Independently-certified industry-specific disclosures to the capital market: The JORC Code in the Australian mining industry

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Abstract

We investigate the compliance with the Australian JORC Code for the mining industry, the quality of the disclosure and its impact on the Australian capital market. The assessment of compliance and reporting quality is conducted by two experienced geologists. The overall reporting quality has improved in the post-JORC 2012 period. The geologists exhibit varying degrees of (dis)agreement on the extent of improvement and which firms improve the most, which reflects the level of difficulty faced by experts in interpreting the content of JORC reports. Both geologists agree that the greatest improvement is seen in early stage projects, consistent with the expectation that there are more uncertainties surrounding these and the additional information disclosed under the most recent JORC code appears to assist in reducing the uncertainties to some extent.

The capital markets study shows that JORC announcements have a significant impact on investors' assessments of firm value, and that the announcement impact is higher after the 2012 revisions designed to strengthen the disclosure requirements. This is consistent with post-2012 JORC reports conveying higher information content. There continues to be quite significant information leakage prior to announcement date. Further tests show a widening of bid-ask spreads in the post-2012 period, suggestive of higher information asymmetry. While the probability of informed trading declines for large firms, it remains statistically significant for small firms.

1. Introduction

This study relates to the challenge of investor communications in the mining sector which is characterised by high information uncertainties with respect to estimates of mineral resources and ore reserves (the stores of value). The high degree of industry specific (and indeed ore specific) technical knowledge required to assess the value of geological deposits also gives rise to heightened information asymmetry between stakeholders (management, equity and debt holders and, investigating geologists and mining engineers). The net effect of high information risk and information asymmetry presents a challenge for capital formation especially for exploration or smaller companies with a limited production history.

One mechanism to reduce information asymmetry is the *timely* provision of *high quality* information when reporting on geological estimates of mineral resources and ore reserves, with inherently significant uncertainty/risk. Timely disclosure can reduce information asymmetries while high quality disclosure (i.e., transparent disclosure with as minimal uncertainty as possible) can reduce information risk at any given stage of the project. The information risk may not be (and indeed cannot be) eliminated, but high-quality reporting standards can assist in disclosure of the underlying geological findings, and the assumptions underlying the projections of resources and reserves, as well as, the factors (including economic factors) that impact on valuations. The Joint Ore Reserves Committee (JORC) in Australia designed such a code of disclosure in 1988 with the intention to assure best practice translation of geological findings into economic terms. This was a pioneering step soon followed by other countries with significant mining sectors such as Canada (National Instrument 43-101) and South Africa (SAMREC Code[1]).

The JORC Code is the primary disclosure channel for resource and reserve estimates required by the Australian Securities Exchange (ASX) Listing Rules. As part of the ASX's continuous disclosure requirements, information that may potentially influence the perceived value of a mineral deposit must be disclosed via the ASX without delay. The JORC Code has a long history in Australia, with an early version released in 1989 (Bird et al., 2013). Several subsequent amendments have been made to improve reporting consistency and clarity of measurement rigour. The most recent revision was released in December 2012 (and prior to that in 2004). The primary objective of the 2012 changes was to enhance the quality and credibility of disclosure of mining companies with respect to their mineral resources and reserves, in order to reduce information *uncertainty*, as well as, to reduce information *asymmetry* between investors and insiders to the firm. The means of achieving this are increased requirements based

[1] SAMREC is the South African Mineral Resource Committee

on the principles of transparency, materiality and competence. While largely principles based, the requirements are more prescriptive than pre-2012.

An aspect of interest to JORC and the ASX, is the level of compliance with the 2012 changes to the JORC Code and the relevant ASX Listing Rules. If the level of compliance is low and the quality of reporting has not improved, then the impact on the information environment of mining firms is likely to remain unchanged. The twin issues of the degree of compliance and changes in the quality of reporting are explored in Section 5. Further, the changes to the JORC Code in 2012 potentially require more detailed work and longer time periods to completion of the reports underlying JORC announcements. There are several potential effects of these changes on the capital market (i.e., investors). The benefit of reducing information risk for investors and, information asymmetry between stakeholders, may very well come at the cost of delays to information release (albeit with higher uncertainties) and thereby increase the potential for insider trading prior to information release. On the other hand, given this would result in more information being impounded in price prior to information release, it potentially reduces the degree of market reaction around the public announcement date for the same information, and a more muted price drift post-announcement. Section 6 explores questions along these dimensions.

This paper is an investigation into the relevance and usefulness of the JORC Code as a reporting mechanism. First, we engage geologists to assess compliance with the JORC Code and the quality of the content released, based on a sample of JORC announcements. We also analyse whether there is any improvement after the 2012 revisions to the JORC Code. We do find higher compliance and improved disclosure quality after the recent amendments to the Code. However, the two geologists do not always agree with each other on each of these dimensions; this reflects the high level of uncertainty inherent in the exploration and development process. The detailed disclosures of technical information in the announcements do not resolve the inherent uncertainty. Second, we investigate the capital market effects of JORC reporting to find that the news element is higher on announcement date although there continues[2] to be significant news leakage in the pre-announcement window. Further, this paper is the first to establish that the 2012 changes have led to a predictable increase in the *probability* of informed trading.

2. Background to the Disclosure Requirements for the Mining Industry in Australia

[2] Prior research has shown pre-announcement news leakage (see Bird et al, 2013; Clements et al, 2013).

The mining sector is of great significance to the Australian economy and mineral resource explorers and producers comprise a significant proportion of the market capitalization of the Australian Securities Exchange (ASX). The disclosure of mineralised orebodies in Australia is governed by a disclosure code first published in June 1988 by the Joint Ore Reserves Committee (JORC)[3]. The 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves' commonly referred to as the 'JORC Code', has been a mandatory disclosure requirement for all mining firms listed on Australian stock exchanges since July 1989 (Rendu, 2000).

The JORC Code specifies minimum requirements for the public reporting of exploration results, mineral resources and ore reserves in an industry characterised by high uncertainty with respect to relevant estimates important for valuation. It provides a system for classifying tonnage and grade estimates taking account of geological confidence levels and technical or economic factors. Figure 1 illustrates the progression of geological certainty surrounding a given orebody. Resources differ from reserves in that the latter are deemed to carry economic value, and thus represent the economically minable portion of an identified resource. The categories 'inferred', 'indicated', and 'measured', with respect to resources, and 'probable' versus 'proved' for reserves, represent the level of certainty regarding the tonnage, grade, densities, and mineral content. For example, 'inferred' with respect to resources denotes low certainty, while 'measured' is characterised as having high certainty. Thus, the Code stipulates minimum geological reporting requirements, which need to be interpreted in the context of their stage of certainty. Further, while resources may not be economically minable, they may still carry significant value, by virtue of their potential as future reserves (Rudenno, 2012).

The disclosure requirements in the JORC Code are principles based; the basic underlying principles are transparency, materiality and competence in reporting to the public. Due to the unique nature of each ore body, the view has been taken that the disclosures provided should suit the individual features of each location, with materiality being an important consideration. The JORC Code has undergone several revisions since its first introduction in June 1988, with each revision strengthening the requirements and definitions of key concepts. Since 1992 the JORC Code has specified a checklist identified *within* it as 'Table 1' (henceforth, '*JORC Table 1*' to avoid confusion with Table 1 in this paper) currently entitled 'Checklist of Assessment and Reporting Criteria' as a frame of reference for the type of criteria to be considered in the preparation of disclosures pursuant to the Code. Revisions made to the Code

[3] JORC is a joint committee of the Australian Institute of Mining and Metallurgy (AusIMM), the Mining Council of Australia (MCA), and the Australian Institute of Geoscientists (AIG) with the latter joining in 1992 (Stephenson, 2000).

in 2004 also introduced the requirement JORC reports to be prepared and signed off by a (defined) 'Competent Person'[4], thus introducing additional reporting independence. The 'competent person', who is responsible for allocating categories to estimates of mineral resources and ore reserves.[5]

Summary of the Changes to the JORC Code in 2012

The 2012 Edition of the JORC Code was released on the 6th February 2013 accompanied by changes to Chapter 5 of the ASX's Listing Rules (and related Guidance Notes 31 and 32). It became effective for all publicly listed companies from the 1st December 2013 with earlier adoption encouraged.[6] The changes are intended to ensure consistency with international reporting developments and ensure confidence in public reporting by circumventing some inconsistent application by companies of the 2004 JORC Code. The then Chairman of JORC, Peter Stoker, stated that the changes were designed to improve:

> *"the minimum standard for a Public Report to include the release of much more of the material information about Exploration Results, about the estimation process for Mineral Resources and Ore Reserves and about the material factors that could impact upon the investors' understanding of the minerals project."*

The 2012 Edition introduced an annual reporting requirement, as well as, materially increased the reporting obligations for mining and exploration companies on several key disclosure items. These include a higher level of prescription and a greater emphasis on the definition of terminology. It introduced more specific disclosure of methods and techniques, as well as, the consent of the competent person who prepared the same. The requirements for data underlying disclosure of highly uncertain estimates were strengthened, and the conversion of resources to reserves now requires companies to perform feasibility studies taking account of a myriad of factors, including operational, economic and financial ones. The changes also align the definitions in the JORC Code for categories of resources and reserves with those contained in the template of the Committee for Mineral Reserves International Reporting Standards (CRIRSCO). Main differences between the 2004 and 2012 Editions of the JORC Code include the revised 'JORC Table 1', historical and foreign estimates, production targets, annual report requirements, competent person consent, and a preliminary feasibility study or feasibility study as detailed in JORC (2013). While the ASX and JORC were supportive of these changes, others

[4] Competent persons are required to be members of a recognised professional body and to have a minimum of five years of experience in a relevant mineralisation.
[5] Stephenson and Stoker (2014) offer contrasts of such requirements between Australia and other countries.
[6] There was one exception to this – the requirement for a pre-feasibility or feasibility study to be completed to declare an ore reserve came into effect on 1 December 2014.

believed that the stricter requirements for the disclosure of production targets would hinder capital-raising especially in the case of junior exploration companies (Palethorpe, 2014).

A detailed tabulation of the differences between the 2004 and 2012 Editions of the JORC Code is available in JORC (2013) and we summarise the main changes in the Code, and relevant concurrent changes to ASX Listing Rules in Appendix 1.

3. Research Questions

We conduct two studies. The first study (the 'Quality of Disclosure Study') is a detailed survey of a sample of JORC announcements conducted by two experienced geologists to ascertain the level of compliance with the letter and spirit of the JORC Code and whether the 2012 changes did improve the quality of disclosures.

The second study (the 'Capital Marker Study') investigates whether the 2012 amendments to the JORC Code had an impact on the capital markets effects of JORC-related announcements on the ASX. Here we study (i) changes in abnormal returns, abnormal volumes and bid-ask spreads to ascertain whether there is pre-announcement information leakage, (ii) whether information asymmetry is reduced by such announcements, and (iii) whether the probability of informed trading had changed.

4. Samples for the two studies

We seek data for all companies in the 'metals and mining' sector (GICS 151040 group) for the period 2003 through to 2014, a period encompassing the recent mining boom and the significant changes made to the JORC Code in 2012.[7] This industry group accounted for 9.5 per cent of the total market capitalization on the ASX as of 31 December 2014, mostly concentrated in 21 of the largest firms (Appendix 2).

Sample for Study 1: Quality of Disclosure Study

We download mining sector company announcements to the ASX for the years 2003 to 2014 from the Australian Company Announcement (ACA) database housed at SIRCA. The announcements are classified by SIRCA into groups identified by a numerical code which corresponds to announcement type.[8] We obtain 153,137 announcements of which the largest category is '*Progress Reports*' with 36,081 announcements between 2003 and 2014; reports containing geological and otherwise JORC related information are a major proportion of these

[7] These changes were effective (mandatory) in calendar 2014, although they available for early adoption in 2013.
[8] We encountered some announcements which lacked categorization codes. As such, the figures we report only include announcements with at least one associated categorization in the database.

'progress reports'. Table 1 also provides a breakdown of the other categories.[9] To further refine the sample to 'JORC only' announcements, we again draw upon the Australian Company Announcements (ACA) database via more refined keyword searches. Our initial sample based on the keyword searches 'JORC' and 'Joint Ore Reserves Committee' yielded 9,212 announcements between 2003 and 2014.

Since the assessment of compliance and quality is labour intensive requiring the services of suitably experienced geologists, it is not possible to study all reports from the entire 2003-2014 period at reasonable cost. The sheer volume of JORC related announcements on the ASX as required us to restrict our survey sample. Therefore, we restrict ourselves to reports issued in 2011, that is, prior to the 2012 changes, or the 'pre-period'), and in 2014 (the 'post-period'); we refer to this set of announcements as the 'restricted sample'. We further reduce the sample to a manageable set of 50 announcements in each of the pre- and post-periods, to form a sample of 100 reports (the 'test sample'). The two geologists independently assess each of the 100 reports, allowing us to subsequently calibrate inter-rater reliability.

The process of deriving the 'test sample' of 100 reports (50 in each of the pre- and the post-period) from the 'restricted sample' of announcements made in 2011 and 2014 is depicted in Figure 2. The procedure is an effort to isolate announcements that have either (a) a large (positive or negative) announcement day share price effect (a news element), or (b) no appreciable announcement day effect. Thus, we try to capture announcements with 'news' and 'no news'. The exact process followed as depicted in Figure 2 is described here:

1. We calculate the 'Daily Abnormal Share Returns' for all JORC related announcements in pre- and post-periods surrounding the 2012 changes to the JORC Code (i.e., for the years 2011 and 2014).
2. Within each of the time periods (2011 and 2014) we rank the abnormal returns and divide them into deciles, with 'Decile 10' containing announcements with the most positive abnormal returns and 'Decile 1' containing announcements with the most negative daily abnormal returns.
3. Based on the decile rank of the JORC announcements within each time period, we randomly draw 50 JORC announcements. We draw 15 announcements in each of deciles 1 and 10 (most negative and positive, respectively), and 10 announcements in each of deciles 5 and 6 (smallest size of abnormal returns, irrespective of sign), as

[9] A full listing of announcement categories may be found at:
http://datanalysis.morningstar.com.au/licensee/datpremium/html/ASX_Announcements_Onesheet.pdf

shown in Figure 2. Thus, we end up with 50 JORC announcements for each of the pre- and post-2012 periods.

Sample for Study 2: Capital Market Study

Our sample spans the period from January 2003, which marks the first full calendar year following the introduction of the Global Industry Classification Standard (GICS) system in Australia, to December 2014. We obtain stock price data from the Merged Share Price - Price Relatives (SPPR) database maintained by SIRCA, and accounting data from Morningstar (formerly Aspect-Huntley). Analyses requiring the use of daily trading information, including returns, volume and, the number of trades, are based on data from Core Research Data (CRD). Intra-day trade data for tests into the probability of informed trading is sourced from the Thomson Reuters Tick History (TRTH). A dataset of JORC related announcements is sourced from the SIRCA database Australian Company Announcements (ACA), through a search on the terms "Joint Ore Reserves Committee" and "JORC. [10]

5. Study 1: Quality of JORC Disclosures post- vs pre-2012

The focus of this paper is on JORC reporting as an important subset of information disclosure in the mining sector. We investigate compliance with the JORC Code and the quality of associated announcements. Here we are assisted by two geologists[11] to assess the compliance with, and quality of, JORC related disclosures in our announcements sample, and any change in quality after the 2012 changes to the Code.

