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VALUING RESOURCE INVESTMENTS

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ABSTRACT

The Millennium Boom of 2003–2011 made the resources industry hugely profitable and led to a surge in new projects around the world. This had major implications for the Australian economy: resource investment accounted for almost half of all business investment at the peak, the capitalisation of resource companies as a group surged by approximately 50% relative to the market, and the buoyancy of the sector helped Australia to avoid the worst of the global financial crisis. This paper examines the wealth-creating effects of new resource projects at the individual company level. Results show that substantial increases in shareholder returns occurred around the time of announcements of government approval for projects, the finalisation of feasibility studies, and changes in the status of projects such as when a company committed to invest in a project. This capital-market approach seems to be a viable alternative to conventional ways of valuing resource projects.

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1. Introduction

The Australian economy experienced an unprecedented resources boom in the first decade or so of the 21st century. During this period there was a huge increase in commodity prices and an associated increase in Australia's terms of trade. As observed in Figure 1, the prices of iron ore and coal and Australia's terms of trade were comparatively steady during the period 1993–2003. A sharp increase in commodity prices occurred after 2003. Coal prices trebled and iron ore prices rose ten-fold from 2003 to 2012. Although the price of natural gas increased earlier than that of coal and iron ore, and decreased in 2012, its peak in 2008 was still substantially above the 2003 value. The terms of trade peaked in 2011, almost doubling from 2003.

This surge in commodity prices stimulated a large upswing in resource investment in Australia. Figure 2 shows that the share of resource investment grew from 1.8% of GDP in 1993 to almost 8% of GDP in 2012, accounting for 45% of all business investment in the economy (investment itself reached approximately 18% of GDP in that year). The surge in resource investment has played a vital role in the recent strong performance of the Australian economy. These developments alone highlight the necessity of understanding the economics of this commodity boom, its resource investments, and their consequences. While the recent boom was unusually large, commodity booms are recurrent features that have long shaped the Australian economy; thus, a repeat of this experience can be expected some time in the future, perhaps in a somewhat less spectacular form.[2]

There are three conventional ways of assessing the role of resource projects in the macroeconomy. The first is an accounting approach that simply takes the cost of a project, as reported by the company involved, as its contribution to the economy. An example might be the habit of politicians during resource booms of quoting the (large) estimated cost of projects on the drawing board as an indicator of the vibrancy of their economy. Multiplier analysis, a variant of this approach, is based on an input–output table of inter-industry flows and purports to measure the income and employment generated in supplying industries that can be indirectly attributed to the project. This approach has been subject to harsh criticism because of its rudimentary economic underpinnings that involve fixed-proportion production

[2]Literature on the economics of the recent resources boom in Australia is still evolving; prominent contributions include Atkin et al. (2014), Banks (2011), Battellino (2010), Bhattacharyya and Williamson (2011), Bishop et al. (2013), Connolly and Orsmond (2011), Corden (2012), Gruen (2006, 2010, 2011a, b), Henry (2006), Jääskelä and Smith (2013), Kent (2013), Parkinson (2011), Plumb et al. (2013), Rayner and Bishop (2013), Rees (2013), Sheehan and Gregory (2013), Stapledon (2013) and Walker and Tyers (2013). For recent finance research that deals with the Australian resources sector, see Bird et al. (2013), Ferguson and Scott (2011), and Ferguson et al. (2011a, b, 2013).

functions, no resource limitations, and no role for prices. The second approach is computable general equilibrium (CGE) modelling, which involves detailed sets of demand and supply relationships that reflect optimising behaviour of firms and households, linked by inter-industry flows and accounting identities. CGE modelling also measures the indirect (or flow-on) effects of a project, but has more satisfactory economic foundations than input–output multipliers. Benefit–cost analysis is the third approach, which entails a comparison of all benefits and costs of a project from an economy-wide perspective, including allowance for any identifiable distortions and external effects. Of the three approaches, CGE modelling is now the most widely used in Australia.[3]

This paper uses an alternative approach of analysing the value of resource investments from a capital-market perspective. We use the increase in the share price of the company in question (appropriately adjusted for market-wide changes) following the announcement that a project has reached a significant milestone, such as gaining government approval or completion of a feasibility study. The increased shareholder wealth can be taken to represent the market's assessment of the change in the future profitability of the company. This in turn may be interpreted as the increase in the net present value of the project and the increase in its value to the economy as a whole if there are no substantial external effects. If the company is partly foreign-owned, then part of these benefits accrue to the economies of other countries, but they are still benefits that are rightly attributed to the project.[4]

Three important milestones in the life of a resource project are receipt of government approval, publication of the results of a feasibility study, and a change in the status of the project from "under consideration" to "committed", for example. We present evidence that, on average, all three substantially add to project value and generate shareholder wealth. Importantly for regulators, announcements of government approval tend to be a more important type of event, as these are associated with larger abnormal returns. Moreover, this positive relation between resource investments and abnormal returns tends to be stronger for smaller firms and those with lower investment discretion, which is consistent with the findings of McConnell and Muscarella (1985) and Titman et al. (2004).

[3] For examples of these approaches, see Brown Copeland and Co. (1985), Dixon and Jorgensen (2012), Higgs and Powell (1992), Kouparitsas (2011), Rayner and Bishop (2013), and Ye (2008). For assessments of the approaches, see Clements and Greig (1994), Dwyer et al. (2005), and Layman (2004).

[4] For companies in general (not just resource companies), there is substantial evidence that stock prices tend to respond favourably to announcements of capital investment decisions (Burton et al., 1999, Chan et al., 1995, Chen et al., 1991, 2002, McConnell and Muscarella, 1985). The main reason is that new capital investment is likely to be associated with good growth opportunities for the company (Titman et al., 2004). Higher capital investment could also lead to investors having greater confidence in the company and its management.

The remainder of the paper is organised as follows. Section 2 briefly discusses the process typically followed for a resource investment and Section 3 elaborates the implications for wealth creation. Section 4 sets out the event-study methodology used to measure abnormal returns and contains information on the data. The basic findings on abnormal returns are presented in Section 5, and in Section 6 these returns are related to key firm and project characteristics. Section 7 concludes.

2. The Resource Investment Lifecycle

Unlike most other investments, resources investment is not a one-off event; it is a complex process and entails a long lead time, from a preliminary investment idea to the completion of the project (Hogan et al., 2002). In what follows, we briefly discuss three key aspects of this lifecycle and how it can be treated as a dynamic stochastic system.

Government Approvals

Governments regulate the whole process of resource investments by issuing approvals. In different states of Australia, details of the approval process can differ, but there are broad similarities. Before starting to explore a target area, a company must obtain an exploration licence. After submitting an exploration licence application, the company must also obtain environmental approval for the exploration from the Environmental Protection Authority, a work permit for some specific activities, and an agreement with the landholder. Exploration licences are usually allocated on a first-come first-served basis; however, for some resources (such as coal in Queensland and New South Wales) there is a competitive bidding process. Should the company then consider that the project is economically viable and wish to proceed, it must apply for a full mining licence. If the project is not commercially viable, but may become viable within 15 years, the company may apply for a retention lease.

During the mine development stage, three types of approval are needed before starting construction on project: mine lease approval, environmental approval, and other development approvals. The company must also complete an environmental impact assessment and reach agreement with the landholder, similar to the application procedure for an exploration licence, and obtain mine construction and mining plan approvals.

Feasibility Studies

Before making a final investment decision, a company will engage in intensive financial analyses to evaluate the project. As described by Rudenno (2012), a typical project involves three feasibility study rounds: a scoping study, a preliminary feasibility study, and a definitive feasibility study. A scoping study will be conducted after the initial exploration to further delineate the size of the ore body and test the quality and grade of the deposit. A scoping study can cost millions of Australian dollars and take several months to complete (Rudenno, 2012). If the results of the scoping study indicate the likely economic viability of the deposit, the company will start a preliminary feasibility study. In this stage, more intensive investigation work will be conducted. Unlike a scoping study, which usually deals with inferred or indicated mineral resources, a preliminary feasibility study focuses on the probable or proved ore reserves and provides more precise estimates of the resources. A preliminary feasibility study can take up to a year to complete and cost around ten million dollars (Rudenno, 2012).

Once it receives positive results from the preliminary feasibility study, the company starts to prepare the final analysis, known as the definitive feasibility study. A typical definitive feasibility study can take a couple of years to complete, can cost tens of millions of dollars, and provides more precise estimates of ore reserves (Rudenno, 2012). Feasibility studies usually generate a large amount of unique data on the company's future investment opportunities.

