.00321	0.716
12	B4*SPEC*RSC			0.00039	0.056*
13	B4*SPEC*RSV			0.00253	0.266
14	Obs.	1467		1467	
15	*F*-statistic	4.96		4.30	
	Prob(*F*-statistic)	0.000		0.000	
	Ajd. *R*-squared	0.0312		0.0501	

In Appendix F.8, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.9 Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects using alternative price data provided by SIRCA

Panel		**A – Eq. 3.4**		**B – Eq. 2.4 and Eq. 2.5**	
B	Variable	Coef.	P>t	Coef.	P>t
1	C	-0.07829	0.392	-0.08740	0.333
2	RSC (RESOURCES)	0.00007	0.007***	0.00005	0.032**
3	RSV (RESERVES)	0.00133	0.139	0.00116	0.214
4	RSC_GRADE	-0.00079	0.982	0.00289	0.935
5	RSV_GRADE	0.11216	0.185	0.11847	0.155
6	LNSIZE	-0.00578	0.002***	-0.00583	0.002***
7	COMM_PRICE	0.00491	0.539	0.00318	0.681
8	LNPAGES	-0.00423	0.203	-0.00438	0.184
9	GROWTH	0.01278	0.026**	0.01253	0.028**
10	B4*SPEC			-0.00271	0.773
11	B4*SPEC*RSC			0.00040	0.053**
12	B4*SPEC*RSV			0.00281	0.216
	Obs.	1467		1467	
	F-statistic	3.24		2.98	
	Prob(F-statistic)	0.001		0.001	
	R-squared	0.0191		0.0339	

In Appendix F.9, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.10: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and net operating cash flow

Panel		**A - Table 4.5 (Panel A)**		**B - Table 4.6 (Panel C)**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.17056	0.073*	-0.18013	0.052*
2	RSC (RESOURCES)	0.00006	0.023**	0.00004	0.085*
3	RSV (RESERVES)	0.00225	0.009***	0.00210	0.018**
4	RSC_GRADE	0.01007	0.753	0.01468	0.649
5	RSV_GRADE	0.18715	0.038**	0.19295	0.028**
6	LNSIZE	-0.00675	0.001***	-0.00695	0.000***
7	COMM_PRICE	0.01124	0.177	0.00926	0.248
8	LNPAGES	-0.00020	0.955	-0.00033	0.925
9	GROWTH	0.01081	0.044**	0.01055	0.048**
10	CASHBURN	0.00027	0.618	0.00032	0.543
11	B4*SPEC			0.00126	0.898
12	B4*SPEC*RSC			0.00037	0.064*
13	B4*SPEC*RSV			0.00214	0.386
	Obs.	1322		1322	
	F-statistic	3.55		3.33	
	Prob(*F*-statistic)	0.000		0.000	
	Ajd. *R*-squared	0.026		0.046	

In Appendix F.10, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.11: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and net operating and investing cash flow

Panel		**A - Table 4.5 (Panel A)**		**B - Table 4.6 (Panel C)**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.17101	0.061*	-0.17821	0.046**
2	RSC (RESOURCES)	0.00006	0.028**	0.00004	0.102*
3	RSV (RESERVES)	0.00226	0.008***	0.00210	0.016**
4	RSC_GRADE	0.01149	0.719	0.01562	0.627
5	RSV_GRADE	0.18281	0.034**	0.18743	0.026**
6	LNSIZE	-0.00708	0.000***	-0.00713	0.000***
7	COMM_PRICE	0.00997	0.228	0.00828	0.303
8	LNPAGES	-0.00001	0.998	-0.00019	0.957
9	GROWTH	0.01093	0.040**	0.01063	0.045**
10	CASHBURN	0.00565	0.068*	0.00480	0.101
11	B4*SPEC			0.00040	0.968
12	B4*SPEC*RSC			0.00037	0.065*
13	B4*SPEC*RSV			0.00217	0.384
	Obs.	1322		1322	
	F-statistic	3.68		3.4	
	Prob(*F*-statistic)	0.0001		0.0001	
	Ajd. *R*-squared	0.0281		0.0478	

In Appendix F.11, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.12: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and number of days between the disclosure and firm age

Panel		**A - Table 4.5 (Panel A)**		**B - Table 4.6 (Panel C)**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.076316	0.407	-0.083674	0.357
2	RSC (RESOURCES)	0.000061	0.023**	0.000041	0.086*
3	RSV (RESERVES)	0.001918	0.013**	0.001768	0.026**
4	RSC_GRADE	0.005265	0.874	0.008830	0.791
5	RSV_GRADE	0.105915	0.218	0.110360	0.193
6	LNSIZE	-0.006589	0.000***	-0.006684	0.000***
7	COMM_PRICE	0.007702	0.306	0.006035	0.405
8	LNPAGES	-0.003028	0.310	-0.003176	0.287
9	GROWTH	0.014250	0.005***	0.014038	0.005***
10	FIRM_AGE	-0.000001	0.563	0.000000	0.630
11	B4*SPEC			-0.002387	0.788
12	B4*SPEC*RSC			0.000383	0.056**
13	B4*SPEC*RSV			0.002361	0.305
	Obs.	1467		1467	
	F-statistic	4.19		3.69	
	Prob(*F*-statistic)	0.000		0.000	
	Ajd. *R*-squared	0.028		0.047	