5.1 Methodology

Geologists' Assessment Template

The two geologists employed for this study developed an 'Assessment Template' ('the Template') to calibrate the level of compliance and the quality of JORC announcements in the sample. The criteria used in the Template for assessing compliance and disclosure quality were subjected to several rounds of scrutiny by industry specialists and were field tested by the

[10] We follow the approach in Katselas, Sidhu, and Yu (2015) to create a link table enabling a near perfect match between the Aspect accounting database and returns data per SPPR, or any data source based on historical identification. This also applies to the ACA data on company announcements.

[11] The two geologists were identified with the help of AusIMM and JORC, together with advice from Mr. Peter Stoker, principal geologist at AMC Consultants (Brisbane) and at the time Deputy Chairman of the JORC. At time of commencement of this project and our initial meetings with him, Peter Stoker was the Chair of the JORC. Mr. Stoker has played an active role in the development of disclosure requirements in the JORC Code and, an active advocate of similar developments at the international level.

geologists engaged in this project.[12] The final Template is presented in Appendix 1. It comprises an Assessment Summary for scores from four more detailed sections as follows:

Part 1: JORC Compliance comprising overall compliance and compliance with a checklist based on *JORC Table 1* both pre- and post-2012.

Part 2: Further Scientific Rigour / Integrity

Part 3: Effective Communication, and

Part 4: Impact and Context.

Parts 1 to 3 focus on the quality of information disclosed by companies in their JORC announcements while Part 4 shifts the focus to the broader context under which the JORC announcements are made. Each geologist was required to complete an assessment of each of the reports in our sample, after reading through all the material provided in the selected JORC announcements. Each was required to give a score for each relevant section, as well as, their confidence levels (on a scale of 1 to 3) with respect to each score. A member of the research team then checked each geologist's responses for completeness[13] and coded the same for analysis. The confidence-weighted score (WScore) takes into consideration the confidence level by weighting the raw score by the confidence level. Each of the raw scores is multiplied by the percentage of the confidence level to the maximum confidence level (3) to derive the confidence weighted score. For example, a raw score of 3 with a confidence level of 2 will have a confidence weighted score equals to 2 (3 * (2/3)).

5.2 Results of the survey on compliance and quality of reports

To analyse survey responses from the two geologists, we partition firms into size-based quartiles (by market capitalisation). Quartile 1 (4) comprises the smallest (largest) firms. Tables 2 to 4 show the average raw scores as well as the confidence-weighted scores given by two geologists for Part 1 regarding 'JORC Compliance', Part 2 regarding 'Further Scientific Rigour' and Part 3 regarding 'Effective Communication', respectively.

The results across all three tables suggest an overall improvement in compliance across all size quartiles in the post-period (2014) compared to the pre-period (2011) based on both raw

[12] The industry specialists consulted in the development of the assessment criteria included: Jon Barber (Jon Barber Mining Consultants, Sydney); Richard Evans (Professional Geologist at Minerals Industry Analysis & Advice, Melbourne); Margaret Fairhurst (Professional Geologist at OREVAL); Peter Stoker (Principal Geologist, AMC Consultants, Brisbane and Deputy Chairman JORC); Carlos Tapia Cortez, Serkan Saydam and Wendy Timms (all from the Department of Mining Engineering, UNSW).

[13] Where we found incomplete responses, we double checked back with the geologists that this was an omission due to the lack of information rather than to omission by mistake. The former are coded as missing values.

and confidence-weighted scores. However, the size of the improvement in compliance is inconsistent between the two geologists across these size partitions.

The scores from the first geologist (G1) show that the level of improvement is significantly higher for small firms (quartile 1) and medium size firms (quartile 3) than for large firms (quartile 4) as measured in the raw scores, while the confidence weighted scores indicate that it is the smallest firms that improve the most. The second geologist (G2) believes that the highest level of improvement comes from medium size firms (quartile 2 and 3); the differences are statistically significant when measured using the confidence weighted scores.

The final panel on the right-hand side of each of Tables 2 to 4 shows the differences in scores between the two geologists, and the p-values from t-tests for differences from zero. While most of the differences are not statistically significant, the small sample precludes us from making any strong statements on inter-rater reliability based on these alone.

Results from the Assessment Summary: Review Assessment Total

The 'Review Assessment Total' score is a weighted average score across each type of score for Parts 1 to 3 of the Template, and previously discussed (Tables 2 to 4). The weights applied to each Part are as follows: Part 1 (JORC Compliance) is weighted 50 per cent, while Part 2 (Further Scientific Rigour) and Part 3 (Effective Communication) are weighted 25 per cent each, on the advice of the specialist team who built the Template. This weighted average score is intended to convey an overall idea of the level of compliance with the JORC Code and reporting quality. Table 5 reports two measures of the 'Review Assessment Total' score: (i) a weighted raw score and, (ii) a weighted average of confidence-weighted scores:

(i) the weighted raw score (labelled as 'Score' in Table 5 is calculated as the weighted average score from Parts 1, 2, and 3 of the Template (labelled the 'Review Assessment Total') as shown on the "Assessment Summary" page.

'Score' = Score(Part1)*0.5 + Score(Part2)*0.25 + Score(Part3)*0.25.

(ii) the weighted average of confidence-weighted scores (labelled as 'WScore' in Table 5) is calculated using the confidence weighted scores from Parts 1, and 3 on the "Assessment Summary" page.

'WScore' = WScore (Part1)*0.5 + WScore (Part2)*0.25 + WScore (Part3)*0.25

Descriptive statistics for each measure of the overall score are presented in Table 5. The scores from both geologists, G1 and G2, show improved overall scores for compliance and quality of disclosure using either weighted score. As with their individual responses for Parts 1 to 3, the two geologists show different improvements by size category.

Geologist G1 finds that firms in quartile 1 and 3 experience the highest and statistically significant level of improvement in the post period based on the raw scores. When taking into consideration the confidence level, firms in quartile 1 experience the highest statistically significant level of improvement. For G2 however, responses suggest that mid-size firms (quartiles 2 and 3) experience the highest statistically significant level of improvement in the post period compared to either very large (quartile 4) or very small (quartile 1) firms.

Overall, the responses from Parts 1 to 3, and reflected in the Review Assessment Total provide evidence that there is an overall improvement in the reporting quality of JORC announcements in the post-2012 period.

Results from the Assessment Summary: Impact and Context - Overview

Responses to the questions in Part 4 (Impact and Context) of the Geologists' Assessment Template provide the judgements of the two geologists on the broader contextual evidence which can help us understand our previous results, as well as, further understand the valuation implications of the reports sampled. To provide some preliminary evidence on the internal validity of our survey instrument as well as the responses from our two geologists, Table 6 presents the Pearson correlation matrix for the geologists' responses to the questions in Part 4. Geologist G1 is represented in the lower diagonal and G2 in the upper diagonal.

Results from this correlation matrix show that our instrument and the responses from the two geologists maintain strong internal validity. In terms of the stage of the project (Q1), the correlation table shows that for early stage projects, it is more difficult to assess their project values (Q2); the information presented will be more speculative (Q3), less promising (Q4), and more preliminary (Q7); and they exhibit higher levels of geological (Q5) and contextual (Q6) uncertainties. Q8 through Q12 of Part 4 relate to the valuation of the project. The correlations between the responses to these are mostly statistically insignificant, reflecting the relatively high level of difficulty for geologists to assess valuations given the information presented in the sample reports. Similarly, for the last two questions (Q13 and Q14) on whether the project is described more optimistically or pessimistically, the judgements on these questions could be relatively more subjective compared to the previous questions of Part 4. As a result, we do not form explicit expectations for the correlations between these two questions and the rest of the questions in Part 4 and observe mostly insignificant correlations.

Results from Part 4: Impact and Context - Question 1 Stage of the Project

Figure 3 presents summary statistics for the first question of Part 4 regarding the stage of the project being assessed. The upper two panels display the average raw scores and the

confidence weighted average scores for each of 2011 and 2014. A lower (higher) score indicates a relatively late (early) stage project. The lower panels display histograms of the frequency distributions of early- through to late-stage project reports by size-quartile for 2011 and 2014. Each histogram shows the distribution of judgements made by the two geologists, G1 and G2, with each bar showing different colours for three different levels of confidence.

In the top two panels, the confidence weighted scores indicate that the judgements of each geologist across the two-time periods are similar (with respect to stage of project). For example, G1 has a confidence weighted score of 3.97 in 2011 compared to a score of 4.00 in 2014, while G2 scores project reports in 2011 at 3.22 relative to 3.43 in 2014.

However, when tabulating their frequency distributions based on size quartiles of disclosing firms, the responses exhibit relatively low inter-rater consistency as suggested by the relatively low Cohen's Kappa Statistic[14]. Further, while the inter-rater reliability of the raw scores decreases from 2011 to 2014, the inter-rater reliability on the confidence weighted scores increases (the Kappa Statistic for the confidence weighted scores is slightly higher in 2014). In addition, the frequency distributions indicate that the two geologists are overall more confident about the assessment they gave in 2014 as suggested by the increased proportion of the green shading in each bar, where green indicates a moderate level of confidence (confidence level 3, the highest level of confidence on a scale of 1 to 3).

Summary

Section 5 maps the development of the geologists' assessment template, our sampling procedure to obtain the pre- and post-period (2011 and 2014, respectively) samples of JORC reports, and how we assess any shift in the quality of reporting around the 2012 changes.

We report a significant improvement in reporting quality on several dimensions (Part 1 to Part 3 of the template), including JORC compliance, further scientific rigour and effective communication, after the 2012. After disaggregating the sample into four groups based on firm size, the judgements of these two geologists on the quality of the reports sometimes diverge. Overall, G1 shows that the group of smallest firms experience the highest level of improvement in the post-period whereas G2 shows that the group of middle size firms (quartiles 2 and 3) experience the highest level of improvement in the post-period.

[14] One classic paper on defining the relative strength of agreement using the Cohen's Kappa Statistics is by Landis and Koch (1977) where they define 'Poor' agreement as having Kappa Statistic less than 0; 'Slight' agreement as having Kappa Statistic between 0.00-0.20; 'Fair' agreement as having Kappa Statistic between 0.21-0.40; "Moderate' agreement with Kappa Statistic between 0.41-0.60; 'Substantial' agreement with Kappa Statistic between 0.61-0.80; and 'Almost Perfect' agreement with Kappa Statistic between 0.81-1.00.

The questions developed in Part 4 emphasize on the broader environment under which the JORC reports are disclosed rather than on the quality of each report as in Parts 1 to 3. We find reporting quality tends to increase the most in the post-period for projects in the early stage compared to projects in the mid- and the late- stages. This is consistent with our expectation that there are more uncertainties around projects in the early stage and additional information disclosed under the most recent JORC code appears to assist in reducing the uncertainties to some extent. The inconsistent assessments between the two geologists on Parts 1 to 3 highlight the level of difficulty faced even by the experts in the area when evaluating the quality of the information disclosed in the JORC report. The overall picture is increased geologists' confidence in making judgements under the most recent version of the JORC code.

6. Study 2: Capital Market Study

While the revisions to the JORC Code have introduced further refinements to the disclosure of mining ore reserves, they have also potentially led to longer time delay between discovery and disclosure. We know from prior work on the capital market effects of disclosure regulations, that slowing down disclosure can lead to a 'chilling effect' increasing information asymmetry between stakeholders, slower price discovery and an increase in the probability of informed trading. In this second study, we investigate the impact of the 2012 changes to the JORC Code on price discovery, the probability of informed trading and signs of information leakage prior to JORC announcements.

6.1 Descriptive Statistics on Liquidity in the Australian Mining Sector

A significant majority of firms in the mining sector are very illiquid stocks, with a small number of large firms accounting for substantially all the liquidity in the sector. Figures 4a to 4c depict time series evidence on several common proxies for liquidity. We partition firms into large, medium, or small based on market capitalisation, based on whether they fall above the 70^{th}, between the 30^{th} and the 70^{th}, or below the 30^{th} percentile, respectively.

Figure 4a plots the monthly number of trades per firm, and we observe a striking difference between the partition with the largest firms and the remaining two groups. In 2014 for example, the largest 30% of firms by market capitalisation, trade approximately 1250 times per month on average, while the group with the smallest firms experienced perhaps one trade each day.

Another measure of market liquidity of firms is the bid-ask spread. The spread imposes a cost on each transaction as a price protection in the event of poor liquidity and against the

probability of trading with another possessing more precise information about firm value. It is a common proxy for the degree of information asymmetry surrounding a stock's true value.[15] We see from Figure 4b that the spread is consistently higher among small firms across all time periods. The low trading activity in the stocks of small and medium firms is reflected in the wider spread as price protection against poor liquidity. The spreads for large firms comprise approximately 2 per cent of a firm's stock price. These increase significantly only during several times over the period of observation, most notably being a rise to just above 5 per cent of a firm's share price, on average, during the financial crisis period. At the other extreme, small firms show marked variation in spreads over the period, hovering around 10 per cent at a minimum, and spiking to above 40 per cent of share price in 2008.

Amihud (2002) offers another measure of illiquidity calculated as follows:

$$ILLIQ_{it} = 1/60 \sum_{d=-60}^{-1} |R_{it}|/VOLD_{it} \qquad \text{Equation 1}$$

were, R_{it} is the daily stock return, and $VOLD_{it}$ is the daily dollar volume. This ratio represents the absolute return per dollar of trading volume, with the mean taken over the prior 60 days. A larger number suggests lower liquidity since it reflects a larger change in price (i.e., a larger return) per dollar of shares traded. This ILLIQ measure daily is plotted in Figure 4c[16],[17]. Again, we see that small firms consistently have lower liquidity (a higher number on ILLIQ) relative to medium and large sized firms. Larger firms attract greater public attention and enjoy higher visibility, a greater flow of information, and attract large institutional investors.[18]

6.2 Capital Market Reactions to Various Announcement Types

We investigate the capital market announcement effects by reporting 3-day cumulative abnormal returns (CAR) around all announcements for which we have data from SIRCA. We proceed with a market model approach to ascertain abnormal returns, before cumulating over the 3-day window around each announcement event. In doing so, we perform the estimation using data from t-120 to t-20 relative to the announcement date, from which we calculate abnormal returns (AR) as follows:

[15] A large literature cites factors such as inventory holding costs, stock return volatility, and firm size as being closely associated with a firm's stock liquidity, and its bid-ask spread (Huang and Stoll, 2001).
[16] Each data point representing a 60 day backward arithmetic mean of $|R_{it}|/VOLD_{it}$.
[17] For the purpose of plot, we exclude firms with a share price less than $1, and trim the distribution at the 1% and 99% percentiles of the construct ILLIQ.
[18] The ILLIQ measure is also an indicator of disagreement between investors over firm value (Harris and Raviv 1993; Amihud 2002). In particular, investor agreement about new information may prompt price changes without trade necessarily occurring. An increase in trade volume however, indicates disagreement (i.e. both the buyer and seller to a transaction possess heterogenous beliefs).

$$AR_{i,t} = R_{i,t} - (\alpha_i - \beta_i R_{m,t}) \quad \text{Equation 2}$$

Where, $AR_{i,t}$ is the error upon regressing each firm's return ($R_{i,t}$) on a market proxy, which in the current case, involves returns on the ASX300 Metals and Mining index ($R_{m,t}$). α_i and β_i are the parameters estimated by the model. We obtain daily returns for the mining companies for which we have announcement data, from Core Research Data (CRD) from SIRCA. We rank the announcements each monthly based on the value of announcement date CARs (a measure of announcement 'surprise'). We then divide the ranked sample into deciles; announcements with the most positive CARs in decile 1 to the most negative in decile 10. At this stage, we utilise all announcements, and winsorise the distribution at the 1st and 99th percentiles.