Changes in the Status of Projects

As mentioned previously, a resource project tends to move through a sequential process. This process can be thought of as a project "life cycle", from birth to death. The Investment Monitor (hereafter denoted by IM) published quarterly by Deloitte Access Economics tracks the development of projects with a gross fixed capital expenditure of A$20 million or more in the resources sector.[5] The IM divides the life cycle into five stages: possible, under consideration, committed, under construction, and completed. The IM of March 2012 describes these stages as follows:

> [W]here a project is just an idea, or a promoter is in the early stages of putting a package together, a project will be listed as 'possible'. Where serious feasibility studies are underway, or budget approval is pending, a project is 'under consideration'. A project then progresses to 'committed' when a decision to proceed is announced and to 'under construction' when construction begins.

When construction is completed, the lifecycle is over and the project is removed from the IM.

[5] There are two other major sources of information on Australia resource projects: (i) Resources and Energy Major Projects published by the Bureau of Resources and Energy Economics; and (ii) Prospect Magazine published jointly by the WA Department of Mines and Petroleum and the Department of State Development. For systematic comparisons of IM with these other two sources, see Clements et al. (2014a, b). In addition, the AME Group and Wood Mackenzie offer internally collated project-level data on a consultancy basis.

The Uncertain Life of Resource Projects

The above discussion indicates that before it can be completed, a resource project must pass through a complex development process that is full of uncertainties. The project may be cancelled at any time because of unprofitability, a lack of funds, or rejection by a government approval body. In other words, over its lifecycle, the probability that a project will move from one stage to the next is usually much lower than 100%.

It is illuminating to formalise this uncertainty by treating the life cycle as a stochastic process in the form of a discrete Markov chain (Clements and Si, 2011). This approach considers the probability of a project currently in state i of the cycle (either possible, under consideration, committed, under construction, completed, or deleted) moving to state j in the next period. We define the random variable X_t as the state occupied by a project in period t and let $p_{ij} = P(X_{t+1} = j \mid X_t = i)$ be the conditional probability of the project moving from state i to state j at the end of period t. This p_{ij} is known as a transition probability. If there are six states, then these probabilities can be arranged in a 6×6 matrix $\mathbf{P} = [p_{ij}]$.

Panel A of Table 1 gives estimates of the transition probabilities, with time measured in quarters, derived from the IM data between 2001 and 2012.[6] To interpret these, consider the first row, which refers to a project that is currently classified as possible. The first entry in this row is 92.5%, which means that if a project is currently classified as possible, there is a 92.5% chance that it will remain in this classification in the next quarter. The subsequent entries in the first row show that there is a 3.3% chance it will move to the next state, under consideration, a less than 1% chance it will move to committed status, and so on. The six percentages in this row add to 100, indicating that the project must move into one of these states in quarter t+1. Importantly, the second last entry in this row, 2.2%, indicates there is a small but non-trivial probability of a possible project being abandoned in the subsequent quarter. The other entries in the Deleted column are 1.8%, 1.5%, 0.3%, 0%, and 100%. Thus, for a project under consideration, there is a 2% chance it will be abandoned in the next quarter. The chance of abandonment decreases to 1.5% for a committed project and to 0.3% for a project under construction.

The 2.2% chance of a possible project being abandoned refers to the direct effect over one quarter. Over two quarters, in addition to direct abandonment, the project can also be abandoned indirectly by, for example, first moving into state j (j>1) in one step and then being abandoned in the second. The chance of this occurring is $p_{1j} \cdot p_{j6}$. As the project can

[6]For details, see the Appendix.

move in the first step to any state $j = 1, \ldots, 6,$ the overall two-step probability of abandonment is $\Sigma_{j=1}^{6} p_{1j} \cdot p_{j6},$ which is the inner product of the first row and last column of $\mathbf{P}$:

$$\begin{bmatrix} 92.5 & 3.3 & 0.7 & 0.9 & 0.5 & 2.2 \end{bmatrix} \begin{bmatrix} 2.2 & 1.8 & 1.5 & 0.3 & 0 & 100 \end{bmatrix}' = 4.3\%.$$

In other words, over a period of 6 months, a project that is initially classified as possible has a 4% chance of being abandoned.

In addition to considering the two-step probability of moving from state $i = 1$ (possible) to j=6 (deleted), we can consider the probability of moving from any of the origin states, $i = 1, \ldots, 6,$ to another of the destination states, $j = 1, \ldots, 6.$ These 36 two-step probabilities are given by the 6×6 matrix $\mathbf{P} \cdot \mathbf{P}$. In general, the m-step probabilities, written as $\mathbf{P}^{(m)}$, are obtained by multiplying the original one-step transition matrix $\mathbf{P}$ by itself m times. The $(i, j)^{th}$ element of $\mathbf{P}^{(m)}$ is $p_{ij}^{(m)} = P(X_{t+m} = j \mid X_t = i),$ which is the probability that a project will move from state i to j in m steps. Under certain (mild) conditions, after a large number of steps, the multi-step probabilities converge to their steady-state values, given by the matrix $\lim_{m \to \infty} \mathbf{P}^{(m)}$. Panel B of Table 1 gives these limiting probabilities. The entries corresponding to the first four states are all zero, indicating all projects move out of these intermediate states over the longer term, to end in either of the last two states as completed or deleted (the absorbing states). Thus, for example, if a project is currently classified as possible, ultimately it has a 58% chance of being completed and a 42% chance that it will be abandoned (from the first entries in the completed and deleted columns).

Life is clearly precarious for resource projects that are classified as possible; only about one-half survive to completion. However, the success rates gradually grow for projects that survive to the more advanced states of the cycle. The probability of completion of a project that is under consideration is 74%, for example (the second entry in the panel B part of the completed column). In summary, these results provide a numerical illustration of the difficulties and uncertainties in bringing a resource project into production.

3. Resources and Wealth Creation

As shares in a company represent a claim on its future earnings, stock prices should reflect some form of investor evaluation of these future earnings. That is, the value of a stock is the appropriate fraction of the discounted present value of expected future earnings. If the stock market is working efficiently, then observed prices, on average, equal this benchmark value, and prices change as a result of the receipt of new information that causes the market evaluation of the company's future prospects to be revised up or down. Another way of expressing this idea is to state that prices reflect all publicly available information, so that the stock market can be considered as a mechanism that processes information such that the future prospects of a company are appropriately priced (Fama, 1970). These prices then work in the interests of the broader economy as signals that guide capital to those purposes for which it is most highly valued.

This approach to the stock market provides a practical way to value investments in resource projects. A substantial event in the life of a prospective new project, such as granting of approval by government, changes the company's expected future earnings, and the capitalised value is the stock-price change at the time the approval is announced. Thus, the change in the stock price at this time is a measure of the change in its value. To operationalise this idea, we need to be precise about what is meant by the term "announcement" and its date, as well as what companies are likely to be affected. Also required is an asset pricing model that provides the "baseline" return to isolate the impact of the announcement of the new information from other developments in the market that are taking place at the same time. Nonetheless, the approach essentially involves a simple but fundamental economic theory—the theory of efficient capital markets—that is useful in valuing resource projects.

Ball and Brown (1968) and Fama et al. (1969) proposed an event-study methodology to measure the value of new information. In essence, the observed change in a company's stock price, adjusted for the change in the overall market, is examined before, during, and after the announcement of new information (the "event"). These adjusted returns are then averaged over all affected companies to give an estimate of the underlying abnormal return that can be attributed to the event. This average abnormal return (AAR) represents the estimated overall "value" of the event.

How should this value be interpreted? Consider the case of a mining company that obtains development approval for its project. Because the government approval is an essential prerequisite for the project to proceed, the capital market would most likely interpret this event as enhancing the future profitability of the company, thereby leading to a higher stock price and shareholder wealth. The wealth creation is real in the sense that shareholders could realise it by selling their shares at the higher price (or borrow against the asset) and use the proceeds for consumption or other investment purposes. The real income of shareholders has thus increased. In this sense, it is obviously a private gain. If there are no external effects that might create a distortion, the private gain coincides with the social gain, so there is also a gain to the economy as a whole. If some of the company's shares are foreign-owned, then part of this gain goes overseas, but it is still a gain for some economy.

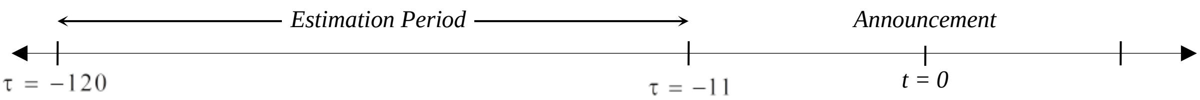
The stock price rises on account of upward revision of the expected future earnings of the company because of the higher probability that the project will be initiated and become profitable. As the higher earnings are attributable to the project, the enhanced capitalisation of the company can be interpreted as a measure of the increased value of the project. Accordingly, the higher market capitalisation resulting from project approval has three interpretations: It is (i) higher private wealth for shareholders; (ii) higher wealth for the economy as a whole (foreign and domestic, with the split depending on the pattern of ownership); and (iii) an increased value of the project itself. The event-study approach therefore provides a useful way of calculating the change in the value of projects from the viewpoint of the economy as a whole.