In Appendix F.12, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix F.13: Ordinary Least Squares regression of 2-day and 10-day abnormal volume turnovers return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects

Panel		**A- 2-day Ab. turnover**	**B - 10-day Ab. turnover**
B	Variable	Coef. P>t	Coef. P>t
1	C	0.81930 0.639	2.8614 0.033**
2	RSC (RESOURCES)	0.00129 0.000***	0.0002 0.534
3	RSV (RESERVES)	0.02053 0.052*	-0.0045 0.664
4	RSC_GRADE	-0.25951 0.626	-0.2145 0.471
5	RSV_GRADE	-0.06527 0.966	-2.4256 0.067*
6	LNSIZE	-0.11360 0.029**	-0.0063 0.738
7	COMM_PRICE	0.27391 0.074*	-0.0431 0.596
8	LNPAGES	0.01987 0.807	-0.0052 0.932
9	GROWTH	0.25996 0.017**	0.0287 0.603
10	B4*SPEC	-0.05240 0.756	0.0582 0.678
11	B4*SPEC*RSC	-0.00001 0.995	-0.0001 0.907
12	B4*SPEC*RSV	-0.00553 0.926	0.0789 0.190
	Obs.	1467	1451
	F-statistic	96.16	2.53
	Prob(F-statistic)	0.000	0.0449
	R-squared	0.035	0.005

In Appendix F.13, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

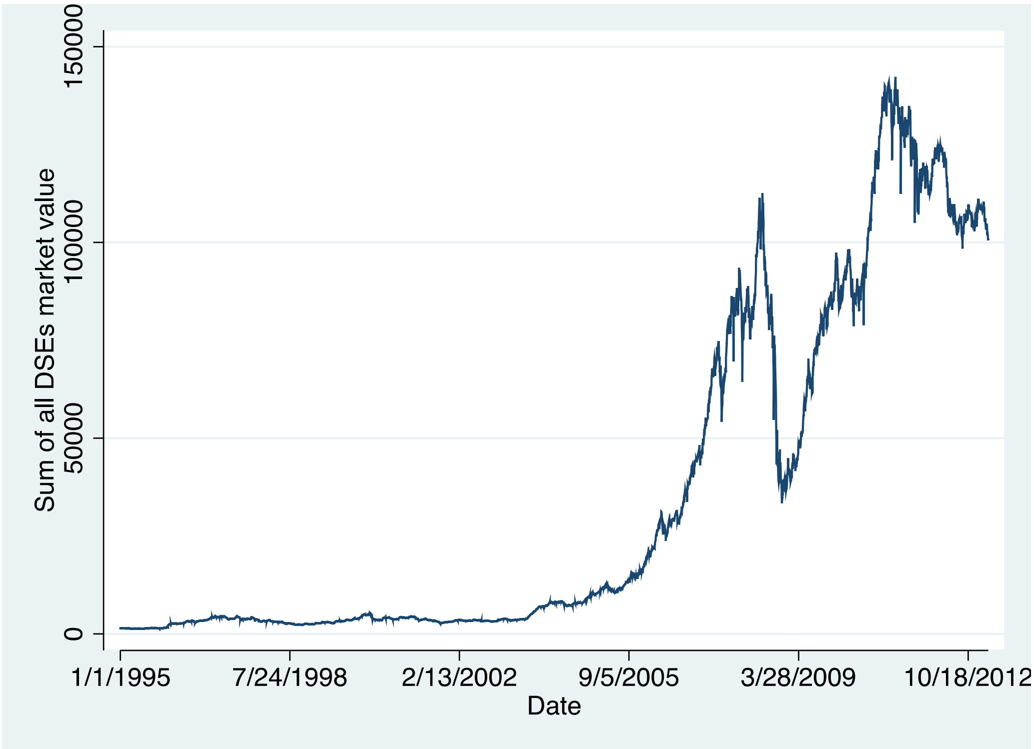
Appendix G: Choice of performance benchmark

Appendix G.1: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects using alternative performance benchmark