Table 7 summarises each type of announcement by size of CAR decile. The table offers insights into the nature of information likely to have the largest effect on returns surrounding the announcement. In other words, we delineate the announcements which led to the greatest 'surprise' *ex post*, as a means of identifying the announcements which prompted surprises upon announcement. In all, we have 203,307 surprises, and the CARs across the distribution of these range from a mean of -16.94% for decile 10 (most negative surprises), to a mean of 19.74% for decile 1 (containing the most positive surprises). Observation of these mean values, and un-tabulated results indicate that the distribution is right skewed, indicative of a bias towards positive surprises over our period of investigation. The table summarises the proportion of eight announcement types, comprising those often cited in the literature as being relevant to firm value, and announcements of direct relevance to this report. *BSH* and *CSH* denote the proportion of announcements regarding an investor becoming a substantial shareholder, or ceasing to be a substantial holder, respectively. The *EARN* column contains the proportion of earnings announcements, with *PP* and *PI* providing data on announcements of private placements and public issues, respectively. The columns labelled *ASX*, *PR* and *DIR* present the proportion of announcements related to *ASX* initiated announcements relevant to the company, progress reports, and announcements regarding director changes. Remaining announcement types are grouped as 'other' announcements.

Notably *EARN*, which hovers around the 14 per cent mark in any decile, fails to show any discernible pattern across surprise deciles, indicating a degree of symmetry in the importance of the conveyed signal over our window. Announcements initiated by the ASX (labelled 'ASX') show concentration at the extreme deciles, suggesting that such announcements (which include ASX queries[19]) are price sensitive. This category, however,

[19] An ASX query may occur where, for example, unusual trading activity takes place and the ASX asks the company where, to its knowledge, there may be undisclosed information behind the activity.

does not include notification of trading halts, suspensions, or notification of official listing; which fall under different classifications in the database.

The *PR* (Progress Reports) column represents the single most frequent announcement type for mining companies (as previously seen in Table 1).[20] The proportion of PR announcements is highest at the top and bottom deciles (which contain the largest announcement surprises). Progress Reports typically contain information pertaining to geological information, and so include largely JORC related information which is relevant to the valuations of mining firms. The proportion of firms in this column is similar to that for EARN (earnings announcements), and each of these announcement types comprise the majority of announcements. Thus, it is reasonable to assume that not only do such reports comprise a major proportion of all disclosures of mining companies; they also represent about 25% of all announcements in the highest surprise decile, based on any announcement.

The *Price Sens* column indicates the proportion of announcements flagged by the ASX as price sensitive. The distribution conforms to a 'U' shape, with 42.51 per cent flagged as price sensitive in decile 1, and 35.14 per cent in decile 10. In un-tabulated analysis within the sample of PR announcements alone, the price sensitive proportion increases dramatically across all deciles, with a maximum of 85.42 per cent of announcements in decile, being flagged as price sensitive.

In summary, this section establishes that JORC reporting does impact on price as observed in the CAR around announcement dates.

6.3 Capital Market Effects of JORC Announcements: pre- vs post-JORC 2012

We next compare the capital market effect of JORC announcements pre- and post- the changes in 2012. A growing body of research examines the capital market effects of geological reporting in Australia (Bird *et al*. 2013; Ferguson *et al*. 2013; and Clements and Li 2014). We add to this literature by considering market microstructure implications, which allows us to draw inferences about the change in the information environment in a more nuanced way. The literature we draw upon includes Bollen, Smith and Whaley (2004), and Sidhu et al (2008). The latter examines the probability of informed trading (PI) both before and after the introduction of Regulation Fair Disclosure (Reg FD) in the United States. This regulation fundamentally changed the information exchange between companies and the analysts following a firm. In

[20] The 'Other announcement' column indicates a large proportion of announcements are from categories not reported in Table 4.3. There are almost 200 actively used categories of announcements in SIRCA. Outside of the Top 20 reported in Table 4.2, the percentages drop rapidly to a fraction of a percent representation per category.

particular, it prohibited private communication between these parties without simultaneous public disclosure. Sidhu et al (2008) find that rather than enriching the information environment by requiring public disclosure of private information, Reg FD instead caused a 'chilling effect'. This in turn led to private information persisting for longer, and an increased probability of informed trading, contrary to what the regulators intended. Given that the objective of JORC 2012 is to improve transparency, we adopt the approach in Sidhu et al (2008). In this section we examine the behaviour of stock returns and trading volume around JORC announcements in the period after the 2012 changes to the JORC Code relative to the pre-2012 period.

Cumulative abnormal returns during t-20 to t+10 days around JORC announcements

We first examine the behaviour of returns surrounding JORC announcements, both before and after JORC 2012. We start with our 'surprise' portfolios or deciles (based on CARs) presented in Table 4.3 to create three categories of 'positive' (deciles 1 to 3), 'none' (deciles 4 to 7), and 'negative' (deciles 8 to 10), to denote positive surprises, no surprises, and negative surprises in the manner of Ball and Brown (1968).[21] Setting the index at 1 at t-20 relative to the announcement for each firm, we proceed to cumulate daily abnormal. This is not unlike the approach taken by Bird et al (2013) and Clements and Li (2014). We take the approach in Ball and Brown (1968) to use a return index, since this provides an intuitive visualisation of the changes in returns over the period of interest. We calculate the overall mean for each day from days t-20 to t+10, separately for the negative, positive, and zero surprise firms. The partitions allow us to track stock behaviour leading up to, and following the announcement separately for each of these groups.

We present these results for the pre-2012 period in Figure 5a while the post-2012 (results are shown in Figure 5b. In Figure 5a, the announcements which prompt low or no announcement effects (line with the longer dashes), experience little drift both prior to and after the announcement. Firms with negative surprises (the solid line in Figure 5a) on average experience a gradual decline from the t-20 conditioning day, and a more rapid decline in the days leading up to the announcement. Those with positive announcement reactions (line with shorter dashes) exhibit notably negative cumulative abnormal returns between about t-10 to t-3, before turning positive through to t+1 and then remaining flat. While this provides some evidence that traders anticipate the announcement tone accurately several days prior to the announcement, we return to this observation shortly with additional microstructure evidence.

[21] Firms with a market capitalisation in the bottom 10% of the distribution in the month of the announcements are removed from the sample, and as stated earlier, we truncate our distribution at 1% and 99%, according to the 3-day CAR.

Figure 5b isolates announcements occurring during the period 2013-2014, after the release of JORC 2012. First, the mean abnormal return in the days immediately surrounding the announcement, for positive reaction events (line with shorter dashes), is approximately 7 per cent. For both positive and negative reaction announcements, we witness some reversal in abnormal returns in the days between t+1 to t+5, providing evidence of an initial market overreaction at both ends of the reaction distribution.

Cumulative abnormal volume during t-20 to t+10 days around JORC announcements

Figure 6a displays for pre JORC 2012 period the abnormal trade volume around announcements again for portfolios of positive, negative and no news. We estimate abnormal volume as the difference between daily dollar volume and, expected volume (calibrated as the mean daily volume from days t-100 to t-20). To understand the build-up of volume around the event, we cumulate abnormal volume from t-20 to t+10, surrounding the announcement date.

We see that JORC announcements in portfolios which carry new information (positive and negative news portfolios denoted by the shorter dashed and solid lines, respectively) also experience a build-up of abnormal trade volume for at least the 10 days prior to the announcement. The magnitude of this build-up is striking; 200 per cent for negative reaction announcements, and 160 per cent for positive reaction announcements. Evidently, abnormal trading takes place well before the announcement date, in anticipation of the impending news.[22] Some potential explanations are (a) there are active traders aware of the forthcoming announcement information at least from t-20, or (b) mining analyst recommendations in anticipation of the information may also play a role (Brown, Feigen and Ferguson 2014).

Figure 6b presents results for the post-2012 period. Abnormal volume preceeding positive news declines and, increases in the 2 days prior to the announcement. Liquidity in these firms evaporates significantly, before increasing to around the t-20 level following the announcement. In contrast, reactions to negative news follow a similar path to that in Figure 6a, before levelling off at about 4 times above abnormal volume. Anecdotally, JORC 2012 succeeded in curbing abnormal trading prior to positive news announcements, but not for negative news announcements. Alternatively, it is possible that abnormal trading in relation to upcoming positive surprises is undertaken more discreetly, or over a longer period of time preceding the t-20 day period.

Differences in announcement abnormal returns post- vs the pre-JORC 2012

[22] Announcements are cleaned to ensure minimal contamination by other announcement events which may preface the information. In particular, we remove JORC announcements which fall on the same day as other announcements, or have more than one JORC announcement during our window of interest.

Next, we provide statistical evidence on the differences in announcement abnormal returns pre- vs. post- JORC 2012. We measure the JORC announcement effects as the cumulative squared residuals from the market model. This serves the purpose of capturing the magnitude of the effect, irrespective of the sign since we have no expectation model to categorize the ex-ante effect of a given JORC announcement. The intention is to provide evidence on whether JORC 2012 alters the incidence of information leakage prior to the release of geological reports.

The left-hand margin in Table 8 presents the squared abnormal returns[23] for the following three windows around announcement date: (i) the pre-event period (days t-20 to t-2 relative to the announcement); (ii) the event period (days t-1 to t+1); and the post-event period (days t+2 to t+10). Within each of these three windows, results are presented first for all announcements, then separately for small, medium and large firms. The firm size partitions are based on ASX market capitalisation breakpoints (at the 30th and 70th percentiles) at the time of the announcement, with partitions re-formed monthly. The columns in Table 4.8 show the number of firms in each size category and relevant squared abnormal returns both pre- and post-JORC 2012.

Differences in the squared abnormal returns between pre-JORC 2012 and post-JORC 2012 for the pre-announcement period (t-20 to t-2) are significant and negative for all sized firms under investigation. In short, these unconditional tests of differences fail to provide any clear indication that the introduction of JORC 2012 reduced pre-announcement information leakage, based on an abnormal return setup.

The 'Event' period test results are consistent with the JORC reports providing higher information content post-JORC 2012 relative to the pre-JORC 2012. Post-JORC 2012 shows a significant increase in abnormal returns, relative to before the change, albeit to a lesser extent for large firms. This is encouraging news for the proponents of the new regime, as it suggests that the information, upon release, carries a greater impact than previously. The smaller effect for large firms is not surprising. Given that each report often documents the results of either one or several sites, the impact of such reports on the value of large firms would be marginal.

Finally, results for the 'Post' period (t+2 to t+10) document the presence of drift up to 10 days following the announcement.

In all *pre*, *event* and *post* announcement period tests, cumulative squared abnormal returns are significantly higher following the 2012 change to the JORC Code. As such, we

[23] We square abnormal returns in these tests to examine the magnitude of the reaction irrespective of the direction.

cannot safely rule out the presence of information leakage prior to JORC announcements. In fact, examining the magnitude suggests that greater leakage may be occurring following JORC 2012. The *event* results indicate that JORC 2012 reports result in greater market impact than those prepared under JORC 2004.

6.4 Transaction Cost Effects

The bid-ask spread pre- vs post-JORC 2012

Table 9 shifts the focus to the bid-ask spread, in an attempt to assess whether JORC 2012 had an impact on the cost of trade. While the bid-ask spread is a noisy measure of the presence of informed trading, it may provide some evidence of whether JORC 2012 had an impact on mitigating the effect. We observe from Table 9 that spreads widen following the introduction of JORC 2012, almost across the board. It's tempting to conclude that although the objective of the Code change was to enhance the information environment of mining companies, it may have caused a 'chilling effect', with information being withheld. We address this question in the next section. Meanwhile, in further (un-tabulated) analysis we find that the spread decreases as the number of issued reports increases, in all size partitions.

The probability of informed trading pre- vs post-JORC 2012

Next, we examine the earlier evidence on information leakage in a more specific way. It is widely argued that information leakage via informed trading is detrimental to capital markets, as it may crowd out market participation by lesser informed liquidity traders who comprise a necessary subset of traders.[24] In the absence of liquidity traders (i.e. those who transact for reasons not driven by information), at the extreme, trade would not take place. Milgrom and Stokey (1982) demonstrate that the equilibrium of revealed information via price changes prompt other traders to avoid trading, due to fear of revealing their private endowment, and thus "swamping" the private signals of other agents. Akerlof (1970) provides the same intuition using a used car analogy in his 'market for lemons' thesis. Thus, the presence of liquidity traders provides market confidence; uninformed traders always lose against the better informed, and liquidity traders reduce the potency of this effect. Consequently, the presence of informed traders negatively affects liquidity, consequently widening spreads and increasing transaction costs (Glosten and Milgrom, 1985). Therefore, an important means of improving trade and the ability to raise capital on favourable terms is to introduce means of improving the flow of information regarding matters likely to materially affect firm value. Given that a

[24] Another line of thought suggests that informed trading actually promotes market efficiency and information dissemination; however empirical research shows scant support for this thesis.

significant component of mining firm value relates to the natural resources it controls (Rudenno, 2012), timely and unbiased disclosure of geological information should provide a means of mitigating information asymmetry. We argue that the introduction of JORC 2012, via its "if not, why not?" disclosure requirement, reduces the ability of firms obfuscating value relevant geological information, thereby improving transparency. On the other hand, the time and care required to provide the enhanced disclosure required by JORC 2012, could lead to delays in disclosure, producing a chilling effect very much akin to that in the case of the U.S. Regulation FD as found by Sidhu et al. (2008).

Measures of the *probability of informed trade (PIN)* have long been used in the finance literature using United States (U.S.) data to infer the likelihood of encountering, and thus transacting, with a trader endowed with superior (non-public) information. These studies may fall under one of two categories: those which use daily trade imbalance data to solve for this probability via maximum likelihood estimation (e.g. Easley et al., 1996; Easley et al, 2008; Duarte and Young, 2009; and Aslan et al, 2011), or others which decompose the bid-ask spread to identify the cost of adverse selection i.e., a cost embedded in the spread to compensate for the risk posed by informed traders (Bollen Smith and Whaley, 2004; Sidhu et al., 2008). In either case, intraday trade and quote data are employed.

Prior research (e.g. Aslan et al, 2011) provides evidence of the extent of industry level informed trade, within the United States. While they report the probability of informed trade within mining in that country, their use of Easley et al. (1996) and related measures, and the heavy reliance by these measures on liquidity for estimation, may not be suitable within the relatively illiquid market for most mining firms in Australia. Given typical liquidity filters found in prior research (e.g. Aslan 2011; Duarte and Young 2009; Easley et al 2002; Easley et al 1996), which generally require estimation of daily buyer and seller initiated orders for a year, almost all firms outside of the top decile by size in Australia, would be excluded (recall Table 4.1). Regardless of data constraints, the literature suggests that the Easley et al. (1996) measure is more a measure of liquidity than a measure of informed trading (Andersen and Bondarenko 2014; Akay et al. 2012). Therefore, we turn to a model by Bollen, Smith and Whaley (2004), which enables additional latitude when dealing with illiquid stocks.