4. Methodology and Data Description

We use a one-factor market model to evaluate market reactions to important events in the life cycle of resource investments. This model takes the form

(1) $R_{i\tau} = \alpha_i + \beta_i R_{m\tau} + \varepsilon_{i\tau} \quad i = 1, \cdots, N; \tau = 1, \cdots, T,$

where $R_{i\tau}$ is the daily return on stock i from $\tau - 1$ to τ, defined as $\left(p_{i\tau} - p_{i,\tau-1}\right) / p_{i,\tau-1}$, with $p_{i\tau}$ the price of i on day τ; $R_{m\tau}$ is the return on the market; α_i and β_i are parameters to be estimated; ε_{it} is a disturbance term for stock i with an expectation of zero and variance σ_i^2; N is the number of events; and T is the number of days in the estimation period. To estimate Equation (1), we use a 110-day window that starts 120 days before the event day (denoted as day 0) and ends 11 days before. This window can be conveniently denoted by (–120,–11). This is illustrated as follows (MacKinlay, 1997):



The disturbance term of Equation (1) captures new information about the company that hits the market. Therefore, the impact of new information is the abnormal return, that is, the difference between actual and expected returns, $R_{it} - E\left(R_{it} \mid R_{mt}\right) = R_{it} - \left(\alpha_i + \beta_i R_{mt}\right)$. If we measure abnormal returns 10 days before and 10 days after the event (on day $t = 0$), they can be estimated as

$$AR_{it} = R_{it} - \left(\hat{\alpha}_i + \hat{\beta}_i R_{mt}\right) \qquad t = -10, \cdots, +10,$$

where t is the day relative to the announcement day and the hats denote estimated parameters.

The variance of AR_{it} is

$$\text{var}\left(AR_{it}\right)=\sigma_i^2\left[1+\frac{1}{T}+\frac{\left(R_{mt}-\bar{R}_m\right)^2}{\sum_{\tau=1}^{T}\left(R_{m\tau}-\bar{R}_m\right)^2}\right],$$

where $\bar{R}_m=\sum_{\tau=1}^{T}R_{m\tau}/T$ is the average market return during the estimation window.

The abnormal returns are aggregated in two dimensions to make overall inferences regarding the event of interest. First, they are aggregated over time by defining the cumulative abnormal return for stock i from t_1 to t_2:

$$CAR_i\left(t_1,t_2\right)=\sum_{t=t_1}^{t_2}AR_{it},$$

with variance (Aktas et al., 2004, Ruback, 1982)

$$\text{var}\left(CAR_i\left(t_1,t_2\right)\right)=\sigma_i^2U\left[1+\frac{U}{T}+\frac{U\left(\sum_{t=t_1}^{t_2}R_{mt}/U-\bar{R}_m\right)^2}{\sum_{\tau=1}^{T}\left(R_{m\tau}-\bar{R}_m\right)^2}\right]+2\left(U-1\right)\text{cov}\left(R_{it},R_{i,t-1}\right),$$

where $U=\left|t_2-t_1+1\right|$ is the number of days between t_1 and t_2. The first-order autocovariance $\text{cov}\left(R_{it},R_{i,t-1}\right)$ can be estimated from the estimation window.

The second aggregating approach involves averaging over events. For N events, the average abnormal return for day t is

$$AAR_t=\frac{1}{N}\sum_{i=1}^{N}AR_{it}.$$

The AARs are then aggregated over the event window from t_1 to t_2 to give the corresponding cumulative concept:

$$CAAR\left(t_1,t_2\right)=\sum_{t=t_1}^{t_2}AAR_t=\frac{1}{N}\sum_{i=1}^{N}CAR_i\left(t_1,t_2\right).$$

Then, following MacKinlay (1997), the significance of the abnormal returns can assessed using

$$t=\frac{AAR_t}{\sqrt{\text{var}\left(AAR_t\right)}}\text{ and }t=\frac{CAAR\left(t_1,t_2\right)}{\sqrt{\text{var}\left(CAAR\left(t_1,t_2\right)\right)}}.$$

To implement the above measures, we consider the firms listed on the Australian Securities Exchange (ASX) in the resources sector and collect announcements on project approvals granted to mining companies by the government, the completion of feasibility studies, and a change in status for resource projects. The announcements were collected from the DatAnalysis database by searching for key words.[7] The announcement date (t = 0) is

[7] The key words used in our searches for announcements were "approval" and "permit" for government approvals, and "scoping study", "preliminary feasibility study", "definitive feasibility study", and "bankable

taken to be the date on which the company's initial announcement appeared in DatAnalysis. The stock prices and indices are derived from the DataStream database. We use returns on the ASX300 market index as a proxy for market returns for ASX-listed stocks.

Our sample comprises 1,128 announcements by 463 companies spanning the period 2001–2012. Table 2 gives the distribution of events by year and type of announcement.[8] The number of observations mostly increases over time, reflecting the growth of resources activity as the boom gathered speed. Government approvals account for the largest proportion of announcements.[9] Some clustering of announcements is evident for 2011–2012; however, on a daily basis, the announcements do not seem to be abnormally bunched.[10]

Table 3 reports information relating to the resource companies.[11] Firm size is the market capitalisation of the announcing company for the fiscal year prior to the announcement. Capital investment is the firm's capital expenditure for the year preceding the announcement. Free cash flow is defined as the ratio of free cash flow to total assets for the year prior to the announcement. Debt is the ratio of total liabilities to total assets for the year prior to the announcement. It is evident that the average firm size for the whole sample is somewhat less than $A3 billion, but this varies considerably across the different groups. Firms gaining government approval and announcing feasibility study results have a similar average size of the order of $A200 million, but firms with projects that change status are much larger on average (more than $A9 billion). Smaller firms tend to have a higher propensity to announce that they have received approval or completed a feasibility study, because such an event is more likely to be price-sensitive. In contrast, for a larger firm that may have a substantial number of projects, such an event may not be material. In addition, smaller firms may feel a greater need to "advertise" progress in their projects to potential suppliers of capital. There are fewer small firms in the third category (change in project status) because the underlying information comes from IM, which tends to concentrate on larger projects. These reasons account for the preponderance of small firms in the first two categories relative to the third. As discussed below, this can have implications for the interpretation of our results.

Free cash flow is negative on average for all groups in Table 3. In addition, the first two groups have similar patterns for free cash flow and debt ratios. For firms in the change-of-

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feasibility study" for feasibility studies. Using the project information given in the IM, we collected the announcement dates for changes in project status.

[8] In the Appendix, these announcements are split by type of approval, feasibility study, and status change.

[9] A possible reason is that most approvals give the company exclusive rights to explore their targeted area for 5–10 years. Therefore, companies may apply for approvals well in advance of possible mine development.

[10] For further details on the data, see the Appendix.

[11] The data are from DatAnalysis.

status group, free cash flow is greater (less negative) and debt is higher, on average.

5. Abnormal Returns and Wealth Creation

As mentioned above, we used the market model to calculate abnormal returns around event announcement dates. Table 4 and Figure 3 summarise the results by averaging the abnormal returns over events for the day of the announcement, and the days before and after the announcement. As shown in column 2 of Table 4, the overall AARs spike on the day of the announcement at 3.04%, which is significant at the 1% level. The important implication is that the announcements create substantial wealth. Furthermore, no significant spikes are evident before or after the announcement day, except for days +3 and +4, but those AARs are only −0.32% and −0.33%, which are small compared to the AAR for the announcement day. This suggests that there is no or limited evidence of information leakage occurring before the event day, or price drift/reversal thereafter. In other words, prices jump substantially on the announcement day and subsequently remain at the higher values, at least on average. The increase in shareholder wealth is more or less permanent.