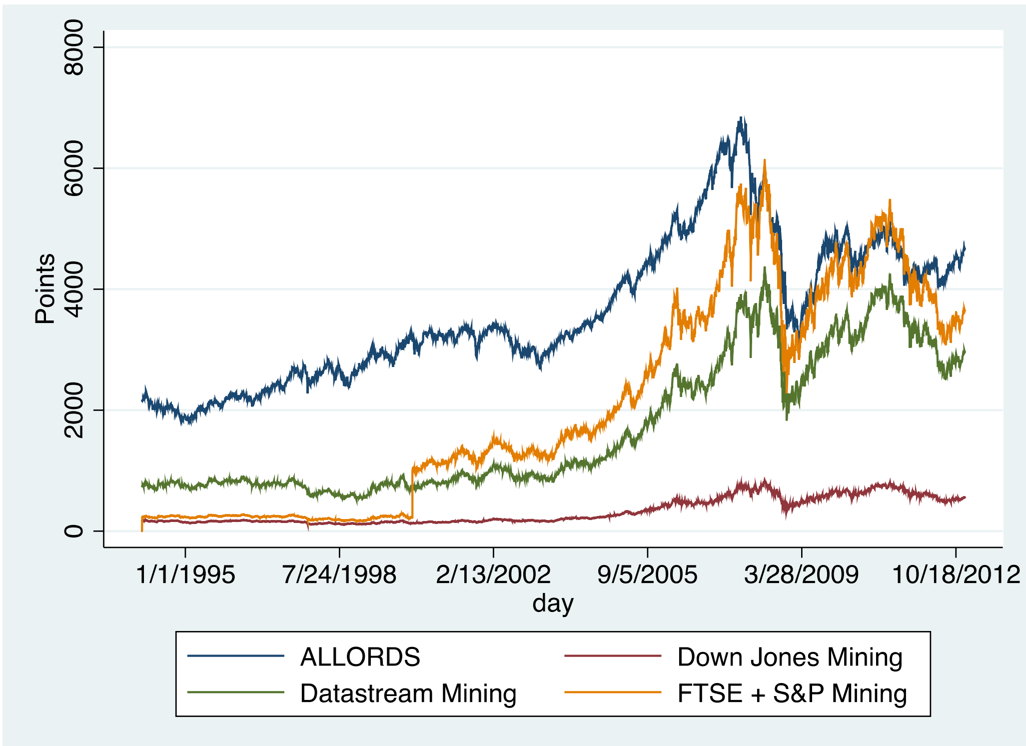
Panel		A – ASX S&P 300 Metals and Mining		B -Down Jones Aus. Mining		C – Aus. Datastream Mining		D – All Ordinaries	
B	Variable	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.05741	0.568	-0.06126	0.549	-0.06294	0.537	-0.16583	0.093*
2	RSC (RESOURCES)	0.00004	0.116	0.00004	0.117	0.00004	0.120	0.00004	0.108
3	RSV (RESERVES)	0.00162	0.036**	0.00165	0.033**	0.00162	0.038**	0.00162	0.037**
4	RSC_GRADE	0.01071	0.744	0.01054	0.748	0.01032	0.753	0.02162	0.511
5	RSV_GRADE	0.08353	0.379	0.08665	0.370	0.08899	0.356	0.18044	0.052*
6	LNSIZE	-0.00650	0.000***	-0.00642	0.000***	-0.00643	0.000***	-0.00607	0.001***
7	COMM_PRICE	0.00551	0.457	0.00550	0.459	0.00516	0.487	0.00524	0.477
8	LNPAGES	-0.00450	0.135	-0.00441	0.147	-0.00456	0.131	-0.00477	0.119
9	GROWTH	0.01468	0.004***	0.01481	0.003***	0.01482	0.003***	0.01438	0.004***
10	B4*SPEC	-0.00277	0.751	-0.00289	0.741	-0.00300	0.730	-0.00297	0.731
11	B4*SPEC*RSC	0.00038	0.056*	0.00038	0.054*	0.00038	0.055*	0.00039	0.05**
12	B4*SPEC*RSV	0.00275	0.182	0.00283	0.169	0.00284	0.170	0.00278	0.197
	Obs.	1467		1467		1467		1467	
	F-statistic	4.05		4.05		4.02		4.14	
	Prob(*F*-statistic)	0.000		0.000		0.000		0.000	
	Ajd. *R*-squared	0.0447		0.0447		0.0446		0.0458	

In Appendix G.1, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix G.2: Cumulative market value of all non-disclosing MDSE firms in the sample



Appendix G.3: Level of alternative benchmark indices over time



Appendix H: Alternative sample partitioning

Appendix H.1: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects using alternative sample windows under differing JORC revisions