Bollen Smith and Whaley (2004) is a bid-ask spread decomposition model, which enables isolation of its adverse selection cost component. The cost of adverse selection is believed to be priced via a widening of the bid-ask spread; done so by lesser informed parties to each potential stock transaction as compensation for the probability of trading with one who

is better informed.[25] In short, isolation of the adverse selection cost of the spread enables one to draw inferences about the extent of such price protection taken, and hence the probability of encountering an informed trader. The model, which decomposes the spread into its direct costs related to liquidity, and indirect costs related to holding and possibly liquidating at an unfavourable price, is as follows:

$$SPRD_{it} = \alpha_0 + \alpha_1 InvTV_i + \alpha_2 IHP_{U,i}(\tau_i) + \alpha_3(IHP_{I,i}(\tau_i) - IHP_{U,i}(\tau_i)) \quad \text{Equation 3}$$

In the model, *SPRD* is the effective bid-ask spread calculated as *SPRD* = 2 × [Transaction Price − Midquote], *TV* is the average number of shares traded over a month, *INVTV* is the inverse of *TV,* which ensures an intuitive directional relationship with the spread. Using a hedging argument, and drawing upon Black and Scholes (1973), Bollen, Smith and Whaley propose that the IHP is calculated as follows:

$$IHP_{k,i} = S_{k,i}N\left(\frac{ln(\frac{S_{k,i}}{X})}{\sigma_i\sqrt{\tau_i}} + 0.5\sigma_i\sqrt{\tau_i}\right) - X_iN\left(\frac{ln(\frac{S_{k,i}}{X})}{\sigma_i\sqrt{\tau_i}} + 0.5\sigma_i\sqrt{\tau_i}\right) \quad \text{Equation 4}$$

Where, k = U, I represents uninformed and informed traders, respectively. $IHP_{U,i}$ is calculated as an out-of-the-money call option with an exercise price equal to the ask price. $IHP_{I,i}$ is calculated as an in-the-money (ITM) call option with an exercise price of the stock price plus 1% (which exhibited the highest R^2 upon estimating 1% - 10% ITM, as per Bollen, Smith and Whaley (2004) and Sidhu et al. (2008)). Upon estimating this model, the result on α_3 is interpreted as the probability of encountering an informed trader; inferred from the adverse selection cost component of the spread. To estimate the model, we draw intraday data from SIRCA's Australian Equities (AE) database, necessary to infer the number of trades per day, and the average time between trades in minutes. The remaining data; daily bid, ask, and returns necessary to calculate stock return volatility, we download as daily observations.

We wish to test the null that there was no change in the probability of informed trade from the pre to the post JORC 2012 period. To do so, we modify Equation 3 to resemble Sidhu et al (2008) in their examination of the probability of informed trade surrounding Regulation FD:

$$SPRD_{it} = \alpha_0 + \alpha_1 InvTV_i + \alpha_2 IHP_{U,i}(\tau_i) + \alpha_3(IHP_{I,i}(\tau_i) - IHP_{U,i}(\tau_i)) +$$

$$\alpha_4 D_t + \alpha_5 InvTV_i D_t + \alpha_6 IHP_{U,i}(\tau_i)D_t + \alpha_7(IHP_{I,i}(\tau_i) - IHP_{U,i}(\tau_i))D_t + \epsilon i \quad \text{Equation 5}$$

[25] Bollen, Smith and Whaley (2004) premise their model on an uninformed market maker, who potentially holds inventory of stock, which subsequently requires liquidation. Arguably, traders in an auction market may effectively price protect in a similar fashion, by decreasing their bid prices, and increasing ask prices.

Where, D is a dummy variable assuming a value of 1 in the months after mandated adoption of JORC 2012 (2014), and 0 otherwise (2011). To estimate the model, we provide use monthly mean values except in the case of σ_i, which is the standard deviation of daily stock returns over the 60 days prior. We present our results in Table 10.

We present our results for all firms in Panel A, as well as separately for small and large mining firms in Panels B and C, respectively. To enable meaningful demarcation between small and large firm, consistent with the distribution of trading volume and liquidity of mining stocks in Australia, we define firms in the top 10% by market capitalisation as large, and the remaining 90% as small. Doing so also ensures sufficient observations among smaller, less liquid firms, necessary to estimate the model.

There are several results of interest within Table 10. First, the result on IHP_i-IHP_u in Panel A provides our estimate of the probability of informed trade in the pre JORC 2012 period, which is 1.049% and marginally significant at the 5% level. Importantly, note the result on $D*(IHP_i-IHP_u)$, which is -0.0151% and not significant for this overall sample of all firms. Thus, the difference in informed trade in the post- JORC 2012 period is both economically and statistically insignificant from that in the pre-period. However, the estimate on *D* alone, indicates the change in the bid-ask spread following the introduction of JORC 2012, which is 0.00076588 and statistically significant at the 1% level.

Panel B presents the results for small mining firms defined here as those with a market capitalisation lower than the 90th percentile ranked on market capitalisation. For this set of firms, note that the parameter estimate for the probability of informed trade in the pre JORC 2012 period (IHP_i-IHP_u) is higher with a value of 1.669% and highly significantly different from zero ($p<0.0001$); Meanwhile, the change experienced upon interacting with the post-JORC 2012 dummy variable is insignificant ($p=0.5420$). Thus, the changes to the JORC Code have not succeeded in reducing the probability of informed trading in the post-JORC 2012 period. Since the interaction term is insignificant, the probability of informed trading remains statistically different from zero, as per the pre-period.

Finally, Panel C presents the results for large firms (the top 10% of firms by market capitalisation). The pre-2012 probability of informed trade is 1.876% and only very marginally significant at the 10% level. Meanwhile, the parameter estimate for the change following JORC 2012 i.e., $D*(IHP_i-IHP_u)$, is a highly significant decrease of 1.79 per cent ($p=0.0003$). Evidently, JORC 2012 succeeded in reducing the probability of informed trade for firms within the top 10% of the size distribution. The remaining firms, on average fail to show any significant

impact, suggesting that information-based trading related to geological information of small mining companies remains unaffected by JORC 2012.

6.5 Summary of Study 2: Capital Market Study

The mining industry in Australia is characterised by very thin stock liquidity across most stocks; most of the liquidity in this sector is accounted for by the largest 10 to 30 per cent of firms, by market capitalisation. JORC reports (typically contained in the ASX's 'Progress Report' type) are an important communications channel for mining firms since they convey credible signals of the 'store' of wealth controlled by mining firms. JORC reports are an especially important communication channel for small firms since each mineral resource or ore deposit of small firms represents a larger proportion of their individual valuation. Based on the capital market reactions across the predominant ASX announcement types, JORC and Earnings announcements elicit the highest proportion of market reaction. In other words, they appear to have the highest proportion of information content or 'news' relative to other types of announcements. Thus, JORC reports are an important element of the information environment of mining firms.

In tracking abnormal returns from 20 days prior to announcement data to 10 days beyond, we see a less noticeable drift in the post-JORC 2012 period relative to the pre-period. But there still appear to be sizeable abnormal returns made prior to announcement, prima facie evidence of information leakage. This is also evidenced in the charts of abnormal trading volume calibrated for the same windows around announcement date. Tests of squared abnormal returns around JORC announcement dates suggest that the extent of information leakage prior to announcements is higher after the 2012 changes to the JORC Code. This is suggestive of a 'chilling effect' i.e., delays in information release, albeit with the intention of reducing information uncertainty through more rigorous levels of technical evidence, may have had the perverse effect of permitting greater information leakage prior to the announcements. This is further corroborated by a widening of bid-ask spreads around announcement dates (suggestive of higher information asymmetry) in the post-JORC 2012 period. Finally, while we observe a decline in the probability of informed trading for large firms post-JORC 2012, there is no appreciable shift for small firms; the probability of informed trading for small firms remains statistically significant.

7. Concluding Comments

This paper investigates (a) compliance with the JORC Code, as well as, the quality of reporting, before and after the 2012 revisions to the Code and related ASX Listing Rules and,

(b) the impact of the JORC Code on the Australian capital market before and after the recent revisions to the Code.

The assessment of compliance and reporting quality in a sample of JORC announcements is conducted by two experienced geologists, based on an assessment template developed after consultation with geologists, mining engineers and valuation experts. The main findings are that overall reporting quality has improved in the post-JORC 2012 period but the geologists exhibit varying degrees of (dis)agreement on the extent of improvement and which firms improve the most, which reflects the level of difficulty faced by experts in interpreting the content of JORC reports. Both geologists agree that the greatest improvement is seen in early stage projects, consistent with the expectation that there are more uncertainties surrounding these and the additional information disclosed under the most recent JORC code appears to assist in reducing the uncertainties to some extent.

The capital markets study shows that JORC announcements have a significant impact on investors' assessments of firm value, and that the announcement impact is higher after the 2012 revisions designed to strengthen the disclosure requirements. This is consistent with post-2012 JORC reports conveying higher information content. There continues to be quite significant information leakage prior to announcement date. Further tests show a widening of bid-ask spreads in the post-2012 period, suggestive of higher information asymmetry. While the probability of informed trading declines for large firms, it remains statistically significant for small firms.

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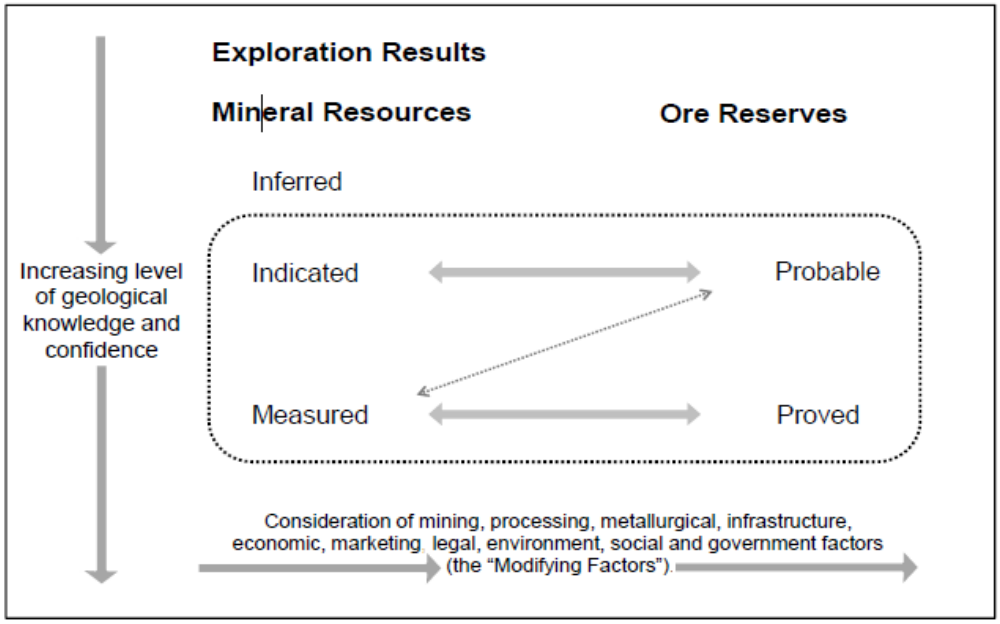
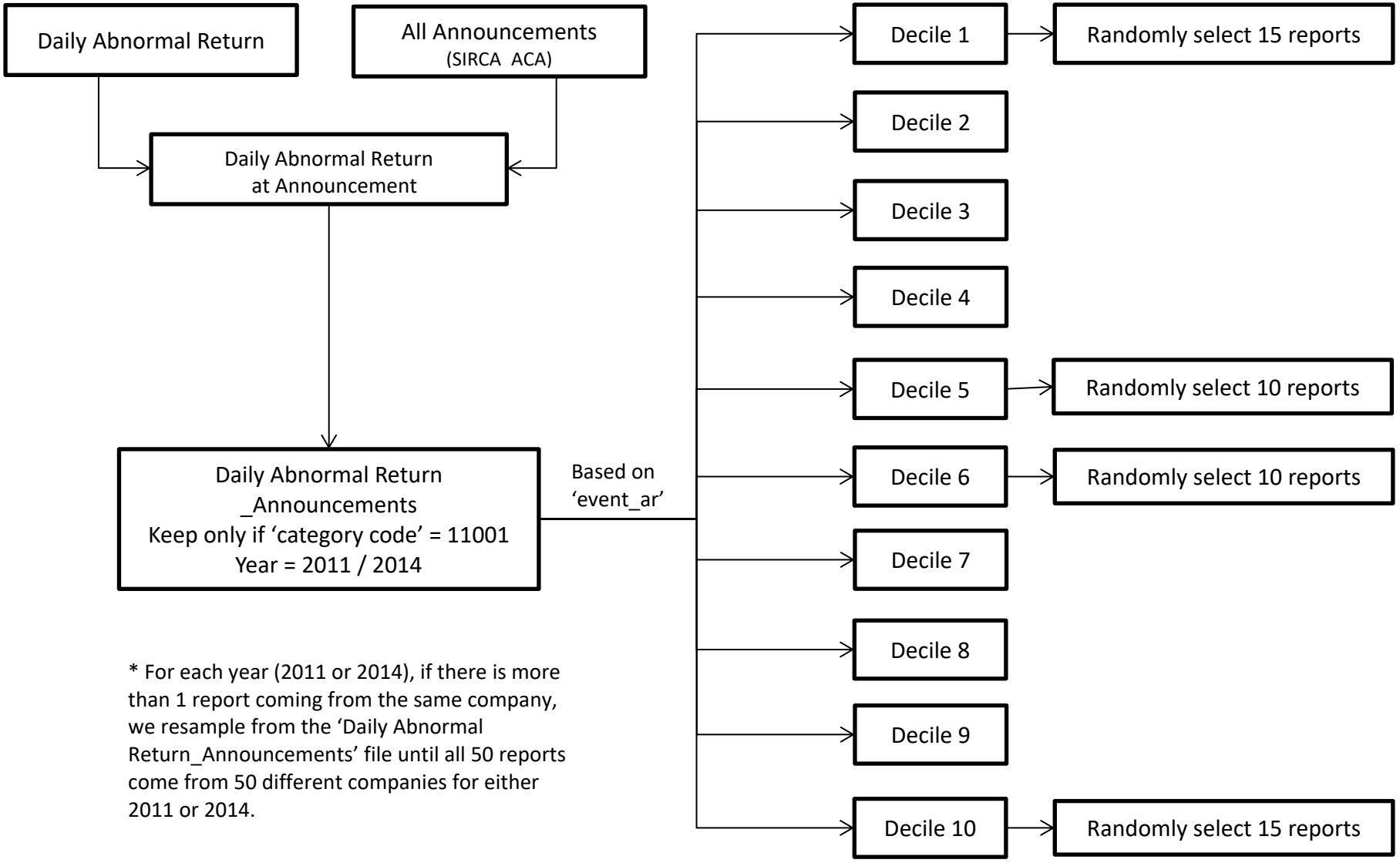
Figure 1: Exploration Certainty and Identification (JORC 2012)