Next, we split the results according to the type of event. Several interesting results are evident in columns 3–5 of Table 4 and panels B–D of Figure 3. Government approvals have the largest and most significant AARs (4.03%) on the announcement day. The announcement-day AARs for feasibility studies (2.06%) and changes in project status (2.07%) are also significant and positive, but are smaller. As mentioned above, firms that announce approvals and feasibility studies tend to be smaller; thus, the large AARs for government approvals may reflect a small-firm effect. In Section 6 we control for this possibility by including a firm size variable in a regression involving AARs. For each type of event, the AARs spike on the event day and fluctuate around zero before and after. These results are consistent with the theory of efficient markets, whereby prices immediately and permanently react to the release of new information.[12]

In addition to the daily AARs, we analyse the cumulative abnormal returns to allow for possible information leakage and/or after-hours announcements. Results for a 3-day window, CAR(−1,1), are reported in panel A of Table 5. From column 2, the average CAR is 3.15%, significant at the 1% level, which is similar to the findings in Table 4. The median abnormal

[12] In the Appendix, AARs are split by type of government approval, feasibility study, and status change. The results indicate the following. (i) Exploration and development approvals are more important than environmental approvals, on average. (ii) Among feasibility studies, completion of scoping studies and definitive feasibility studies is associated with significant AARs. (iii) Regarding changes in status, there are three types: (a) before project commitment (comprising the IM states of "possible" and "under consideration"); (b) committed; and (c) post committed ("under construction" and "completed"). The AARs for announcements of types (a) and (c) are significant, while those for (b) are insignificant.

return is 1.12%, which is also significant at the 1% level. In addition, 59% of the price changes are positive, indicating that the results are not driven by outliers. The remaining columns of this panel give the corresponding results split by event type, for which government approvals again seem to be the most important.[13]

The dollar value of the wealth effects are obtained by multiplying 3-day cumulative abnormal returns by the corresponding market capitalisation in the preceding year. Panel B of Table 5 and Figure 4 give the results. Total wealth creation is slightly greater than $A7,000 million. The majority of this increase comes from changes in project status, but it is possible that this result partly stems from the dominance of large projects run by large companies for this type of event.[14] The economic interpretation of these results is addressed in the final section.

6. What Drives Market Reactions?

In this section we explore how abnormal returns are related to firm and project characteristics.

Firm Characteristics

Prior research indicates that a large firm value has a negative effect on the market reaction when firms announce new investment decisions.[15] To investigate this possibility, we use market capitalisation at the end of the fiscal year before the event to measure firm size. We sort abnormal returns into quintiles for firm size and calculate the equal-weighted portfolio returns. Table 6 gives the results for the 3-day CARs. Panel A refers to all event types and shows that except for the highest quintile, abnormal returns decrease monotonically with firm size, as expected. All portfolio returns are positive and significant. The low–high spread is 4.38% and significant, again supporting a small-firm effect. The other information in this panel on the distribution of returns indicates that the better performance of small firms does not seem to be due to outliers. Panels B–D of the table give the same information for the three types of events. The results are broadly similar to those in panel A, except that the small-firm effect does not seem to operate as strongly for announcements regarding changes in project status. Again, this is probably explained by the predominance of large firms in this

[13] We also examined the CARs for 2-, 5-, and 11-day windows and the results are broadly similar to those of Table 5. The only major exception is that for an 11-day window, the mean CARs for announcements of feasibility studies are no longer significant. See the Appendix for details.

[14] To avoid distortion, outliers in panel B are trimmed by removing observations in the upper and lower 5% tails. Panel C contains the results when there is no trimming, and estimated wealth created is substantially larger at about $36,000 million, which highlights the role of large projects/companies. On the basis of conservatism, we favour the lower figure.

[15] See Chen et al. (2000), Hertzel and Smith (1993), and Kang and Stulz (1996).

category. Note also that announcements of government approval seem to generate the highest returns for most matched portfolios (but again this needs to be qualified by the over-representation of small firms in approval announcements).

According to Jensen (1986), free cash flow plays a critical role in explaining the market reaction to capital investment announcements. Companies with high free cash flow tend to undertake less valuable investment projects rather than pay out funds to shareholders. Companies with low free cash flows are more likely to seek new external financing for capital investment projects. Because of the monitoring that tends to come with external financing, governance of these companies is likely to be more transparent, which enhances their performance. Thus, companies with low (high) free cash flows are more likely to experience positive (negative) market reactions to capital investment announcements. There is evidence supporting this hypothesis, but this is related to firms that mostly have positive cash flows.[16] Resource companies can be quite different because their projects are highly capital-intensive, need large capital expenditure before profits are generated, and many have negative cash flows.

Does this agency-theory hypothesis hold for resource companies? To investigate this issue, a company's free cash flow is defined as operating income before depreciation minus interest expense, taxes, preferred dividends, and common dividends, all divided by the book value of total assets, for the year preceding the announcement (Chen et al., 2009). We sort 3-day CARs into quintiles for cash flows and calculate equal-weighted portfolio returns. The distributional characteristics of the portfolio returns are reported in Table 7. The results are somewhat consistent with the theory. Panel A of Table 7, for all types of events, indicates that returns monotonically decrease as cash flows increase except for the third-lowest portfolio. In addition, the difference in returns between the lowest and highest portfolios (2.98%) is positive and significant. Panels B–D show the disaggregated results. Although the spread is positive in each case, these are only significant for government approvals.

Finally, as a way to control for all factors simultaneously, Table 8 contains the results for regression of the 3-day CARs on firm size and cash flow, as well as the book-to-market ratio and capital expenditure. Even with these additional controls, the results for firm size are basically consistent with those of Table 6. Size has a negative impact on returns and this is usually significant (but not for status changes),. Free cash flow also has a negative effect and now this is mostly significant (but not for status changes), which provides slightly more support for the agency theory than the results in Table 7. Row 4 of Table 8 gives the results

[16]See Del Brio et al. (2003) and Vogt (1997), for example, but note that Chen and Ho (1997) and Chen et al. (2009) do not find supportive evidence.

after including two dummy variables for announcements on feasibility studies and status changes, together with the other variables. The coefficients for the dummy variables are both negative. Although these are not significant, they still indicate that government approvals (the base case for the dummies) are the most important type of announcement in driving higher shareholder value.[17]

Project Characteristics

Table 9 reports the results of regressions of 3-day CARs on project characteristics. As project information is available only for feasibility studies, the abnormal returns here refer to those announcements. Surprisingly, the impact of the net present value (NPV) of projects on returns is insignificant. The NPV of a resource project is highly dependent on future commodity prices and the exchange rate. As these are notoriously difficult to predict, one possible reason for the insignificance of the NPV is that investors do not regard the estimated NPV as being very accurate and thus it is of limited value in pricing the share. The results also show that project cost has a negative, but insignificant, effect on abnormal returns, whereas the length of the production life of the project is positively related to abnormal returns and is significant at the 5% level. It is plausible that investors refer to use project life as a proxy for expected profitability rather than the possibly noisy NVP. When adding firm size (model 2 of the table), project life is still significant. The type of product to be produced by the project is insignificant, as shown by models 3 and 4.[18]

7. Broader Implications and Summary

Before production commences, a resources project usually experiences a long and complex life history. The first stage involves an initial idea, and then the project proceeds through a series of stages, including government approvals, feasibility studies, and securing financing. Eventually, if all goes well, construction is completed. However, much can go wrong along the way and for each stage there is a nontrivial chance of failure. Thus, a significant milestone is achieved when a project actually progresses through the life cycle and we measured the increase in its value corresponding to this progression. We did this by analysing the stock market reaction to announcements that (i) government approvals have been granted for the project to proceed, (ii) feasibility studies have been completed, and (iii)

[17] As a sensitivity test, we repeated the regressions with 5-day CARs and the results are broadly similar to those of Table 8. One change, however, is that the coefficient for the dummy variable for feasibility studies, although still negative as in Table 8, is now significant. The coefficient for the status change dummy remains negative and insignificant. Details are contained in the Appendix.

[18] For results using 5-day CARs, see the Appendix. Project life continues to have a positive effect on returns, but is now less significant. The other results are broadly similar to those of Table 9.

the project has moved to a subsequent stage in its life cycle. Our results show that, on average, substantial shareholder wealth is created when projects meet these milestones. We also explored the relationship between this wealth creation (in the form of abnormal returns) and the characteristics of companies, and found a small-firm effect: Smaller-sized companies tend to have higher abnormal returns than larger companies do. There was also some support for the agency-theory hypothesis that companies with more debt face more stringent monitoring and thus are better governed and tend to have larger abnormal returns. The results also indicate that projects with a longer production life have larger abnormal returns, on average, but, surprisingly, the NPV of projects (as estimated in feasibility studies) has a minimal impact on returns. It seems likely that investors impute little value to estimated NPVs, as these are highly dependent on future values of commodity prices and exchange rates, which are notoriously volatile and difficult to predict.

The three conventional approaches of measuring the value of resource projects are (i) recorded cost/multiplier analysis, (ii) computable general equilibrium modelling, and (iii) benefit–cost analysis. The capital-market approach we used differs from these. Instead, it measures a type of social surplus, which is similar to consumer or producer surplus. That is, it represents the additional benefits of the project after the cost of all inputs, including the opportunity cost of capital, has been covered. It seems that this is a viable measure that has not been fully appreciated previously.