Panel		**A – After 1998**		**B – After 2000**		**C -After 2004**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.07971	0.382	-0.07672	0.400	-0.06385	0.496
2	RSC (RESOURCES)	0.00004	0.078*	0.00004	0.090*	0.00004	0.106
3	RSV (RESERVES)	0.00182	0.022**	0.00175	0.028**	0.00185	0.024**
4	RSC_GRADE	0.00624	0.853	0.00520	0.878	0.00238	0.947
5	RSV_GRADE	0.10665	0.206	0.10680	0.205	0.09732	0.258
6	LNSIZE	-0.00686	0.000***	-0.00717	0.000***	-0.00734	0.000***
7	COMM_PRICE	0.00674	0.354	0.00645	0.375	0.00632	0.389
8	LNPAGES	-0.00278	0.510	-0.00286	0.499	-0.00307	0.482
9	GROWTH	0.01408	0.005***	0.01388	0.006***	0.01603	0.002***
10	B4*SPEC	-0.00126	0.887	-0.00205	0.818	-0.00466	0.609
11	B4*SPEC*RSC	0.00038	0.056*	0.00038	0.055*	0.00039	0.051*
12	B4*SPEC*RSV	0.00227	0.319	0.00238	0.294	0.00214	0.381
	Obs.	1454		1443		1372	
	F-statistic	4.01		4.05		4.07	
	Prob(*F*-statistic)	0.000		0.000		0.000	
	Ajd. *R*-squared	0.0466		0.0472		0.0506	

In Appendix H.1, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix H.2: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects in a sample excluding the year of GFC (2008)

Panel		**A - Table 4.5 (Panel A)**		**B - Table 4.6 (Panel C)**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.05133	0.623	-0.06769	0.506
2	RSC (RESOURCES)	0.00007	0.016**	0.00004	0.065*
3	RSV (RESERVES)	0.00184	0.026**	0.00160	0.054*
4	RSC_GRADE	-0.00375	0.913	0.00032	0.993
5	RSV_GRADE	0.09003	0.363	0.10357	0.281
6	LNSIZE	-0.00753	0.000***	-0.00764	0.000***
7	COMM_PRICE	0.01136	0.191	0.00902	0.273
8	LNPAGES	-0.00271	0.384	-0.00283	0.363
9	GROWTH	0.01302	0.014**	0.01277	0.015**
10	B4*SPEC			-0.00367	0.693
11	B4*SPEC*RSC			0.00038	0.056*
12	B4*SPEC*RSV			0.00396	0.078*
	Obs.			1284	
	F-statistic	1284		4.09	
	Prob(*F*-statistic)	4.32		0.000	
	Ajd. *R*-squared	0.000		0.055	

In Appendix H.2, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix H.3: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects including observations with resource and reserve downgrades or bad news events

B	Variable	Coef.	*P>t*
1	C	-0.02426	0.784
2	RSC (RESOURCES)	0.00005	0.040**
3	RSV (RESERVES)	0.00118	0.220
4	RSC_GRADE	0.02658	0.370
5	RSV_GRADE	0.02302	0.785
6	LNSIZE	-0.00603	0.000***
7	COMM_PRICE	0.00938	0.169
8	LNPAGES	-0.00162	0.594
9	GROWTH	0.01652	0.000***
10	B4*SPEC	0.00147	0.854
11	B4*SPEC*RSC	0.00037	0.061*
12	B4*SPEC*RSV	0.00256	0.276
	Obs.	1656	
	F-statistic	4.06	
	Prob(*F*-statistic)	0.000	
	Ajd. R-squared	0.0418	

In Appendix H.3, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix H.4: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects examining the definition of MDSEs by excluding the largest firm

B	Variable	Coef.	*P>t*
1	C	-0.06917	0.445
2	RSC (RESOURCES)	0.00004	0.091*
3	RSV (RESERVES)	0.00177	0.025**
4	RSC_GRADE	0.00868	0.794
5	RSV_GRADE	0.09804	0.244
6	LNSIZE	-0.00777	0.000***
7	COMM_PRICE	0.00612	0.398
8	LNPAGES	-0.00307	0.306
9	GROWTH	0.01420	0.005***
10	B4*SPEC	-0.00155	0.861
11	B4*SPEC*RSC	0.00038	0.056*
12	B4*SPEC*RSV	0.00241	0.285
	Obs.	1462	
	F-statistic	4.37	
	Prob(*F*-statistic)	0.000	
	Ajd. *R*-squared	0.0488	

In Appendix H.4, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix H.5: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects with base metals sample containing bad news

B	Variable	Coef.	*P>t*
1	C	-0.02327	0.861
2	RSC (RESOURCES)	0.00007	0.058*
3	RSV (RESERVES)	0.00136	0.236
4	RSC_GRADE	-0.00546	0.930
5	RSV_GRADE	0.05233	0.650
6	LNSIZE	-0.00347	0.408
7	COMM_PRICE	0.02398	0.021**
8	LNPAGES	-0.01095	0.046**
9	GROWTH	0.01876	0.067*
10	B4*SPEC	-0.03391	0.203
11	B4*SPEC*RSC	0.00065	0.063*
12	B4*SPEC*RSV	0.00418	0.298
	Obs.	399	
	F-statistic	1.66	
	Prob(*F*-statistic)	0.080	
	Ajd. *R*-squared	0.1297	