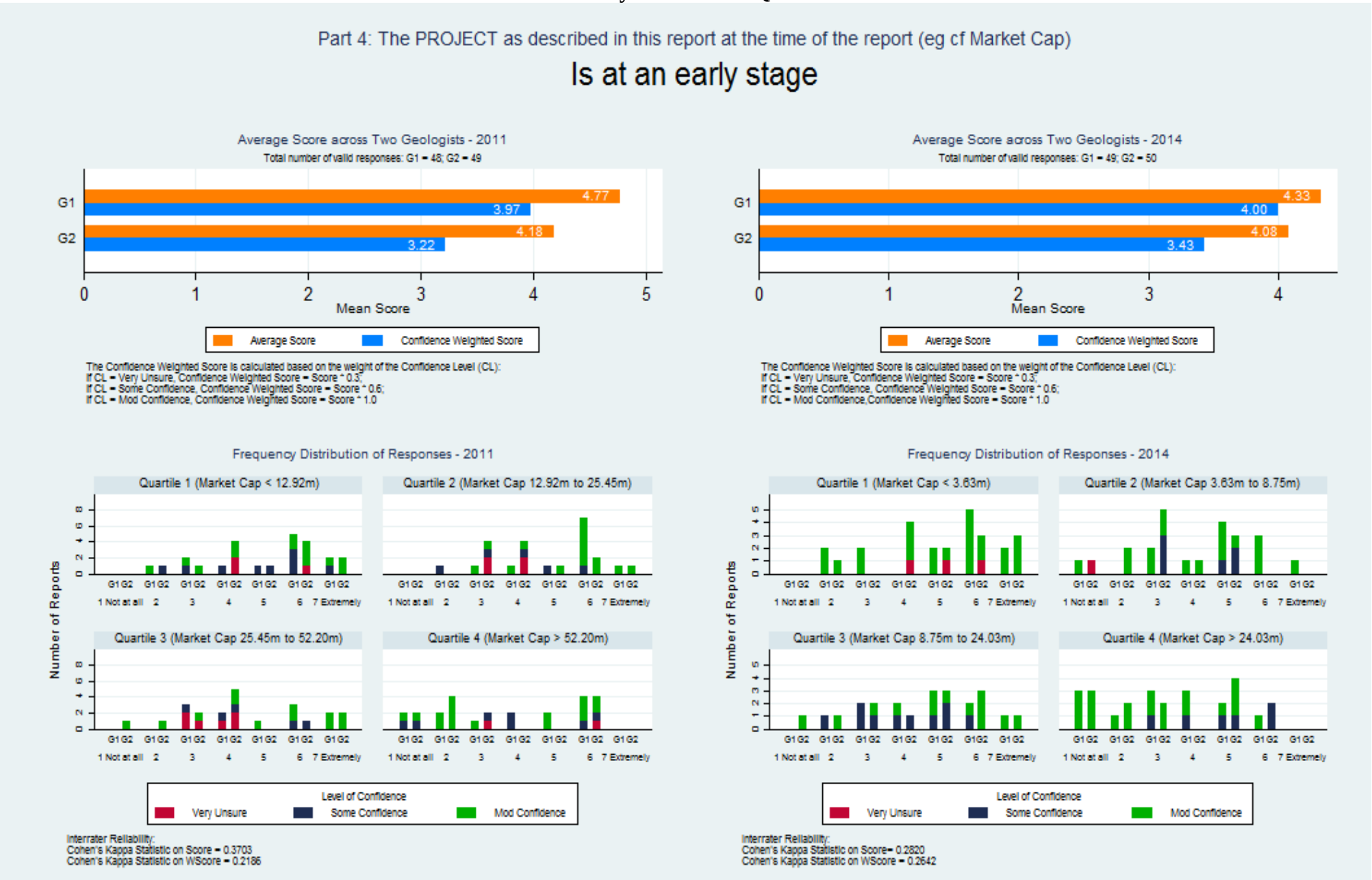
Source: JORC, 2012. Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (The JORC Code), available from: http://www.jorc.org.

Figure 2 Geologists' sample of JORC announcements: Sampling procedure based on abnormal returns



* For each year (2011 or 2014), if there is more than 1 report coming from the same company, we resample from the 'Daily Abnormal Return_Announcements' file until all 50 reports come from 50 different companies for either 2011 or 2014.

FIGURE 3 Summary Statistics on Question 1 of Part 4



Figures 4a to 4c Liquidity Measures (GICS 15104 – Metals and Mining)

Plots of the mean monthly number of trades, bid-ask spreads, and Amihud's Illiquidity measure, partitioned at the 70th and 30th percentiles on ASX market capitalisation as breakpoints. 'L', 'M' and 'S' identify these partitions as Large, Medium and Small firms, respectively.

Figure 4a Mean Monthly Number of Trades per Firm

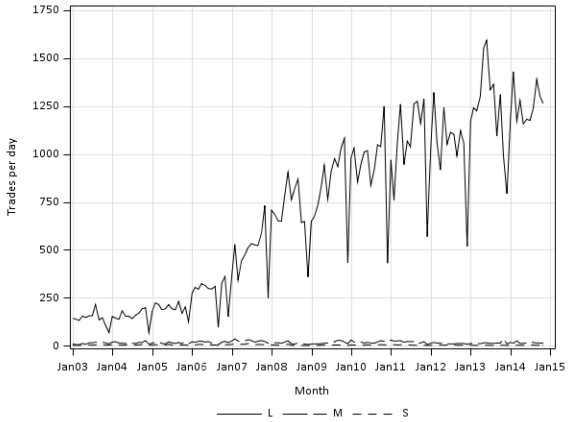


Figure 4b Mean Monthly Bid-Ask Percentage[26] Spreads

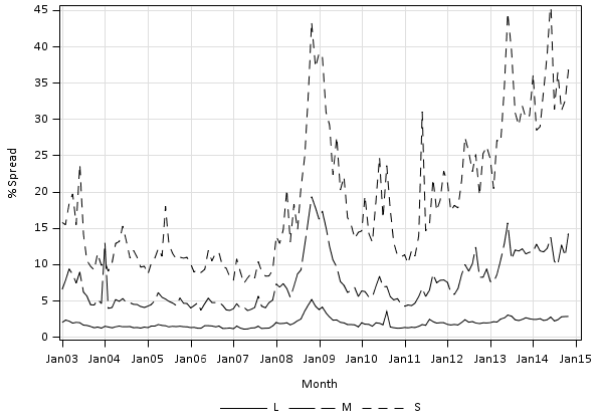
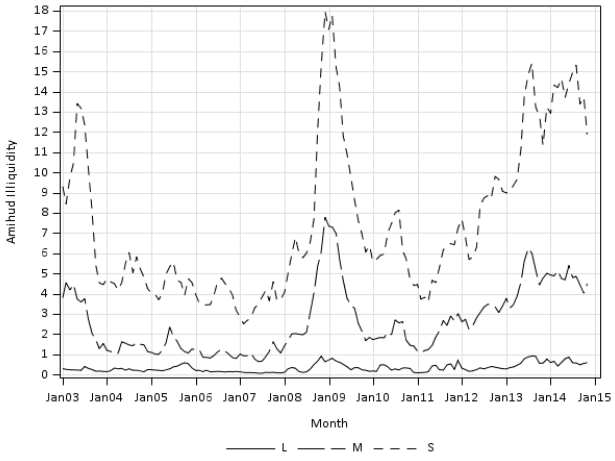


Figure 4c Mean Amihud (2002) Illiquidity[27]



[26] The '% Spread' the mean monthly spread of each firm is divided by the month end share price. Each series is the mean across all firms within each size group.

[27] Illiquidity is calculated daily as the absolute value of the stock return divided by dollar turnover on each day, averaged over the 60 days prior to each month.

Figures 5a and 5b Cumulative abnormal returns by JORC Announcement reaction

This figure presents a return index time series', commencing at t-20, to t+10, where event day 0 denotes the day of announcement. We separately present the mean for positive, zero, and negative surprise firms, with the surprise groups ascertained by ranking 3-day announcement CARs estimated using a market model approach, and allocating according to breakpoints at the 30% and 70% cut-offs. Surprise groups are re-sorted monthly.

Figure 5a pre-JORC 2012 (2003-2011)

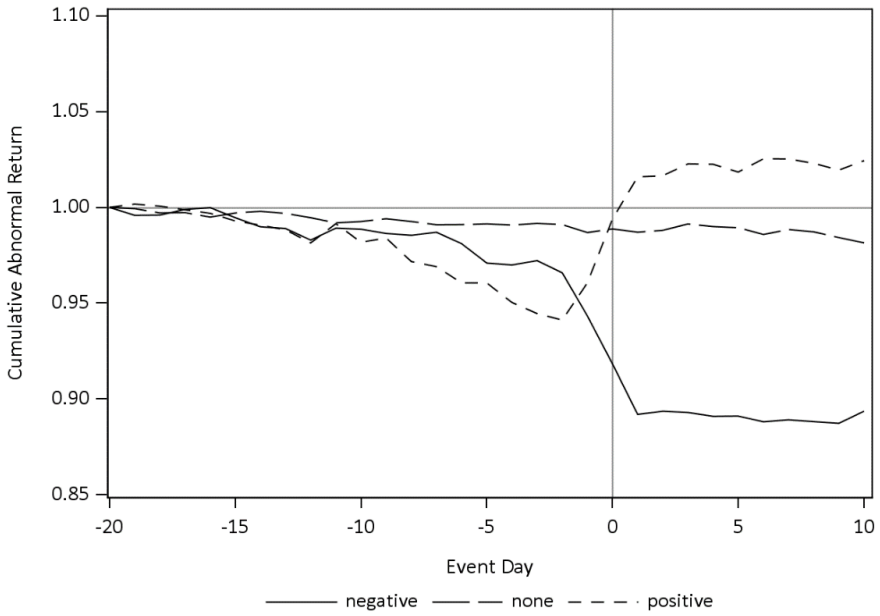
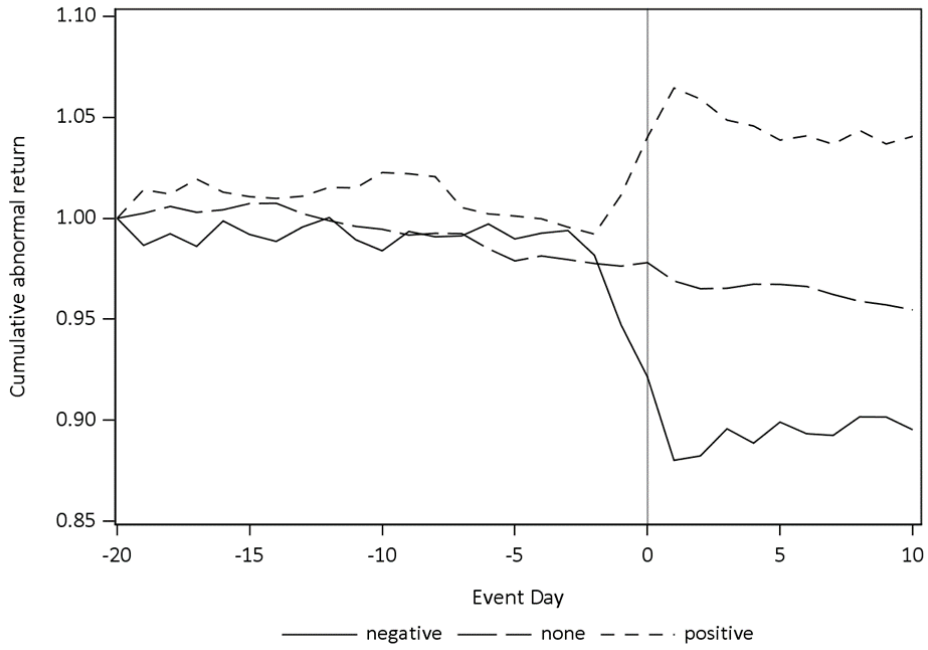


Figure 5b post-JORC 2012 (2013-2014)



Figures 6a and 6b Cumulative abnormal volume by JORC announcement date reaction

This figure presents a time series of cumulative abnormal volume, surrounding JORC announcements. We estimate abnormal volume as the difference between daily dollar volume, and estimated volume; the mean daily volume from t-100 to t-20. The series commences at t-20, and cumulates abnormal volume through t+10, where event day 0 is the day of the announcement. We separately present the mean cumulative abnormal volume for positive, zero, and negative surprise firms, with the reaction groups ascertained by ranking 3-day announcement CARs estimated using a market model approach, and allocating according to breakpoints at the 30 percentile and 70 percentile cut-offs. Surprise groups are re-sorted monthly.

Figure 6a pre JORC 2012 (2003-2011)

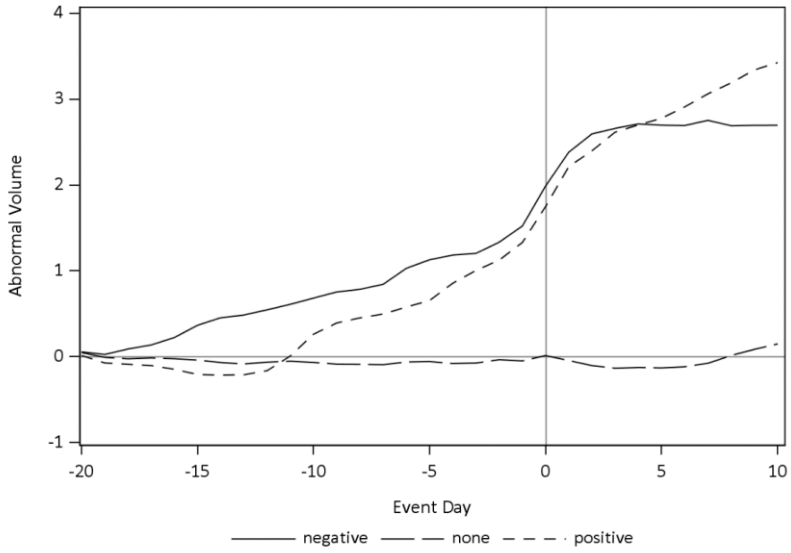


Figure 6b post JORC 2012 (2013-2014)

Cumulative abnormal volume by JORC announcement date reaction ()

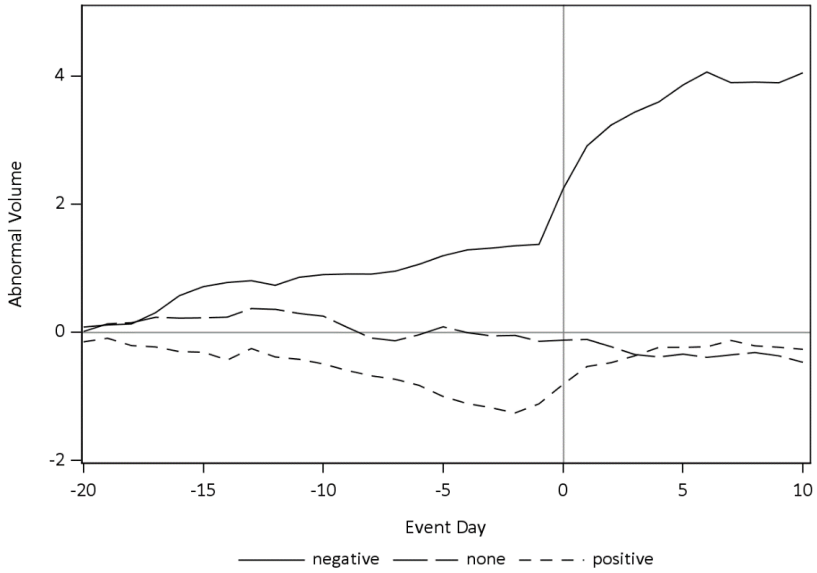


Table 1
Frequency of the 20 most frequent types of mining company announcements, by type (2003 - 2014)

	Year												
Description	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*Total*
Progress Report	4	1162	1637	2458	3574	4096	3975	4789	4716	2430	3733	3507	36081
Appendix 3B	12	1007	1225	1901	2739	2098	2356	2746	2553	1200	1564	1573	20974
Change of Director's Interest Notice	10	720	913	1140	1571	1875	1793	1724	1817	962	1502	1324	15351
Issued Capital	8	467	657	856	1075	1048	1644	1634	1605	799	591	565	10949
Change in substantial holding	.	353	637	844	895	1009	1132	1107	1177	664	911	995	9724
Progress Report (Other)	1	198	308	245	358	889	913	1266	1290	956	1261	1131	8816
Results of Meeting	.	251	312	383	482	438	611	645	601	192	451	489	4855
Proxy Form	1	194	278	334	412	414	582	606	513	156	413	431	4334
Top 20 shareholders	.	225	290	324	410	404	584	551	482	111	438	391	4210
Full Year Accounts	.	261	343	387	486	489	646	608	564	37	150	148	4119
Full Year Audit Review	.	266	348	389	491	484	639	605	565	25	98	80	3990
Placement	.	180	237	298	329	295	592	555	419	234	399	433	3971
Director Appointment/Resignation	.	170	220	228	349	361	400	446	526	243	473	416	3832
Company Administration (Other)	1	124	146	265	258	230	296	543	745	379	439	374	3800
Full Year Directors' Statement	.	261	341	384	486	480	636	601	560	.	.	2	3751
Full Year Directors' Report	.	260	339	383	482	478	634	599	552	.	1	2	3730
Annual Report	.	206	250	271	359	362	528	455	413	74	418	379	3715
Becoming a substantial holder	2	134	243	262	382	401	385	435	381	235	386	365	3611
Second Quarter Activities Report	.	158	197	219	248	304	281	377	419	387	387	347	3324