There are qualifications to the approach that need to be kept in mind. First, using the capital market to provide an unbiased measure of value presupposes that the market is efficient. While this is considered controversial by some, it is regarded as a natural assumption by others. Second, there is an issue regarding the size of companies. Consider an event that changes the prospects of a single project that is relatively small in the context of the overall operations of a large resource company. This might not be considered to be sufficiently material to warrant a special public announcement of the event. However, if a smaller company had the same project, an announcement would be mandatory if the event were price-sensitive, as it would be likely to be. Our approach cannot measure the impact of a project in the large-company case. Third, our approach is clearly only suitable for publicly listed companies because only such companies are required to make announcements on substantial developments in their businesses. Notwithstanding these qualifications, it seems that our approach is a simple, practical way of valuing projects. It may be useful not only to financial and macro economists but also to regulators in deciding whether or not to approve a certain project. In doing so, they endeavour to balance the potential costs against the underlying economic value. The approach introduced in here could provide policy-makers with another way of analysing the economic value of resource projects.

Two other aspects of our results should be highlighted. First, there are significantly positive abnormal returns on announcement days, which confirms the importance of the approval, feasibility study, and status change milestones in the economic life of projects. Second, the abnormal returns were mostly zero before and after announcements, so there is rapid embodiment of new information in prices. The little information leakage or price drop off is a characteristic of a well-functioning, efficient market.

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TABLE 1

TRANSITION PROBABILITIES,

AUSTRALIAN RESOURCE INVESTMENTS

Stage i	Stage j						Total
	Possible	Consideration	Committed	Construction	Completed	Deleted	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			A. One-Quarter Transition Probabilities				
1. Possible	92.5	3.3	0.7	0.9	0.5	2.2	100
2. Consideration	0	92.4	2.1	2.5	1.3	1.8	100
3. Committed	0	0	68.1	27.7	2.7	1.5	100
4. Construction	0	0	0	86.4	13.3	0.3	100
5. Completed	0	0	0	0	100	0	100
6. Deleted	0	0	0	0	0	100	100
			B. Limiting Transition Probabilities				
1. Possible	0	0	0	0	58.47	41.53	100
2. Consideration	0	0	0	0	73.53	26.47	100
3. Committed	0	0	0	0	93.39	6.61	100
4. Construction	0	0	0	0	97.90	2.10	100
5. Completed	0	0	0	0	100	0	100
6. Deleted	0	0	0	0	0	100	100

Note: All entries are to be divided by 100.

TABLE 2

NUMBER OF ANNOUNCEMENTS

Year	Government approvals	Feasibility studies	Changes in status	Total
(1)	(2)	(3)	(4)	(5)
2001	10	5	27	47
2002	7	6	18	33
2003	12	7	23	45
2004	16	6	28	53
2005	24	13	47	85
2006	42	10	49	101
2007	68	13	45	127
2008	56	17	31	104
2009	51	12	17	80
2010	67	44	9	120
2011	98	48	5	151
2012	108	88	1	198
Total	559	269	300	1,128

TABLE 3

CHARACTERISTICS OF RESOURCE COMPANIES

Statistic	Firm size ($A m)	Capital investment		Free cash flow (% of total assets)	Debt (% of total assets)
		Value ($A m)	% of total assets		
(1)	(2)	(3)	(4)	(5)	(6)
		A. Total (N=1,128)			
Mean	2657	167	15.50	–28.12	19.09
Median	36	2.23	11.82	–20.86	9.22
Minimum	0.75	–1.87	–5.91	–583.2	–1.23
Maximum	202,610	13,403	257.87	90.92	258.97
SD	15,799	859	17.37	46.42	22.70
		B. Government Approval (N=559)			
Mean	233	16	14.68	–32.72	15.65
Median	24	1.35	10.31	–23.77	7.36
Minimum	0.75	–1.87	–5.91	–576.96	0.21
Maximum	40,458	1,669	257.87	75.15	258.97
SD	1,872	93	18.34	52.33	23.39
		C. Feasibility Study (N=269)			
Mean	252	14.84	15.74	–33.68	12.58
Median	30	2.20	12.33	–25.61	7.24
Minimum	2	–0.16	–0.94	–583.20	0.21
Maximum	28,848	2,016	206.36	90.92	113.17
SD	1,790.74	123.23	17.78	47.68	15.29
		D. Changes in Status (N=300)			
Mean	9,326	585	16.85	–14.15	31.71
Median	150	12	12.68	–6.10	32.39
Minimum	2.2	–0.16	–0.94	–123.43	–1.23
Maximum	202,610	13,403	73.64	75.15	77.87
SD	29,471	1584	14.77	25.79	22.25

TABLE 4

AVERAGE ABNORMAL RETURNS

(Percent per day)

Day relative to announcement day	Total (N=1,128)	Type of event: Government approvals (N=559)	Type of event: Feasibility studies (N=269)	Type of event: Changes in status (N=300)
(1)	(2)	(3)	(4)	(5)
–5	0.14 (0.86)	0.27 (1.05)	–0.21 (–0.64)	0.20 (0.88)
–4	–0.17 (–1.02)	–0.16 (–0.60)	–0.19 (–0.59)	–0.15 (–0.70)
–3	0.36 (2.17)	0.72 (2.68)	–0.15 (–0.45)	0.15 (0.66)
–2	0.25 (1.52)	0.16 (0.58)	0.34 (1.02)	0.35 (1.54)
–1	0.18 (1.11)	–0.15 (–0.53)	0.97 (2.95)	0.09 (0.38)
0	3.04 (18.54)	4.03 (15.22)	2.06 (6.33)	2.07 (9.08)
+1	–0.07 (–0.43)	0.16 (0.60)	–0.86 (–2.63)	0.21 (0.92)
+2	–0.26 (–1.58)	–0.38 (–1.43)	–0.38 (–1.17)	0.07 (0.33)
+3	–0.32 (–1.98)	–0.43 (–1.64)	–0.32 (–0.99)	–0.12 (–0.54)
+4	–0.33 (–1.98)	–0.09 (–0.33)	–0.91 (–2.76)	–0.25 (–1.09)
+5	–0.19 (–1.17)	–0.05 (–0.21)	–0.50 (–1.51)	–0.18 (–0.78)

Note: t-values in parentheses.

TABLE 5

CUMULATIVE ABNORMAL RETURNS

AND WEALTH CREATION

Statistic	Total (N=1,128)	Type of event		
		Government approvals (N=559)	Feasibility studies (N=269)	Changes in status (N=300)
(1)	(2)	(3)	(4)	(5)
		A. 3-Day Cumulative Abnormal Returns		
Mean (%)	3.15	4.05	2.18	2.36
t-statistic	11.82	9.46	4.02	6.39
Median (%)	1.12	1.60	0.34	1.03
p-value	<0.0001	<0.0001	0.01	<0.0001
% Positive	59	61	51	61
		B. Dollar Value of Wealth Creation (with truncation)		
Total	7,119	704	–7	6,422
Mean	7	1.38	–0.03	23.79
t-statistic	4.05	6.72	–0.08	3.72
Median	0.30	0.29	0.03	1.07
p-value	<0.0001	<0.0001	0.01	<0.0001
% Positive	60	62	51	62
		C. Dollar Value of Wealth Creation (without truncation)		
Total	36,258	83	–1,633	37,809
Mean	32	0.15	–6	126
t-statistic	1.00	0.06	–0.96	1.04
Median	0.30	0.29	0.03	1.07
p-value	<0.0001	<0.0001	0.01	<0.0001
% Positive	59	61	51	61

Notes: 1. The p-values for the median were determined using the Wilcoxon signed-rank test.

2. To deal with outliers, observations in the upper and lower 5% tails are removed in panel B. This reduces the number of events to 509 (government approvals), 243 (feasibility studies), and 270 (changes in status), a total of 1,022.