In Appendix H.5, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix H.6: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects with sample restricted by firms with non-zero turnover

Panel		**A - Table 4.5 (Panel A)**		**B - Table 4.6 (Panel C)**	
B	Variable	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.06604	0.475	-0.07305	0.424
2	RSC (RESOURCES)	0.00006	0.028**	0.00004	0.094*
3	RSV (RESERVES)	0.00184	0.021**	0.00168	0.038**
4	RSC_GRADE	0.00341	0.922	0.00615	0.860
5	RSV_GRADE	0.10069	0.239	0.10594	0.209
6	LNSIZE	-0.00747	0.000***	-0.00757	0.000***
7	COMM_PRICE	0.00752	0.320	0.00582	0.426
8	LNPAGES	-0.00351	0.319	-0.00362	0.304
9	GROWTH	0.01368	0.009***	0.01357	0.009***
10	B4*SPEC			-0.00176	0.845
11	B4*SPEC*RSC			0.00037	0.081*
12	B4*SPEC*RSV			0.00242	0.294
	Obs.	1403		1403	
	F-statistic	4.48		3.81	
	Prob(*F*-statistic)	0.000		0.000	
	Ajd. *R*-squared	0.029		0.046	

In Appendix H.6, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix I: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects and project location abroad

B	Variable	Coef.	*P>t*
1	C	-0.08065	0.373
2	RSC (RESOURCES)	0.00004	0.084*
3	RSV (RESERVES)	0.00174	0.027**
4	RSC_GRADE	0.00874	0.793
5	RSV_GRADE	0.10611	0.207
6	LNSIZE	-0.00698	0.000***
7	COMM_PRICE	0.00615	0.397
8	LNPAGES	-0.00319	0.285
9	GROWTH	0.01419	0.005***
10	B4*SPEC	-0.00259	0.770
11	B4*SPEC*RSC	0.00038	0.054*
12	B4*SPEC*RSV	0.00245	0.279
13	FOREIGN	0.00210	0.688
	Obs.	1467	
	F-statistic	3.72	
	Prob(*F*-statistic)	0.000	
	Ajd. *R*-squared	0.0466	

In Appendix I, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix J: Ordinary Least Squares regression of intraday abnormal 2-hour buy-and-hold returns on resource/reserve categories, size, commodity price, disclosure levels

Panel		A – Size			B - Specialisation			C – Size and specialisation		
B	Variable	Coef.	*P*>*t*	*F*-stat	Coef.	*P*>*t*	*F*-stat	Coef.	*P*>*t*	*F*-stat
1	C	-0.12813	0.134		-0.11898	0.124		-0.10779	0.155	
2	RSC (RESOURCES)	0.00005	0.021**	4.85***	0.00004	0.039**	4.94***	0.00004	0.042**	4.95***
3	RSV (RESERVES)	0.00050	0.330		0.00112	0.132		0.00107	0.112	
4	RSC_GRADE	0.01882	0.451		0.02093	0.402		0.02226	0.373	
5	RSV_GRADE	0.15426	0.059*		0.14300	0.049**		0.13011	0.067	
6	LNSIZE	-0.00665	0.000***		-0.00659	0.000***		-0.00656	0.000***	
7	COMM_PRICE	0.01253	0.022**		0.01182	0.028**		0.01119	0.036**	
8	LNPAGES	-0.00048	0.898		-0.00114	0.763		-0.00101	0.789	
9	GROWTH	0.01167	0.002***		0.01193	0.002***		0.01179	0.002***	
10	B4	-0.00810	0.120							
11	B4*RSC	0.00002	0.659	0.52						
12	B4*RSV	0.00393	0.353							
13	SPEC				-0.01011	0.097*				
14	SPEC*RSC				0.00024	0.007***	3.92**			
15	SPEC*RSV				-0.00043	0.743				
16	B4*SPEC							-0.00958	0.125	
17	B4*SPEC*RSC							0.00032	0.000***	11.57***
18	B4*SPEC*RSV							-0.00249	0.033**	
	Obs.	1324			1324			1324		
	F-statistic	4.53			5.26			6.96		
	Prob(*F*-statistic)	0.000			0.000			0.000		
	Ajd. *R*-squared	0.0501			0.0629			0.0706		

In Appendix J, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix K: Ordinary Least Squares regression of 2-day buy-and-hold returns on resource/reserve categories, size, commodity price, disclosure levels and reputation effects using a sample for comparison with intraday tests