TABLE 2: Summary Statistics for Part 1 JORC Compliance

		2011			2014			**Score Difference between 2011 and 2014	**WScore Difference between 2011 and 2014
		N	*Score	*WScore	N	*Score	*Wscore		
G1									
Market Cap Quartile									
(Smallest)	**1**	9	1.672	1.269	11	2.282	2.021	0.610 (0.0005)	0.752 (0.0017)
	2	11	1.682	1.144	11	2.064	1.521	0.382 (0.2008)	0.377 (0.1597)
	3	7	1.543	1.144	11	2.145	1.624	0.603 (0.0337)	0.479 (0.0291)
(Largest)	**4**	9	2.022	1.505	11	2.332	1.950	0.310 (0.2195)	0.445 (0.2025)
	Total	36	1.738	1.269	44	2.206	1.779	0.468 (0.0002)	0.510 (0.0002)
G2									
Market Cap Quartile									
(Smallest)	**1**	10	1.950	1.398	13	1.906	1.451	-0.044 (0.8226)	0.053 (0.7859)
	2	12	1.733	1.122	12	1.837	1.439	0.103 (0.6669)	0.316 (0.1248)
	3	8	1.750	1.163	12	1.951	1.538	0.201 (0.1164)	0.375 (0.0146)
(Largest)	**4**	10	2.065	1.538	13	2.040	1.562	-0.025 (0.8454)	0.024 (0.8941)
	Total	40	1.874	1.303	50	1.935	1.498	0.061 (0.5010)	0.194 (0.0355)
*****Difference between Reviewers**	**1**		0.278 (0.1406)	0.129 (0.5390)		-0.376 (0.0348)	-0.570 (0.0066)		
	2		0.052 (0.8378)	0.022 (0.9120)		-0.227 (0.4186)	-0.083 (0.7511)		
	3		0.207 (0.5154)	0.018 (0.9405)		-0.195 (0.0675)	-0.086 (0.4705)		
	4		0.043 (0.8367)	0.034 (0.9019)		-0.292 (0.1012)	-0.388 (0.1288)		
	Total		0.136 (0.2567)	0.034 (0.7669)		-0.271 (0.0045)	-0.282 (0.0097)		

*'Score' is on a scale of 1 to 3, while 'WScore' is the confidence weighted score = Score x (Confidence level/3), where confidence level is on a scale of 1 to 3.
**The 'Score' and 'WScore' differences are calculated as the score in 2014 minus the score in 2011; p-values for t-tests of differences are in parentheses.
***The difference between reviewers is calculated as the score given by G2 minus the score given by G1; p-values for t-tests of differences are in parentheses.

TABLE 3: Summary Statistics for Part 2 Further Scientific Rigour

		2011			2014			**Score Difference between 2011 and 2014	**WScore Difference between 2011 and 2014
		N	*Score	*WScore	N	*Score	*WScore		
G1									
Market Cap Quartile									
(Smallest)	**1**	10	1.650	1.273	12	2.300	2.018	0.650 (0.0056)	0.745 (0.0092)
	2	11	1.595	1.111	12	1.992	1.676	0.396 (0.1421)	0.566 (0.0342)
	3	7	1.314	1.125	10	2.100	1.672	0.786 (0.0096)	0.547 (0.0122)
(Largest)	**4**	10	2.065	1.542	11	2.455	2.142	0.390 (0.0301)	0.601 (0.0109)
	Total	38	1.682	1.273	45	2.211	1.880	0.530 (0.0000)	0.607 (0.0000)
G2									
Market Cap Quartile									
(Smallest)	**1**	11	1.950	1.429	13	2.032	1.567	0.082 (0.6667)	0.138 (0.3971)
	2	12	1.608	1.100	12	1.821	1.421	0.213 (0.3484)	0.321 (0.0797)
	3	10	1.770	1.200	12	2.005	1.550	0.235 (0.1951)	0.350 (0.0270)
(Largest)	**4**	13	2.050	1.521	13	2.141	1.675	0.091 (0.5903)	0.154 (0.3766)
	Total	46	1.850	1.320	50	2.003	1.556	0.153(0.1146)	0.236 (0.0064)
*****Difference between Reviewers**	**1**		0.300 (0.2098)	0.156 (0.5336)		-0.268 (0.1234)	-0.451 (0.0227)		
	2		0.013 (0.9596)	-0.011(0.9510)		-0.171 (0.4666)	-0.255 (0.3130)		
	3		0.456 (0.1645)	0.075(0.7221)		-0.095 (0.4524)	-0.122 (0.3789)		
	4		-0.015 (0.9339)	-0.021(0.9162)		-0.314 (0.0598)	-0.468 (0.0211)		
	Total		0.168 (0.1812)	0.046 (0.6634)		-0.208 (0.0240)	-0.324 (0.0016)		

*'Score' is on a scale of 1 to 3, while 'WScore' is the confidence weighted score = Score x (Confidence level/3), where confidence level is on a scale of 1 to 3.
**The 'Score' and 'WScore' differences are calculated as the score in 2014 minus the score in 2011; p-values for t-tests of differences are in parentheses.
***The difference between reviewers is calculated as the score given by G2 minus the score given by G1; p-values for t-tests of differences are in parentheses.

TABLE 4: Summary Statistics for Part 3 Effective Communication

		2011			2014			**Score Difference between 2011 and 2014	**WScore Difference between 2011 and 2014
		N	*Score	*WScore	N	*Score	*WScore		
G1									
Market Cap Quartile									
(Smallest)	**1**	13	1.850	1.372	13	2.254	1.971	0.404 (0.0166)	0.599 (0.0047)
	2	12	1.908	1.349	12	2.017	1.631	0.108 (0.5456)	0.282 (0.1011)
	3	12	1.875	1.518	11	2.036	1.652	0.161 (0.3550)	0.133 (0.5093)
(Largest)	**4**	13	2.262	1.836	13	2.338	1.942	0.077(0.5767)	0.106 (0.5873)
	Total	50	1.977	1.522	49	2.169	1.808	0.192 (0.0233)	0.286 (0.0045)
G2									
Market Cap Quartile									
(Smallest)	**1**	13	2.035	1.410	13	1.968	1.483	-0.067 (0.5548)	0.074 (0.5074)
	2	12	1.829	1.279	12	2.043	1.553	0.213 (0.1844)	0.273 (0.0156)
	3	12	1.779	1.152	12	2.044	1.560	0.265 (0.1110)	0.408 (0.0003)
(Largest)	**4**	13	2.196	1.684	13	2.146	1.667	-0.050 (0.6514)	-0.017 (0.9019)
	Total	50	1.966	1.390	50	2.050	1.566	0.084(0.2302)	0.176 (0.0059)
*****Difference between Reviewers**	**1**		0.185 (0.1654)	0.038 (0.8122)		-0.286 (0.0565)	-0.487 (0.0052)		
	2		-0.079 (0.6864)	-0.069 (0.5725)		0.026 (0.8489)	-0.078 (0.6147)		
	3		-0.096 (0.6593)	-0.366 (0.0647)		0.008 (0.9246)	-0.092 (0.4827)		
	4		-0.065 (0.6157)	-0.151 (0.4348)		-0.192 (0.1158)	-0.275 (0.0827)		
	Total		-0.011 (0.9009)	-0.132 (0.1437)		-0.119 (0.0638)	-0.242 (0.0021)		

*'Score' is on a scale of 1 to 3, while 'WScore' is the confidence weighted score = Score x (Confidence level/3), where confidence level is on a scale of 1 to 3.
**The 'Score' and 'WScore' differences are calculated as the score in 2014 minus the score in 2011; p-values for t-tests of differences are in parentheses.
***The difference between reviewers is calculated as the score given by G2 minus the score given by G1; p-values for t-tests of differences are in parentheses.

TABLE 5: Summary Statistics for Review Assessment Total (Weighted Average)

		2011			2014			**Score Difference between 2011 and 2014	**WScore Difference between 2011 and 2014
		N	*Score	*WScore	N	*Score	*WScore		
G1									
Market Cap Quartile									
(Smallest)	**1**	13	1.359	1.308	13	2.060	2.017	0.701 (0.0117)	0.709 (0.0042)
	2	12	1.614	1.172	12	1.948	1.609	0.334 (0.2086)	0.437 (0.0463)
	3	12	1.110	1.211	12	1.888	1.654	0.777 (0.0073)	0.442 (0.0201)
(Largest)	**4**	13	1.663	1.589	13	2.090	1.988	0.428 (0.1707)	0.399 (0.1203)
	Total	50	1.439	1.321	50	2.000	1.821	0.560 (0.0001)	0.500 (0.0000)
G2									
Market Cap Quartile									
(Smallest)	**1**	13	1.671	1.447	13	1.953	1.488	0.282 (0.2082)	0.041 (0.8014)
	2	12	1.726	1.156	12	1.884	1.463	0.158 (0.4143)	0.307 (0.0564)
	3	12	1.397	1.150	12	1.988	1.546	0.591 (0.0085)	0.396 (0.0015)
(Largest)	**4**	13	1.856	1.585	13	2.092	1.616	0.236 (0.1951)	0.031 (0.8437)
	Total	50	1.667	1.330	50	1.981	1.529	0.314 (0.0021)	0.199 (0.0113)
*****Difference between Reviewers**	**1**		0.313 (0.2405)	0.139 (0.5149)		-0.107 (0.6186)	-0.529 (0.0050)		
	2		0.113 (0.6321)	-0.016 (0.9136)		-0.064 (0.7831)	-0.146 (0.4864)		
	3		0.286 (0.3317)	-0.061 (0.7132)		0.100 (0.5657)	-0.107 (0.3526)		
	4		0.193 (0.4838)	-0.004 (0.9859)		0.001 (1.0000)	-0.371 (0.0584)		
	Total		0.227 (0.0000)	0.009 (0.9263)		-0.019 (0.0067)	-0.291 (0.0014)		

*The difference between reviewers is calculated as the score given by G2 minus the score given by G1; p-values for t-tests of differences are in parentheses.
**The 'Score' and 'WScore' differences are calculated as the score in 2014 minus the score in 2011; p-values for t-tests of differences are in parentheses.
***'Score' is calculated as the weighted average from Parts 1, 2, and 3. 'Score' = Score(Part1)*0.5 + Score(Part2)*0.25 + Score(Part3)*0.25. Similarly, 'WScore' = WScore(Part1)*0.5 + WScore(Part2)*0.25 + WScore(Part3)*0.25.

TABLE 6 Correlation Matrix for Responses to Questions in Part 4

	P4_Q1	P4_Q2	P4_Q3	P4_Q4	P4_Q5	P4_Q6	P4_Q7	P4_Q8	P4_Q9	P4_Q10	P4_Q11	P4_Q12	P4_Q13	P4_Q14
P4_Q1		-0.1998* 0.0474	0.4934* 0.0000	-0.3231* 0.0011	0.2481* 0.0138	**0.1502** **0.1380**	**-0.1336** **0.1873**	-0.2169* 0.0320	-0.5877* 0.0000	-0.2437* 0.0151	-0.4094* 0.0000	0.2122* 0.0359	**0.0051** **0.9603**	**-0.0132** **0.8970**
P4_Q2	-0.4879* 0.0000		-0.2999* 0.0026	0.6466* 0.0000	-0.4204* 0.0000	-0.3429* 0.0005	0.3178* 0.0014	0.1992* 0.0492	0.3914* 0.0001	**0.1734** **0.0861**	0.4099* 0.0000	**0.0209** **0.8379**	**0.0379** **0.7094**	**0.0131** **0.8973**
P4_Q3	0.5720* 0.0000	-0.5999* 0.0000		-0.3201* 0.0012	0.2774* 0.0057	**0.0335** **0.7422**	-0.2395* 0.0169	-0.2173* 0.0316	-0.3574* 0.0003	**0.0007** **0.9942**	-0.2326* 0.0205	**0.0226** **0.8253**	**0.1444** **0.1539**	**-0.0793** **0.4352**
P4_Q4	-0.3241* 0.0013	0.5330* 0.0000	-0.5881* 0.0000		-0.5291* 0.0000	-0.4395* 0.0000	0.4037* 0.0000	0.2110* 0.0370	0.6655* 0.0000	0.3670* 0.0002	0.4539* 0.0000	**-0.0662** **0.5171**	0.2069* 0.0399	**0.1277** **0.2078**
P4_Q5	0.2905* 0.0045	-0.4807* 0.0000	0.5732* 0.0000	-0.4527* 0.0000		0.3033* 0.0024	**-0.0763** **0.4554**	**-0.0969** **0.3452**	-0.3450* 0.0005	**-0.1437** **0.1580**	-0.2431* 0.0159	**0.1295** **0.2062**	**0.1562** **0.1247**	**-0.1393** **0.1712**
P4_Q6	0.5085* 0.0000	-0.5127* 0.0000	0.5058* 0.0000	-0.4059* 0.0000	0.4195* 0.0000		**-0.1205** **0.2348**	**-0.0591** **0.5633**	-0.3463* 0.0004	**-0.1264** **0.2124**	**-0.0611** **0.5479**	**-0.0409** **0.6895**	**-0.0134** **0.8953**	**-0.0867** **0.3935**
P4_Q7	**-0.1559** **0.1293**	0.2467* 0.0159	-0.2631* 0.0096	0.2599* 0.0106	**-0.0474** **0.6499**	**-0.0788** **0.4476**		0.6492* 0.0000	0.3961* 0.0000	0.2057* 0.0411	0.2841* 0.0044	**0.1528** **0.1332**	**-0.1264** **0.2126**	**0.0291** **0.7746**
P4_Q8	**-0.0097** **0.9258**	**0.0115** **0.9129**	**0.0783** **0.4530**	**0.1947** **0.0586**	**0.0560** **0.5979**	**0.0873** **0.4027**	0.3453* 0.0007		0.3405* 0.0006	0.4546* 0.0000	0.2467* 0.0143	0.2640* 0.0090	**-0.0291** **0.7757**	**0.0251** **0.8059**
P4_Q9	0.4564* 0.0000	0.5253* 0.0000	-0.5438* 0.0000	0.6487* 0.0000	-0.3830* 0.0002	-0.4621* 0.0000	0.2387* 0.0205	0.2382* 0.0208		0.5174* 0.0000	0.6040* 0.0000	**-0.1002** **0.3264**	**-0.1387** **0.1709**	**0.0236** **0.8168**
P4_Q10	**-0.1264** **0.2865**	**0.0927** **0.4388**	**0.0745** **0.5341**	**0.1849** **0.1199**	**0.0680** **0.5757**	**0.0294** **0.8077**	**0.1914** **0.1072**	0.3387* 0.0039	0.2306* 0.0497		0.3942* 0.0001	0.3507* 0.0004	**-0.0545** **0.5922**	**0.0696** **0.4937**
P4_Q11	0.4357* 0.0014	**0.2474** **0.0801**	**-0.1458** **0.3072**	**0.2115** **0.1363**	**-0.1344** **0.3571**	**-0.1818** **0.2016**	**-0.0430** **0.7666**	**0.2191** **0.1263**	**0.0995** **0.4874**	0.4289* 0.0017		**-0.0503** **0.6229**	**-0.1136** **0.2631**	**0.0941** **0.3542**
P4_Q12	**-0.0734** **0.5943**	**0.1339** **0.3342**	**0.0567** **0.6837**	**-0.0466** **0.7357**	**0.0740** **0.6023**	**0.0479** **0.7311**	**0.0189** **0.8919**	**0.2087** **0.1298**	**0.0866** **0.5298**	0.6850* 0.0000	0.3711* 0.0087		**0.0135** **0.8947**	**-0.0373** **0.7150**
P4_Q13	**0.0252** **0.8072**	-0.2347* 0.0213	0.3204* 0.0014	**-0.0900** **0.3833**	0.2270* 0.0278	**0.1750** **0.0881**	**-0.1724** **0.0931**	0.3024* 0.0031	**-0.0867** **0.4059**	0.2352* 0.0467	**0.1473** **0.3022**	**0.2422** **0.0777**		0.5920* 0.0000
P4_Q14	**0.0008** **0.9937**	**-0.0634** **0.5393**	**0.1751** **0.0863**	**0.0277** **0.7886**	**0.0833** **0.4245**	**0.0394** **0.7030**	**-0.0117** **0.9097**	0.2764* 0.0070	**0.1738** **0.0938**	**0.1838** **0.1222**	**0.1603** **0.2611**	**0.0834** **0.5486**	0.3517* 0.0004	

Pearson Correlation for G1 in the lower diagonal and for G2 in the upper diagonal.
Insignificant correlations (two tailed p-value<0.05) are bolded in the correlation matrix.