3. All dollar values expressed in $A in millions.

TABLE 6

CUMULATIVE ABNORMAL RETURNS BY FIRM-SIZE PORTFOLIOS

Portfolio	Mean		Standard deviation	Maximum	Third quartile	Median	First quartile	Minimum
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)
				A. Total				
Lowest	6.62	(8.14)	19.34	115.27	10.03	1.65	–2.90	–23.66
2	4.00	(6.19)	13.00	68.27	8.59	1.60	–2.29	–26.51
3	1.63	(2.76)	11.58	61.66	7.58	0.81	–4.36	–63.52
4	1.28	(2.62)	8.56	28.00	5.44	0.74	–2.87	–25.75
5	2.24	(6.71)	7.29	39.84	3.94	0.96	–1.49	–12.51
Total	3.15	(11.82)	12.82	115.27	6.84	1.12	–2.67	–63.52
Low–high	4.38	(3.17)	–	–	–	–	–	–
				B. Government Approvals				
Lowest	6.53	(5.29)	21.17	115.27	8.05	1.07	–3.26	–21.34
2	5.89	(5.51)	15.01	68.27	10.02	1.74	–1.48	–20.39
3	2.77	(3.06)	9.49	26.10	9.14	2.34	–3.48	–25.85
4	2.58	(3.21)	10.95	61.66	6.20	1.26	–3.55	–17.12
5	2.45	(3.72)	7.22	22.57	5.93	1.68	–2.69	–14.09
Total	4.05	(9.46)	13.76	115.27	8.11	1.60	–2.69	–25.85
Low–high	4.09	(1.93)	–	–	–	–	–	–
				C. Feasibility Studies				
Lowest	6.97	(4.76)	19.21	86.42	10.42	2.98	–2.90	–23.66
2	3.95	(3.22)	12.32	43.87	8.09	1.16	–2.29	–20.73
3	1.72	(1.33)	15.11	43.49	11.12	–0.24	–7.87	–30.15
4	–4.24	(–3.9)	13.04	20.00	1.35	–1.88	–7.16	–63.52
5	2.51	(2.83)	9.43	38.48	4.71	0.53	–2.92	–10.06
Total	2.18	(4.02)	14.58	86.42	7.32	0.34	–4.00	–63.52
Low–high	4.46	(1.52)	–	–	–	–	–	–
				D. Changes in Status				
Lowest	3.03	(2.52)	13.32	70.51	7.09	1.07	–4.69	–23.88
2	3.33	(3.49)	7.24	20.38	8.45	3.39	–0.91	–20.05
3	1.54	(2.01)	8.07	28.00	3.90	0.60	–2.62	–25.75
4	3.10	(5.27)	7.23	39.84	4.18	1.39	–0.37	–11.70
5	0.81	(2.16)	3.93	17.32	2.20	0.82	–1.61	–10.05
Total	2.36	(6.39)	8.52	70.51	5.01	1.03	–1.80	–25.75
Low–high	2.22	(1.24)	–	–	–	–	–	–

Note: t-values in parentheses.

TABLE 7

CUMULATIVE ABNORMAL RETURNS BY FREE-CASH-FLOW PORTFOLIOS

Portfolio	Mean		Standard deviation	Maximum	Third quartile	Median	First quartile	Minimum
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)
				A. Total				
Lowest	5.35	(7.78)	18.25	115.27	10.16	1.63	–3.39	–26.51
2	2.48	(3.92)	13.53	68.27	7.32	0.65	–3.89	–63.52
3	3.01	(4.83)	10.77	52.51	7.34	1.00	–3.02	–30.15
4	2.58	(4.43)	8.88	61.66	6.82	1.66	–2.19	–29.08
5	2.37	(5.42)	10.33	95.56	4.10	1.00	–1.48	–22.55
Total	3.15	(11.82)	12.82	115.27	6.84	1.12	–2.67	–63.52
Low–high	2.98	(2.09)	–	–	–	–	–	–
				B. Government Approvals				
Lowest	6.59	(6.39)	19.65	115.27	10.00	1.74	–2.59	–15.69
2	3.01	(3.03)	12.72	68.27	7.45	0.61	–3.69	–20.39
3	4.99	(5.23)	12.56	58.29	9.82	2.58	–2.19	–25.85
4	1.97	(2.02)	9.18	61.66	6.39	1.55	–3.28	–19.16
5	3.68	(5.42)	12.23	95.56	6.69	1.87	–1.72	–22.55
Total	4.05	(9.46)	13.76	115.27	8.11	1.60	–2.69	–25.85
Low–high	2.91	(2.58)	–	–	–	–	–	–
				C. Feasibility Studies				
Lowest	3.97	(2.90)	19.82	86.42	10.35	0.16	–6.12	–23.66
2	0.72	(0.60)	16.38	43.49	8.06	0.24	–4.36	–63.52
3	3.22	(2.59)	13.26	38.48	8.09	2.32	–2.92	–30.15
4	0.56	(0.47)	11.13	36.57	2.78	–0.63	–4.61	–29.08
5	2.45	(2.38)	10.37	43.87	6.20	0.41	–2.17	–23.25
Total	2.18	(4.02)	14.58	86.42	7.32	0.34	–4.00	–63.52
Low–high	1.52	(0.50)	–	–	–	–	–	–
				D. Changes in Status				
Lowest	2.69	(2.55)	11.07	39.84	6.67	1.63	–2.39	–25.75
2	2.88	(2.94)	9.29	33.46	6.96	0.23	–3.82	–10.93
3	2.50	(3.18)	5.78	12.94	6.92	2.50	–1.49	–11.84
4	2.29	(3.52)	10.27	70.51	3.11	0.91	–1.15	–15.35
5	1.44	(2.64)	4.33	17.32	2.40	0.91	–1.15	–6.80
Total	2.36	(6.39)	8.52	70.51	5.01	1.03	–1.80	–25.75
Low–high	1.24	(0.81)	–	–	–	–	–	–

Note: t-values in parentheses.

TABLE 8

CUMULATIVE ABNORMAL RETURNS AND FIRM CHARACTERISTICS

Model	Intercept	Firm size	Free cash flow	Book-to-market ratio	Capex	Type of event	
						Feasibility study	Change in status
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				A. Total			
1.	9.41 (2.89)	–0.39 (–2.26)	–0.03 (–3.33)	–	–	–	–
2.	14.59 (4.29)	–0.68 (–3.46)	–	0.03 (1.13)	0.02 (0.81)	–	–
3.	2.63 (4.38)	–	–0.04 (–4.30)	–0.01 (–0.24)	–0.04 (–1.56)	–	–
4.	10.37 (2.78)	–0.42 (–1.96)	–0.03 (–3.33)	0.02 (0.73)	-0.03 (-1.18)	-1.39 (-1.49)	–0.36 (–0.35)
				B. Government Approvals			
5.	13.56 (2.21)	–0.60 (–1.73)	–0.02 (–2.15)	–	–	–	–
6.	17.96 (2.96)	–0.84 (–2.36)	–	0.03 (0.73)	0.01 (0.33)	–	–
7.	3.46 (4.10)	–	–0.04 (–2.95)	0.00 (0.00)	–0.05 (–1.56)	–	–
8.	12.98 (2.02)	–0.56 (–1.50)	–0.03 (–2.31)	0.02 (0.44)	–0.04 (–1.10)	–	–
				C. Feasibility Studies			
9.	19.36 (1.86)	–1.05 (–1.81)	–0.05 (–2.46)			–	–
10.	24.54 (2.40)	–1.35 (–2.33)	–	0.05 (0.70)	0.06 (1.20)	–	–
11.	0.77 (0.57)	–	–0.06 (–2.40)	–0.01 (–0.10)	–0.02 (–0.27)	–	–
12.	19.49 (1.85)	–1.07 (–1.79)	–0.05 (–1.88)	0.01 (0.17)	–0.01 (–0.10)	–	–
				D. Changes in Status			
13.	6.15 (1.56)	–0.20 (–1.05)	0.01 (0.31)	–	–	–	–
14.	3.66 (0.91)	–0.04 (–0.16)	–	–0.03 (–0.97)	0.01 (0.02)	–	–
15.	3.17 (3.18)	–	0.01 (0.48)	–0.04 (–1.47)	0.01 (0.35)	–	–
16.	4.45 (1.05)	–0.07 (–0.31)	0.01 (0.55)	–0.03 (–1.08)	0.01 (0.36)	–	–

Note: Firm size is the logarithm of capitalisation; free cash flow and capital expenditure (capex) are measured as ratios to total assets; and the type-of-event variables are dummies taking a value of 1 if the announcement of the event is of the relevant type, and 0 otherwise, with government approvals as the base. Figures in parentheses are t-values.