Panel		A – Size			B - Specialization			C – Size and specialization		
B	Variable	Coef.	*P*>*t*	*F*-stat	Coef.	*P*>*t*	*F*-stat	Coef.	*P*>*t*	*F*-stat
1	C	-0.05529	0.558		-0.03515	0.717		-0.04399	0.647	
2	RSC (RESOURCES)	0.00005	0.107	5.58***	0.00005	0.047**	5.38***	0.00005	0.056*	5.77***
3	RSV (RESERVES)	0.00149	0.071*		0.00150	0.073*		0.00174	0.030**	
4	RSC_GRADE	0.00061	0.987		0.00323	0.928		0.00443	0.902	
5	RSV_GRADE	0.09276	0.287		0.06798	0.446		0.07668	0.384	
6	LNSIZE	-0.00761	0.000***		-0.00766	0.000***		-0.00762	0.000***	
7	COMM_PRICE	0.00951	0.224		0.00872	0.251		0.00781	0.297	
8	LNPAGES	-0.00275	0.538		-0.00239	0.595		-0.00287	0.522	
9	GROWTH	0.01315	0.011**		0.01341	0.009***		0.01303	0.011**	
10	B4	-0.00658	0.405							
11	B4*RSC	0.00010	0.192	2.17						
12	B4*RSV	0.00400	0.076*							
13	SPEC				0.00075	0.934				
14	SPEC*RSC				0.00027	0.146	1.35			
15	SPEC*RSV				0.00190	0.337				
16	B4*SPEC							-0.00092	0.923	
17	B4*SPEC*RSC							0.00037	0.064*	2.38*
18	B4*SPEC*RSV							0.00253	0.269	
	Obs.	1324			1324			1324		
	F-statistic	3.85			3.92			4.24		
	Prob(*F*-statistic)	0.000			0.000			0.000		
	Ajd. *R*-squared	0.0385			0.0476			0.0543		

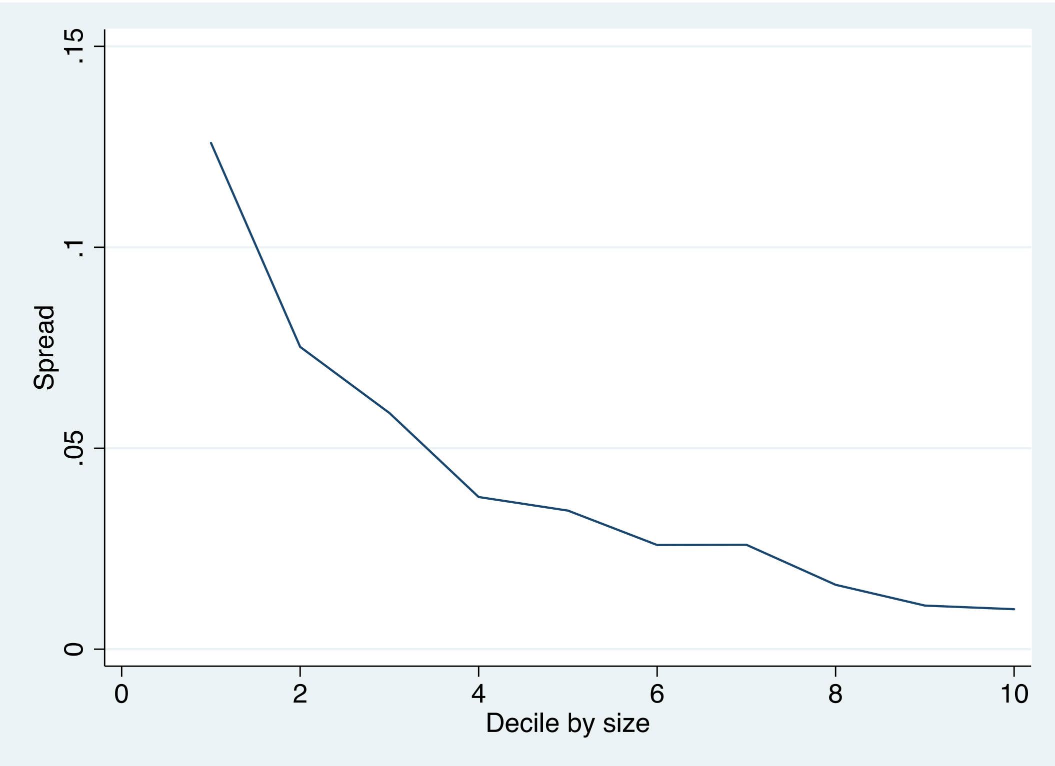
In Appendix K, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix L: Test of reputation with sample divided by size deciles

Appendix L.1: Bid-ask spread by size decile during trading hours

Group	Obs.	Mean
Small Firm	705	0.0684083***
Big firms	486	0.0192712***
Combined	1191	0.0483574***
Difference		0.0491371***

Appendix L.2: Bid-ask spread by size decile during trading hours



Appendix M: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels and reputation effects of technical auditors