Table 7

Market reaction on all types of mining company announcements taken together

This table presents announcement type and 'surprise' deciles, formed by ranking the announcement 3-day CARs, and resorting each month. The CAR column displays the mean CARs for each decile. The columns BSH through to DIR show the proportion of announcements in that decile (or row), which are of that announcement type. BSH is becoming a substantial shareholder, CSH is ceasing to be a substantial shareholder, EARN denotes earnings announcements, PP is a private placement, PI is a public issue of shares, and ASX is an ASX initiated announcement in relation to the firm. PR is a progress report announcement, which are substantially JORC related disclosures, DIR are change of director disclosures, and 'Price Sens' is the proportion of announcements in that decile, flagged as price sensitive by the ASX.

'Surprise' Decile based on CAR	*Announcements*	*CAR (-1, 0, +1)*	*BSH*	*CSH*	*EARN*	*PP*	*PI*	*ASX*	*PR*	*DIR*	*Price Sens*	*Other announcement*
1	20331	0.1974	0.0157	0.0089	0.1338	0.0385	0.0019	0.0210	0.2470	0.0201	0.4251	0.5174
2	20332	0.0871	0.0150	0.0095	0.1422	0.0321	0.0011	0.0100	0.2159	0.0177	0.3731	0.5595
3	20326	0.0474	0.0161	0.0110	0.1546	0.0290	0.0015	0.0086	0.1952	0.0200	0.3418	0.5657
4	20327	0.0221	0.0164	0.0125	0.1606	0.0243	0.0016	0.0073	0.1767	0.0211	0.3234	0.5803
5	20344	0.0033	0.0153	0.0102	0.1457	0.0236	0.0014	0.0096	0.1634	0.0218	0.3146	0.6097
6	20325	-0.0129	0.0175	0.0147	0.1424	0.0210	0.0010	0.0091	0.1526	0.0209	0.3059	0.6223
7	20335	-0.0309	0.0164	0.0124	0.1444	0.0282	0.0012	0.0079	0.1537	0.0217	0.3108	0.6177
8	20327	-0.0530	0.0153	0.0124	0.1575	0.0292	0.0010	0.0076	0.1532	0.0197	0.3110	0.6082
9	20335	-0.0855	0.0140	0.0105	0.1580	0.0358	0.0014	0.0067	0.1526	0.0190	0.3208	0.6093
10	20325	-0.1694	0.0131	0.0105	0.1519	0.0429	0.0005	0.0132	0.1690	0.0215	0.3514	0.5864
All	203307	0.0005	0.0155	0.0113	0.1491	0.0305	0.0013	0.0101	0.1779	0.0203	0.3378	0.5877

TABLE 8

Cumulative Squared Abnormal Returns Surrounding Pre- vs. Post-2012 JORC Announcements

This table presents cumulative squared abnormal returns for JORC announcements reporting pursuant to the 2004 version of the code (Pre-2012), and those prepared according to the 2012 guidelines (Post 2012). *Pre* is the cumulative squared abnormal returns between t-20 to t-2 relative to the report date. Event is the cumulative squared abnormal return between t-1 and t+1, and *Post* is the cumulative squared abnormal return from t+2 to t+10. Observations were excluded where additional announcements fell within these windows, and n denotes the unique number of announcements included in our tests. *Small*, *Medium* and *Large* are size tercile partitions formed based on ASX market capitalisation breakpoints, resorted monthly. Abnormal returns are winsorised at the 1st and 99th percentiles.

		n	*Pre 2012*	*Post 2012*	*Difference*	*t*
Pre						
(t-20 to t-2)	All		0.0699	0.1043	-0.0344	-19.52
	Small	8565	0.1160	0.1783	-0.0623	-13.54
	Medium	18371	0.0723	0.0836	-0.0113	-6.07
	Large	8803	0.0287	0.0366	-0.0079	-4.44
Event						
(t-1 to t+1)	All		0.0151	0.0244	-0.0093	-17.32
	Small	8606	0.0268	0.0426	-0.0158	-11.37
	Medium	18402	0.0150	0.0194	-0.0044	-7.14
	Large	8812	0.0060	0.0070	-0.0010	-1.88
Post						
(t+2 to t+10)	All		0.0347	0.0518	-0.0171	-19.60
	Small	8433	0.0589	0.0855	-0.0267	-11.63
	Medium	18313	0.0350	0.0437	-0.0087	-9.06
	Large	8794	0.0149	0.0187	-0.0035	-4.17

TABLE 9
Bid-Ask Spreads Surrounding Pre—vs. Post-2012 JORC Announcements

This table presents bid-ask spread difference tests for JORC announcements reporting pursuant to the 2004 version of the code (Pre 2012), and those prepared according to the 2012 guidelines (Post 2012). *Pre* is the average bid-ask spread between t-20 to t-2 relative to the report date. Event is the average bid-ask spread between t-1 and t+1, and *Post* is the average bid-ask spread from t+2 to t+10. Observations were excluded where additional announcements fell within these windows, and n denotes the unique number of announcements included in our tests. *Small*, *Medium* and *Large* are size tercile partitions formed based on ASX market capitalisation breakpoints, resorted monthly.

		n	*Pre 2012*	*Post 2012*	*Difference*	*t*
Pre						
(t-20 to t-2)	All	25614	0.0489	0.1432	-0.0943	-10.78
	Small	5445	0.1039	0.1936	-0.0897	-6.59
	Medium	13328	0.0464	0.1020	-0.0555	-5.75
	Large	6841	0.0173	0.0567	-0.0463	-1.73
Event						
(t-1 to t+1)	All	25615	0.0472	0.1431	-0.0958	-10.84
	Small	5444	0.1003	0.2020	-0.1017	-7.24
	Medium	13332	0.0448	0.0890	-0.0442	-5.20
	Large	6839	0.0101	0.0491	-0.0398	-1.96
Post						
(t+2 to t+10)	All	25556	0.0476	0.1252	-0.0776	-9.92
	Small	5406	0.1010	0.1757	-0.0747	-5.65
	Medium	13313	0.0454	0.0892	-0.0439	-5.81
	Large	6837	0.0102	0.0387	-0.0285	-2.35

Table 10: Probability of informed results surrounding JORC adoption (Post = 2014)

This table presents the results of estimating the following regression model:
$SPRD_{it} = \alpha_0 + \alpha_1 InvTV_i + \alpha_2 IHP_{U,i}(\tau_i) + \alpha_3(IHP_{I,i}(\tau_i) - IHP_{U,i}(\tau_i)) + \alpha_4 D_t + \alpha_5 InvTV_i D_t + \alpha_6 IHP_{U,i}(\tau_i) D_t + \alpha_7(IHP_{I,i}(\tau_i) - IHP_{U,i}(\tau_i))D_t + \epsilon i.$
Variable definitions are provided below the table and the variable of primary interest is $D*(IHP_i\text{-}IHP_u)$.

Panel A: All mining (n=3429)			
Variable	Estimate	t	Pr
Intercept	0.000357	1.66	0.0962
InvTV	1171.21583	11.49	<.0001
IHP_u	0.66779	1.08	0.2808
$IHP_i\text{-}IHP_u$	0.01049	2.03	0.0420
D	0.00076588	2.75	0.0060
*D*InvTV*	-349.67888	-2.72	0.0066
$D*IHP_u$	-2.01208	-1.25	0.2104
$D*(IHP_i\text{-}IHP_u)$	-0.00151	-0.26	0.7941
Adj-R2	0.1367		
Panel B: Small mining (n=2661)			
Variable	Estimate	t	Pr
Intercept	0.00038219	3.46	0.0006
InvTV	1065.86796	12.19	<.0001
IHP_u	0.97767	1.95	0.0508
$IHP_i\text{-}IHP_u$	0.01669	5.99	<.0001
D	0.00066004	3.09	0.0020
*D*InvTV*	-262.23257	-2.25	0.0245
$D*IHP_u$	-4.96007	-2.56	0.0104
$D*(IHP_i\text{-}IHP_u)$	0.00338	0.61	0.5420
Adj-R2	0.1333		
Panel C: Large mining (n=768)			
Variable	Estimate	t	Pr
Intercept	-0.00244	-1.50	0.1351
InvTV	3061.26626	3.25	0.0014
IHP_u	-4.28748	-1.96	0.0515
$IHP_i\text{-}IHP_u$	0.01876	1.84	0.0673
D	0.00250	1.54	0.1253
*D*InvTV*	3849.48310	1.77	0.0776
$D*IHP_u$	7.56074	3.02	0.0029
$D*(IHP_i\text{-}IHP_u)$	-0.01792	-3.66	0.0003
Adj-R2	0.2753		

SPRD is the effective bid-ask spread calculated as SPRD = 2 × [Transaction Price − Midquote], TV is the average number of shares traded over a month, INVTV is the inverse of TV, D is a dummy variable assuming a value of 1 in the JORC 2012 period (2014), and 0 otherwise (2011), and $IHP_{k,i}$ is the inventory holding premium, calculated by:

$$IHP_{k,i} = S_{k,i}N\left(\frac{ln(\frac{S_{k,i}}{X})}{\sigma_i\sqrt{\tau_i}} + 0.5\sigma_i\sqrt{\tau_i}\right) - X_iN\left(\frac{ln(\frac{S_{k,i}}{X})}{\sigma_i\sqrt{\tau_i}} + 0.5\sigma_i\sqrt{\tau_i}\right)$$

Where k = U, I representing uninformed and informed traders respectively. IHPU,i is calculated as an out-of-the-money call option with an exercise price equal to the ask price. $IHP_{I,i}$ is calculated as an in-the-money (ITM) call option with an exercise price of the stock price plus 1% (which exhibited the highest R_2 upon estimating 1% - 10% ITM, as per Bollen, Smith and Whaley (2004) and Sidhu et al. (2008)). T-statistics are reported below the coefficient estimates in parentheses, and are corrected for heteroscedasticity and autocorrelation in the residuals.

APPENDICES

APPENDIX 1: The Geologists' Assessment

Company Name

Project Name

Project Significant to Co?

Main Commodity Au / Fe / Cu / Ni / Zn / coal / graphite / other ____

Deposit Style

Reviewer _____ Date of Review / /

Date of Report

Title (& type) **of Report**

ASX: ____ Secondary Listing?

Market Cap $ M @ ____cps as at dd/mmm/yyyy

Location (= Region & Country):

Time Taken ___ min

JORC-compliant Info – None:	Expl Target	Expl Results	Mineral Rc Est	Ore Rv Est	Prod'n Target	Historic Rc/Rvs
New Info						
Material Change						
Annual Review						
Refers to Earlier						
Project Stage = 1 Target / 2 Grassroots / 3 Anomaly Testing / 4 Ore Definition / 5 Delineation / 6 Feasibility / 7 Construction / 8 Production						

Assessment Summary

Section		Score	Weight	Confid 1/2/3	Rationale (= a brief summary of your thoughts for each section)
1	JORC Compliance		50%		
2	Further Scientific Rigour		25%		
3	Effective Communication		25%		

	Review Assessment Total (Wtd Avg)				
Key Principles JORC Cl.4	Materiality Transparency Competence				
4	Impact & Context				

Part 1a JORC Compliance Detailed JORC compliance assessment (complemented by detailed Table 1 review below)

NB Requirement for reporting on some things (eg changes, conflict of interest or 'all relevant info') & so any related non-compliance will not always be determinable in reading a single report

JORC '04 # Clause #s	JORC '12 #	Clause Summary Notes to assist – *Assessment to be completed in conjunction with 2004 vs 2012 comparison*	2012 expansion (strike-through if not required for reports of this date)	Req'd	Fatal Flaw	Compliant	Quality	Confidence	Rationale (Brief documentation required for "non-compliance", & an outline of reasons suggested for Ratings of 1 or 3)
				Y/N	Y/N	Y/N	1/2/3	1/2/3	
4	4	Transparency, Materiality, Competence							
8	9	Competent Person statement, relationship, consent	Conflict of interest stated	Y	Y				
9	10	Doc prepared / direction, Competent Person signed	Now must include Expl & Prod'n Targets	Y					
10	11	AusIMM, AIG or RPO, 5yrs relevant experience		Y	Y				
11	12	Use of Rc/Rv Terminology		Y	Y				
11	12	Use of Modifying Factors		Y	Y				
12	13	Style of Minl'n/adequate description		Y					
13	14	All relevant info, any material changes NB Very hard to assess "all", "any material change" reading 1 report!	Expl Results as well as 'deposit' ie Rc/Rv	Y	?!				
14	15	Reporting of Mineral Resources/Ore Reserves	Date shown. Date of annual review clear. Discuss material changes	Y	Y				
18	17	Expl target: range, 'proximal' caveat	Caveat on 1st ref in text; basis; CP; testing/		Y				

			time; fig. caveat, no headline						
17	19	Material Exploration results	Range of omitted data Sect 1 & 2 in Table 1 using 'if not, why not' Clear diagrams						
19	20 22 23	Mineral Rc & reasonable prospects for eventual economic extraction			Y				
JORC '04 # Clause #s	JORC '12 #	Clause Summary Notes to assist – *Assessment to be completed in conjunction with 2004 vs 2012 comparison*	2012 expansion (strike-through if not required for reports of this date)	Req'd	Fatal Flaw	Compliant	Quality	Confidence	Rationale (Brief documentation required for "non-compliance", & an outline of reasons suggested for Ratings of 1 or 3)
				Y/N	Y/N	Y/N	1/2/3	1/2/3	
20	21	Inferred Min Rc	More info if mostly InfRc; & extrapolation beyond sampling		Y				
23	24	Min Rc & economic viability cut-off grades = Rc qualified CP	Realistic dev't assumptions						
24	25	Mineral Rc estimate defined , sig figures. Discuss uncertainty	Always called "Est"						
25	26	Separate Rc categories.	No endow't outside Rc unless Cl 18 'Expl Target'	Y	Y				
26 35	27 35	Table 1 detail *(score from Sect 1b below)*	'if not, why not' (27 = Rc, 35 = Rv)	Y	Y				