TABLE 9

CUMULATIVE ABNORMAL RETURNS AND PROJECT CHARACTERISTICS

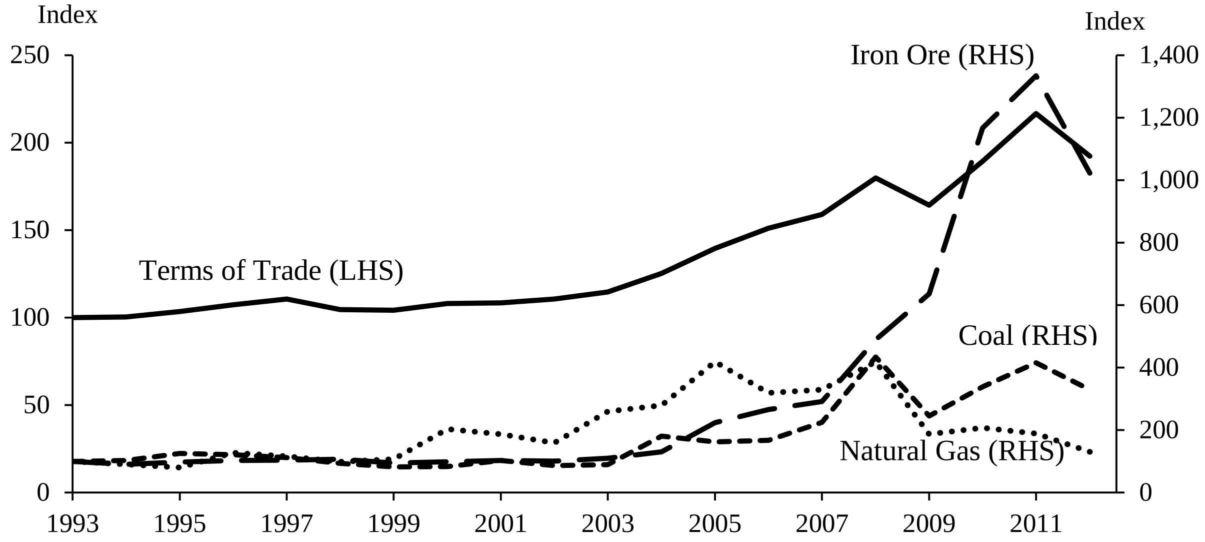
Model	Intercept	Firm size	NPV	Project cost	Production life of project	Type of product (dummies with iron ore as the base)			
						Coal	Gold	Copper	Other
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
1.	–3.72 (–0.71)	–	–0.15 (–0.11)	–1.82 (–1.60)	6.61 (2.39)	–	–	–	–
2.	–2.33 (–0.43)	–0.76 (–0.92)	0.22 (0.15)	–1.74 (–1.52)	6.20 (2.21)	–	–	–	–
3.	–7.02 (–0.97)	–	–0.03 (–0.02)	–1.59 (–1.34)	6.33 (2.07)	–1.17 (–0.18)	1.74 (0.43)	2.98 (0.73)	3.52 (1.00)
4.	–5.95 (–0.81)	–0.75 (–0.89)	0.35 (0.23)	–1.50 (–1.27)	5.94 (1.92)	–0.88 (–0.14)	2.11 (0.52)	2.93 (0.72)	3.64 (1.03)

Note: Firm size is the logarithm of capitalisation; NPV is the logarithm of project NPV (NPV measured in $m); project cost is the logarithm of project capital investment ($m); production life of project is the logarithm of life of project once in production (years); and dummy variables for type of product take a value of 1 if the project product is of the relevant type, and 0 otherwise, with iron ore as the base. Figures in parentheses are t-values. Abnormal returns refer to announcements of feasibility studies.

FIGURE 1

AUSTRALIA'S TERMS OF TRADE AND COMMODITY PRICES

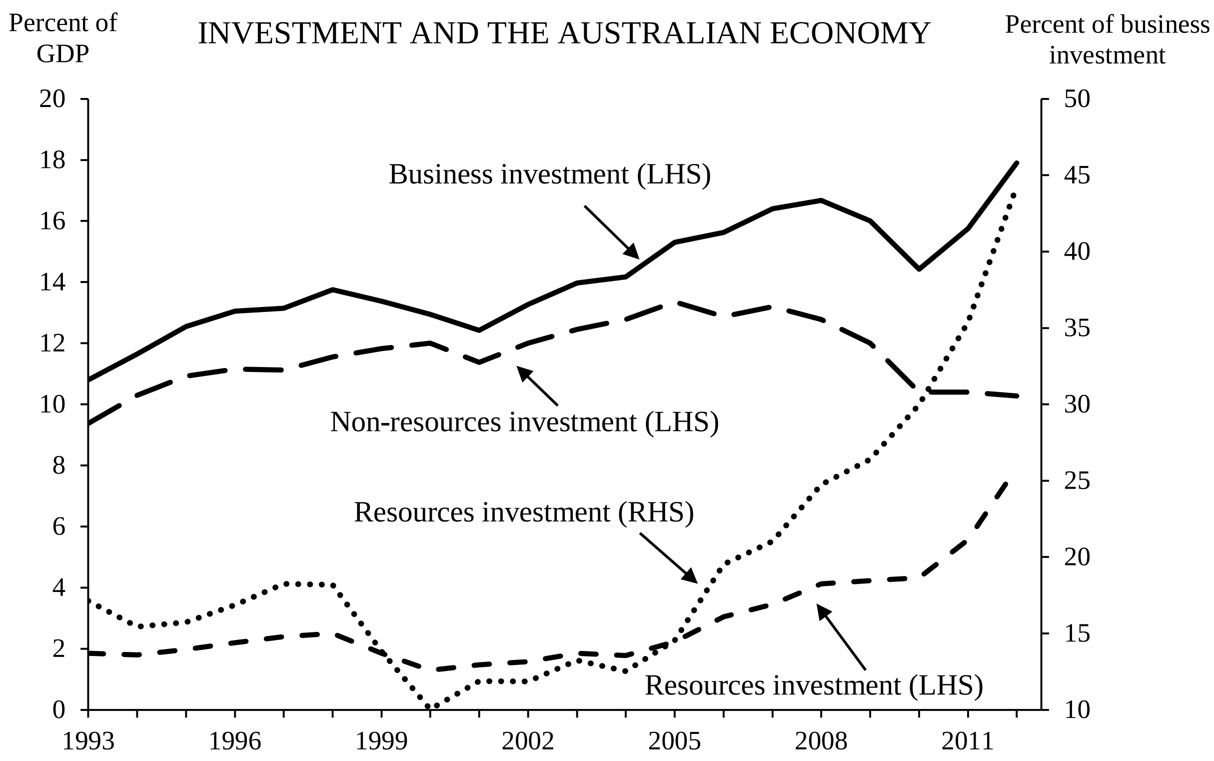
(Indexes, 1993 = 100)



Source: ABS Cat. No. 5206.0 and Index Mundi (http://www.indexmundi.com/commodities).