Panel		A - Table 4.5 (Panel A)		B - Table 4.6 (Panel C)	
B	Variable	Coef.	*P>t*	Coef.	*P>t*
1	C	-0.07056	0.439	-0.07878	0.381
2	RSC (RESOURCES)	0.00006	0.023**	0.00004	0.087*
3	RSV (RESERVES)	0.00187	0.015**	0.00172	0.029**
4	RSC_GRADE	0.00491	0.882	0.00845	0.799
5	RSV_GRADE	0.09982	0.239	0.10531	0.207
6	LNSIZE	-0.00687	0.000***	-0.00691	0.000***
7	COMM_PRICE	0.00778	0.300	0.00612	0.398
8	LNPAGES	-0.00290	0.333	-0.00306	0.307
9	GROWTH	0.01403	0.006***	0.01382	0.006***
10	B4_SPEC	-0.02774	0.285	-0.00281	0.750
11	B4_SPEC*RSC			0.00038	0.054*
12	B4_SPEC*RSV			0.00243	0.284
13	TECHAUD			-0.02645	0.305
	Obs.	1467		1467	
	F-statistic	4.36		3.83	
	Prob(*F*-statistic)	0.000		0.000	
	Ajd. *R*-squared	0.0286		0.0473	

In Appendix M, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix N: Determinants of choice of geological experts

Appendix N.1: Heckman test

Panel A – First stage Probit choice model, determinants of *B4*SPEC*			
	Dep. Variable	**B4*SPEC**	
B	Variable	Coef.	P>z
1	C	-2.56509	0.383
2	RSC (RESOURCES)	-0.00030	0.231
3	RSV (RESERVES)	-0.03217	0.022**
4	RSC_GRADE	-0.77507	0.102
5	RSV_GRADE	1.85350	0.555
6	LNSIZE	0.09370	0.015**
7	COMM_PRICE	0.28105	0.076**
8	LNPAGES	-0.05749	0.296
9	GROWTH	0.10566	0.343
10	GDP_RANK	-0.04364	0.119
11	LNCAPEX_TA	0.02691	0.721
12	LNDEBT_EQ	-0.30674	0.034**
13	FIRST_DISC	-0.13083	0.498
	Obs.	1467	
	Wald chi2	282.28	
	Prob(chi2)	0.000	
	Pseudo R2	0.04	

Panel B – Second-stage Heckman test			
	Dep. Variable	**LNBHAR2**	
B	Variable	Coef.	P>z
1	C	-0.110427	0.289
2	RSC (RESOURCES)	0.000039	0.012**
3	RSV (RESERVES)	0.001466	0.212
4	RSC_GRADE	0.002697	0.927
5	RSV_GRADE	0.123418	0.088*
6	LNSIZE	-0.006152	0.054*
7	COMM_PRICE	0.007955	0.352
8	LNPAGES	-0.003634	0.343
9	GROWTH	0.015303	0.028**
10	B4_SPEC	-0.002256	0.803
11	B4_SPEC*RSC	0.000382	0.043**
12	B4_SPEC*RSV	0.002430	0.258
	MILLS (lambda)	0.008991	0.633
	Obs.	1467	
	F-statistic	37.8	
	Prob(*F*-statistic)	0.000	
	Ajd. *R*-squared	0.046	

In Appendix N.1, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *z*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

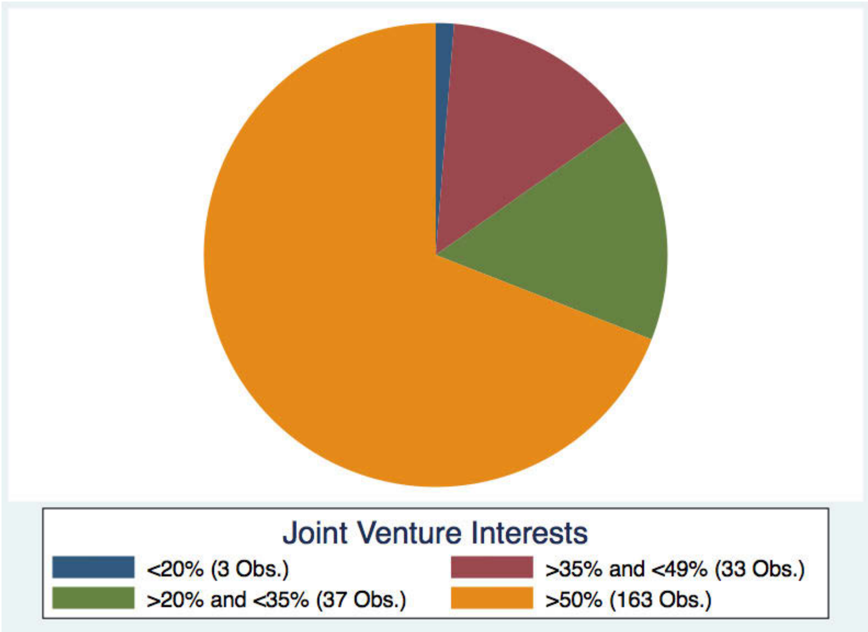
Appendix N.2: Probit regression analysis of geological expert choice on firm size, commodity price, disclosure levels, capital expenditure and extreme high and low gross domestic product per capita