28	29 30 31	Appropriate study conducted for Rv definition. Rv categories	Pre-feas (>Dec14) All key assumptions disclosed	Y	Y				
31	32	Proved ore Rv Category imply highest degree of conf.	Incl'g detailed mine planning						
34	36	Rc incl or add'l to Rv							
	38	n/a	Scoping Study: order of magntd, timing / proportion of InfRc. Cautionary statement						
	39	n/a	PreFeas: all modifying factors to select preferred method						
	40	n/a	Feas: detailed assess of all modifying factors of chosen method						
			Average Score						

Definitions

	0	1	2	3
	Non-existent	*Minimum*	*Good*	*Excellent*
Quality of JORC Compliance	Non-compliance	Weaknesses and failings apparent, creating uncertainty in interpretation	Some possible weaknesses could be interpreted, but general good compliance & eg some risk discussion	Very thorough detailed compliance & expansions on areas of risk etc
Reviewer Confidence		Very Unsure	Some Confidence	Moderate Confidence

CP = Competent Person; Rc = Resource InfRc = Inferred Resource Rv = Reserve, RPO = Recognised Professional Organisation

Part 1b JORC 2012 Table 1 Review Checklist

Do the reports of Exploration Targets, Exploration Results, Mineral Resources or Ore Reserves require 2012 JORC Code enhanced reporting? **Y/N**

Which sections of Table 1 apply: **Sections 1 & 2** **1,2, & 3 or 1,2, 3 & 4**

Criteria	JORC Code Explanation – *Assessment to be completed in conjunction with 2012 Table 1 detail*	Req'd	Fatal	Compliant incl 'ifNot'	Quality	Reviewer Comments
Section 1	Sampling & Data	Y/N	Y/N	Y/N	1/2/3	
Sampling	Nature and quality of sampling, representativeness					
Drill Techniques	Drill type and details					
Drill Sample Recovery	Methods & outcomes, biases etc					
Logging	Nature & extent of logging undertaken					
Sample prep	Methods & appropriateness, QAQC					
Analytical techniques	Methods, parameters, appropriateness, QAQC					
Verification	Data & sample mgt procedures. Independent review. Repeat of key intersections					
Location	Survey info, grid, topographic control					
Data spacing	Esp wrt Rc / Rv confidence					
Orientation	Direction of drilling relative to structure					
Sample Security	Chain of control procedures					
Audits / Reviews	Results of any review of sampling techniques & results; are the reviews internal / external					
Section 2	Expl Results					
Tenure	Type, location, number, ownership of leases, and issues & agts relating to them					
Expl by others	Record and appraisal of earlier work					

Geology	Deposit style					
Drillhole info	Location, RL, dip, azimuth, EoH, intercepts					
Data aggregation	Weighted average, cut-offs, waste inclusion. Metal equivalent calc					
DH vs true width	Esp for expl results, angle & est'd true width; if not known, clearly stated					
Diagrams	Drill plan + appropriate sections w scale					
Balanced reporting	Indication of low grades & distribution					
Other sig't expl data	Mapping, gpx, gc, bulk sampling, met tests, density, groundwater, geotech, RQD, deleterious materials					
Further work	Planned work, esp maps w possible extensions					
Criteria	JORC Code Explanation – *Assessment to be completed in conjunction with 2012 Table 1 detail*	Req'd	Fatal	Compliant incl 'IfNot'	Quality	Reviewer Comments
Section 3	Mineral Resources Estimate	Y/N	Y/N	Y/N	1/2/3	
DB integrity	Validation & data entry checks					
Site visits	By CP					
Interp	Confidence in interp, assumptions made					
Dimensions	Of Rc					
Est & Model tech's	Nature & appropriateness of techniques used; cut-offs, algorithms, search parameters, block size, correlation. Incorporation of geological control. Validation, reconciliation					

	Use of earlier estimates Recovery of by-products; deleterious elements					
Moisture	Dry tonnes, methods					
Cut-off	Basis					
Mining factors	Mining method assumptions, dilution					
Met factors	Basis for met recoveries assumed					
Enviro factors	Whatever assumptions made					
Density	Assumed or determined of diff't material s; how, why					
Rc Classification	Confidence basis, key factors; stating CP view					
Audits	Results of any review of Rc Est; internal / external					
Accuracy	Any discussion of CP view of confidence / accuracy; or a qualitative discussion					
Section 4	Ore Reserve Estimate					
Rc vs Rv	Description of Rc basis for Rv; Clear add'l/incl					
Site visits	By CP					
Study status	Type & level of feasibility assessment (PFS)					
Cut-off	Basis					
Mining factors	Mining method assumptions, dilution					
Met factors	Basis for met recoveries assumed					
Infrastructure	Existence, land avail: mine, water, power, transport, labour					
Costs	Source & method of assumptions					
Revenue	Derivation of price, forex, TCRC, penalties, NSR..					

Market	Supply:Demand; competitor analysis; price & volume forecasts; product specs & acceptance					
Economic	Source of inflation, discount rate etc. Sensitivity					
Social	Status of agreements w stakeholders					
Other	Material risks: natural, legal, government					
Rv Classification	Confidence basis, key factors; stating CP view Proportion Rc converted					
Audits	Results of any review of Rv Est					
Accuracy	Any discussion of CP view of confidence / accuracy; or a qualitative discussion					
Section 5	Diamonds etc Complete similar section in unlikely event this is required					
	Average Score					*Transfer Score to Clause 26/27 above*

Rc / Rv Material Information: price assumptions, saleable products, depth, shape, cut-off grades…

Modifying Factors: mining, processing, metallurgical, infrastructure, economic, marketing, legal, enviro, social, gov't

CP = Competent Person; Rc = Resource Rv = Reserve,

Part 2 Further Scientific Rigour / Integrity

NB – descriptions of the criteria in the following sections are not of the standard to be reported in academic literature – need agreement on criteria, then potentially need to rework the text for academic criteria? (Judgements may be made on the basis of what is included; the quality, or dissonance, of what is included; the clarity of explanation; or even on what is not included and maybe should've been).

Criterion	Score if relevant low=1/high=3	Rationale
Technical program rationale explained & activities adequately defined?		
Demonstration of technical competence		
Program well explained, no technical weaknesses apparent		
Sample & data management systems & processes documented & satisfactory (QAQC; Chain of control; Lab Audits, who by)		
Choices & assumptions explained / justified		
Feasibility assessment work appropriate to project stage (ie considered early and explained clearly		
Mine parameters: stripping ratio clarity, dilution vs mining losses, recovery		
Clarity & adequacy of diagrams used (esp 3D images!!)		
Uncertainties are recognised & explained well		
Any unsupported statements?		
Poor use of scientific terminology / conventions (eg significant figures beyond Rc Est = Cl 25, detection limits) that brings competence into question		
Average Score		Comments

Part 3 Effective Communication

Implication of exploration activities able to be understood: technical, commercial, corporate; also absences, deceptions, overt selling, spirit, …)

Criterion	Score if relevant low=1/high=3	Rationale
Clarity of Context & Purpose		
Headline vs Exec Summary vs Body		
Does text reflect the data provided?		
Logical Flow		
Funding capacity / schedule discussed (eg exploration campaign, further studies, test program, mine sequence)		
Exploration potential, new or extensional, adequately explained		
Technical progression outlined [+/- expected outcomes?]		
Corporate story incorporated		
Sales / Spin (esp wrt to any commentary reflecting value or that might impact public perception of the quality of the project)		
Anything missing?		
Comments on impact of weaknesses in Code on effectiveness of this report (eg no Scoping Study)		
Ownership & management are clear		
Timeliness		
Reference to earlier releases are adequate (date, title, link)		
Consistency & rigour (eg naming conventions etc)		
Grammar, editing		
Average Score		Comments

Part 4 Impact & Context

Considering the ASX Release that you have just reviewed, we would like your view on its characteristics relative to typical JORC Report Projects. We understand that the Report may not provide sufficient data for you to provide a totally informed answer to all of these questions, but it is your impressions in which we are interested. Provide your best estimate in answer to each question. To understand how sure you are of your answers, we have also included an additional set of columns on your level of confidence in your answers. Could you please tick the appropriate boxes below to indicate how you think that it stacks up on the following characteristics:

	Your best estimate of project score on this characteristic							Your level of confidence in this estimate			Rationale
The PROJECT *as described in this report at the time of the report (eg cf Market Cap)*:	*Not at all*			*To a moderate extent*			*Extremely*	*Very unsure*	*Some conf*	*Mod conf*	
	1	2	3	4	5	6	7	1	2	3	
Is at an early stage project											
Is described in terms that allow its value to be assessed *at this stage*											
Would be considered highly speculative *at this stage*											
Is very promising, based on the information provided here											
Involves a substantial amount of geological uncertainty											
Still involves a substantial amount of contextual uncertainty (ie regulatory, permitting, price, …)											
Has results that could materially change the potential viability of the Project											
Could materially change the value of the Company											
Is likely, *at this stage in your judgement*, to have a: - potential NPV that is positive											
- potential NPV that is large relative to the Company											
- potential NPV that is large relative to capex											
- potential capex that is large relative to the Company											
Is described more optimistically than it should?											
Is described more conservatively than it could?											

Is the Project *previously* familiar to you		
Please explain: worked on it before? read prior reports? Other explanation:	YES / NO (strikeout inappropriate response) YES / NO (strikeout inappropriate response)	
Is the Company *previously* familiar to you		
Please explain: familiar with their other projects? familiar with the company generally? Other explanation:	YES / NO (strikeout inappropriate response) YES / NO (strikeout inappropriate response)	

Appendix 2

Table A2.1 Size Distribution of Mining Sector by ASX Market Capitalisation (in $m) Decile Breakpoints

This table presents the size distribution of mining companies between 2003 and 2014. Every month, each firm is allocated to size deciles according to ASX market capitalisation breakpoints. Statistics are based on the market capitalisation over all included periods.

Deciles	*Firms*	*% of Mining Market Cap*	*Median*	*p25*	*p75*	*Min*	*Max*
Micro	65	0.07	2.89	2.26	3.45	0.91	4.01
2	74	0.16	5.47	4.73	6.26	4.07	7.10
3	72	0.26	9.18	8.10	10.41	7.19	11.74
4	65	0.39	14.94	13.26	16.86	11.89	18.92
5	61	0.60	24.12	21.49	27.34	19.20	30.97
6	57	0.94	41.18	35.58	47.78	31.41	55.36
7	46	1.44	75.63	64.35	90.39	56.52	107.98
8	37	2.51	164.00	134.47	202.60	112.05	243.88
9	37	7.17	422.99	319.09	625.53	255.68	925.40
Big	21	86.45	2653.40	1417.25	6114.59	1019.26	100668.41
All	535	100.00	341.38	202.06	714.52	151.82	10207.38

Appendix 3 Summary of Main Changes in the 2012 JORC Code and the ASX Listing Rules

- The revised *JORC Table 1* to be used for reporting of exploration results and estimation of mineral resources and ore reserves for a material project is required to provide all information material to understanding the results. Disclosure is required on an 'if not, why not' basis (i.e., lack of disclosure to be explained or justified).[28] "*Reporting on an 'if not, why not' basis ensures that it is clear to an investor that items have been considered and deemed of low consequence or are not yet addressed or resolved*" (Coombes et al., 2014, p.769). The intention is to provide the basis for the technical information supplied by a competent person, and an opportunity for peer review (Coombes et al., 2014, p.769). 4

- Historical and foreign estimates – there are strict conditions attached to the use of such estimates. Companies are not permitted to use such estimates in economic studies or in deriving production targets (Stephenson and Stoker, 2014, p.783).

- Production targets – a company must not issue a public report containing or referring to a production target that is based solely on an exploration target or solely on a combination of inferred mineral resources and an exploration target; nor can it do so solely or partly on the basis of historical estimates or foreign estimates of mineralisation. A public report with a production target should disclose all material assumptions on which the target is based. The ASX Listing rules also require a number of cautionary statements (Stephenson and Stoker, 2014, p.783).

- Annual report requirements – ASX Listing rules now require a company to include a mineral resources and ore reserves statement in its annual report. The statement must include a summary of the results of the company's annual review of its ore reserves and mineral resources, and a comparison with the prior year including explanations for material changes.

- Competent person consent – Both the JORC Code and ASX Listing Rules require that announcements containing new exploration results or mineral resource or ore reserve estimates in relation to a material mining project should only be issued with the prior written consent of the competent person. This also applies if there are material changes to estimates (Stephenson and Stoker, 2014, p.782).

[28] In contrast, prior to 2012 non-disclosure was assumed to relate to immaterial items but the nature of undisclosed items or the degree of immateriality were an unknown.

- A preliminary feasibility study or feasibility study – is required in order to report proved or probable ore reserves. The adoption of this minimum standard is intended to offer greater clarity and align the Code with standards elsewhere. This requirement also applies to the conversion of any previous ore reserve estimates that were compliant with the 2004 Code, and therefore must be satisfied if there is a material change to that previous ore reserve (such as in estimate tonnages or grade or quality of the mineralisation) that the company wishes to report as an ore reserve (Stephenson and Stoker, 2014, p.782).

- The terms 'preliminary feasibility study' and 'feasibility study' have particular definitions in the 2012 Edition of the JORC Code:

- 'A Preliminary Feasibility Study (Pre-Feasibility Study) is a comprehensive study of a range of options for the technical and economic viability of a mineral project that has advanced to a stage where a preferred mining method, in the case of underground mining, or the pit configuration, in the case of an open pit, is established and an effective method of mineral processing is determined. It includes a financial analysis based on reasonable assumptions on the Modifying Factors and the evaluation of any other relevant factors which are sufficient for a Competent Person, acting reasonably, to determine if all or part of the Mineral Resources may be converted to an Ore Reserve at the time of reporting. A Pre-Feasibility Study is at a lower confidence level than a Feasibility Study.'
- 'A Feasibility Study is a comprehensive technical and economic study of the selected development option for a mineral project that includes appropriately detailed assessments of applicable Modifying Factors together with any other relevant operational factors and detailed financial analysis that are necessary to demonstrate at the time of reporting that extraction is reasonably justified (economically mineable). The results of the study may reasonably serve as the basis for a final decision by a proponent or financial institution to proceed with, or finance, the development of the project. The confidence level of the study will be higher than that of a Pre-Feasibility Study.'

The response among the legal and investment community to the 2012 changes to the JORC was broadly positive, albeit acknowledging the higher compliance costs that would necessarily flow from the changes. See for example opinions expressed in Wickens (2012), that the new rules would improve transparency and make it easier for companies to communicate with the capital markets:

> *"The amendments materially increase the reporting obligations for mining and exploration companies on a number of key disclosure items and introduce greater prescription on the meaning and use of certain terms. They introduce an annual reporting obligation, but also respond to industry calls for a reduction in red tape, albeit in a small way.*
>
> *We believe the changes will lead to Australian-based mining and exploration companies explaining their projects in a way that is more easily comparable, fair and balanced. Although more onerous, we see the industry will benefit from the new rules through improved international confidence in the quality of Australian reporting and the flow through effect this will have on the availability of capital for mining projects.*

.. Maintaining effective market communications is a well-known requirement for success in the mining and exploration industry. The new rules can be read as guidance on how to improve those communications. Companies that embrace this guidance can use it to their relative advantage, showcasing their projects through clearer, more transparent explanation and inching ahead in the ongoing competition for funding."