Panel		**GDP low (Undeveloped)**		**GDP high (Developed)**	
B	Variable	Coef.	P>z	Coef.	P>z
1	C	-4.13163	0.000***	-3.63923	0.000***
2	LNSIZE	0.29552	0.002***	0.28561	0.002***
3	COMM_PRICE	0.35957	0.194	0.34301	0.213
4	GROWTH	0.24404	0.387	0.21435	0.450
5	LNDEBT_EQ				
6	LNCAPEX_TA	0.02877	0.865	-0.01752	0.921
7	BAD_NEWS	-0.28558	0.518	-0.23300	0.600
8	DISC_FREQ	0.18926	0.034**	0.18460	0.037**
9	FIRST_DISC	0.29148	0.447	0.22139	0.566
10	GDP_LOW	0.53818	0.052*		
11	GDP_HIGH			-1.06119	0.089*
	Obs.	615		615	
	Wald chi2	24.64		24.51	
	Prob(chi2)	0.001		0.001	
	Pseudo R2	0.063		0.063	

In Appendix N.2, two-tailed tests of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; *t*-statistics are calculated using robust standard errors correcting for heteroskedasticity.

Appendix O: Joint Venture

Appendix O.1: Joint Venture interests



Appendix O.2: Ordinary Least Squares regression of 2-day buy-and-hold return on resource/reserve categories, size, commodity price, disclosure levels, reputation effects and project equity interest

Panel A		A - All metals	
B	*Variable*	*Coef.*	*P>t*
1	C	-0.08451	0.338
2	RSC (RESOURCES)	0.00004	0.076*
3	RSV (RESERVES)	0.00166	0.102
4	RSC_GRADE	0.01036	0.699
5	RSV_GRADE	0.11001	0.111
6	LNSIZE	-0.00703	0.004***
7	COMM_PRICE	0.00578	0.295
8	LNPAGES	-0.00295	0.358
9	GROWTH	0.01401	0.016**
10	B4*SPEC	-0.00294	0.733
11	B4*SPEC*RSC	0.00041	0.031**
12	B4*SPEC*RSV	0.00242	0.268
	Obs.	1467	
	F-statistic	41.02	
	Prob(F-statistic)	0.000	
	R-squared	0.046	

In Appendix O; Two-tailed test of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; t-statistics are calculated using robust standard errors clustered by year correcting for heteroskedasticity.

Appendix P: Ordinary Least Squares regression of 2-day buy-and-hold returns on resource/reserve categories, size, commodity price, disclosure levels and reputation effects by alternative LME spot traded base metals commodity type sample configuration

Panel		A – Table 4.7, Panel A Configuration 1		B – Table 4.7, Panel B Configuration 2	
B	Variable	Coef.	P>t	Coef.	P>t
1	C	-0.04378	0.782	-0.00381	0.983
2	RSC (RESOURCES)	0.00009	0.019**	0.00007	0.041**
3	RSV (RESERVES)	0.00247	0.046**	0.00118	0.434
4	RSC_GRADE	-0.08352	0.407	-0.04049	0.665
5	RSV_GRADE	0.17056	0.211	0.07774	0.637
6	LNSIZE	-0.00540	0.310	-0.00440	0.392
7	COMM_PRICE	0.01611	0.094*	0.01918	0.075*
8	LNPAGES	-0.01882	0.009***	-0.01472	0.039**
9	GROWTH	0.02903	0.047**	0.02359	0.068*
10	B4*SPEC	-0.02630	0.288	-0.04296	0.083*
11	B4*SPEC*RSC	0.00072	0.000***	0.00070	0.000***
12	B4*SPEC*RSV	0.00369	0.079*	0.00506	0.095*
	Obs.	295		320	
	F-statistic	673.78		741.84	
	Prob(F-statistic)	0.000		0.000	
	R-squared	0.196		0.154	

In Appendix P; Two-tailed test of significance are reported: *** less than 0.01; ** less than 0.05; * less than 0.10; t-statistics are calculated using robust standard errors clustered by year correcting for heteroskedasticity.

Panel B – LME Base metals alternative configurations

Configuration 1	Configuration 2
Cobalt	Cobalt
Cooper	Cooper
Nickel	Nickel
Bauxite	Bauxite
Zinc	Zinc
Lead	Lead
	Tin
	Molybdenum
295 Obs.	320 Obs.
20% Total	21% Total