FIGURE 2

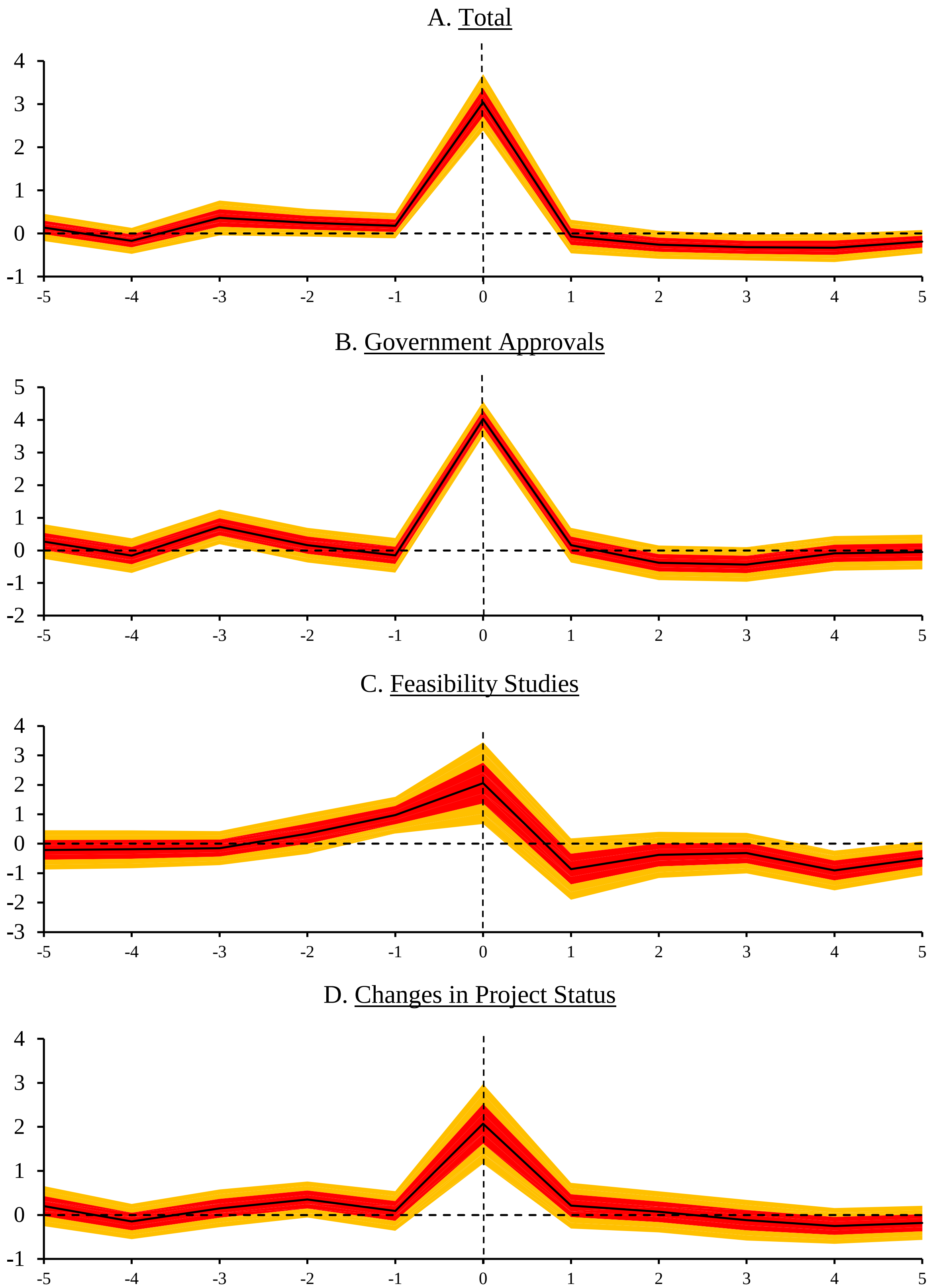
INVESTMENT AND THE AUSTRALIAN ECONOMY



Note: Resources investment refers to investment in the mining and energy industries.
Source: Kent (2013).

FIGURE 3

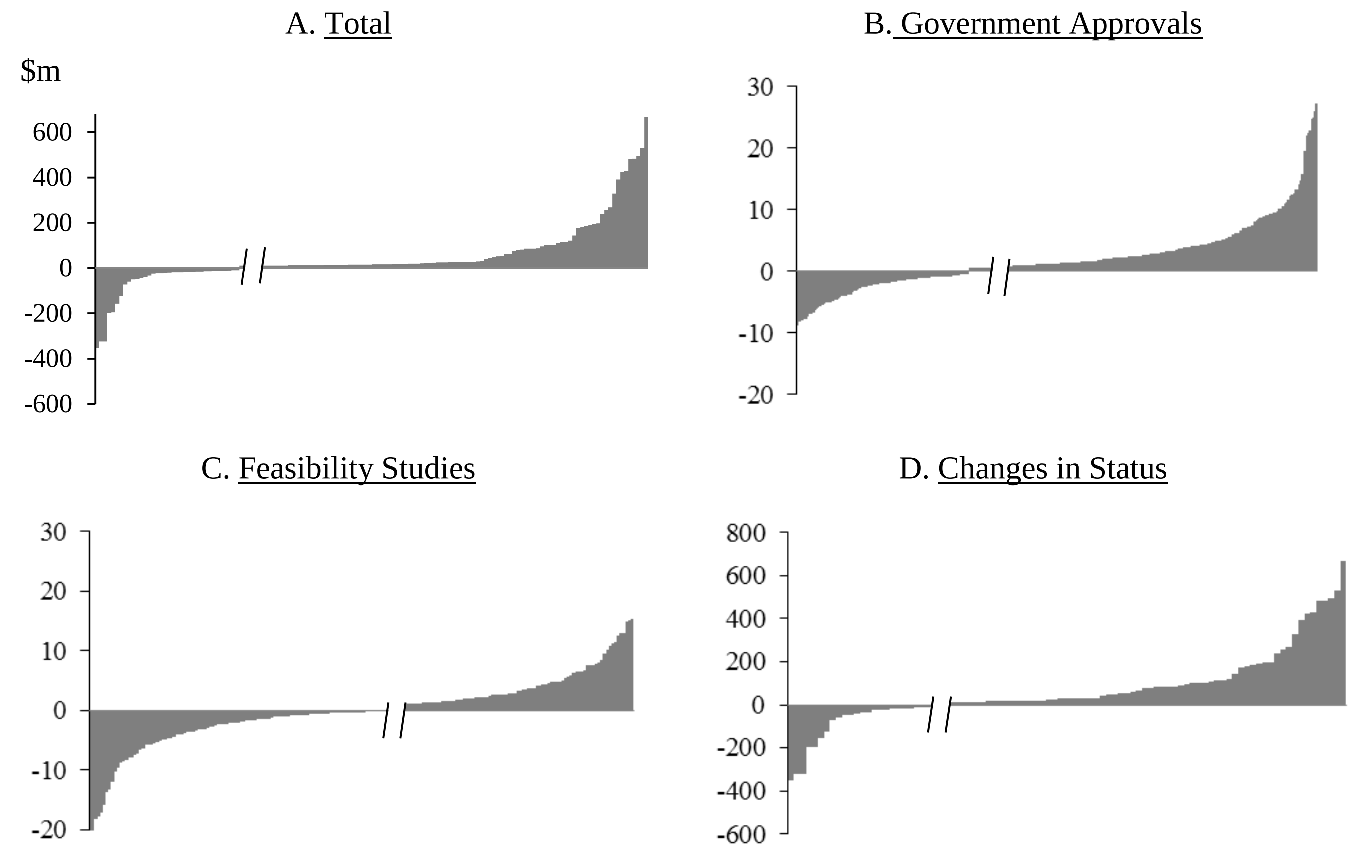
AVERAGE ABNORMAL RETURNS, RESOURCE COMPANIES



Note: Each panel of this figure plots the average abnormal returns (in percent per day) of Table 4 against time measured relative to the announcement day. The solid line is the average abnormal returns, the dark shaded band is the average ±1 SE and the lighter band is ±2 SEs.

FIGURE 4

CHANGES IN WEALTH



Note: This figure presents the Australian dollar value of wealth created following a number of events, ranked in ascending order; these are truncated according to panel B of Table 5. Events with minimal wealth effects are omitted, as indicated by the broken scale on the horizontal axes.

APPENDIX

This appendix contains some details of the transition probabilities, additional results on abnormal returns when events are further disaggregated, and some sensitivity tests.

Estimation of the Transition Probabilities

The transition probabilities in Table 1 are estimated using the project data from Deloitte Access Economics' Investment Monitor for the period 2001:Q1–2012:Q3. These data refer to 1,298 unique projects in the mining and energy industries. After correcting for errors and filtering out projects that do not meet certain criteria there are 745 projects. The details of this procedure are set out in Table A1. The transition probabilities are estimated as the relative frequency for changes in the project status.

Disaggregated Abnormal Returns

Table A2, which is a disaggregated version of Table 2, gives the number of announcements for each type of government approval, feasibility study, and status change. Table A3 lists the average abnormal returns (AARs) corresponding to the split of events in Table A2. Panel A of Table A3 refers to the AARs associated with government approvals. Column 2 of this panel gives the results for all types of approvals, which corresponds to column 3 of Table 4. These results are split in columns 3–5 by type of approval. Panels B and C of Table A3 give the AARs for announcements of feasibility studies and status changes. The results in column 2 of these two panels are the same as those of Table 4.

Sensitivity Results

Panel A of Table A4 summarises the 3-day cumulative abnormal returns, denoted CAR(−1,+1). This panel reproduces panel A of Table 5. The other panels of Table A4 contain the results for CAR(–1,0), CAR(–2,+2), and CAR(–5,+5). Tables A5 and A6 contain the cross-sectional regression results using CAR(–2,+2) as the dependent variable. These results are a sensitivity check on the results of Tables 8 and 9, for which CAR(−1,1) is used as the dependent variable.

TABLE A1

FILTERING THE PROJECT STATUS DATA

Data issue	Impact of filter on		Remaining number of projects
	Number of projects	Total number of projects	
(1)	(2)	(3)	(4)
1. Initial number of projects	–	–	1,298
I. Non-Cost Items			
2. Projects with only an absorbing state (after 2001:1)	2	–2	
3. Moves from absorbing state to transition state	3	–3	
4. Single projects split into two	5	–5	
5. Wrongly assigned new project number	7	–7	
6. Changed major industry	13	–10	
7. Unknown starting history	5	–5	
8. No ending state record	22	–22	
9. Cost filter not applied properly	2	–2	
10. Repeated ending state	3	–	
11. Typographical error in record number	1	–	
12. Blank record number	1	–	
13. Missing new project indicator	1	–	
14. Subtotal		–56	1,242
II. "At least $20m" Filter			
15. Projects <$20m dropped in 2009:3	72	–72	
16. Projects <$20m dropped in previous quarters	196	–196	
17. Completed or deleted projects in 2009:3	124	–124	
18. Subtotal		–392	850
III. Recording Issues			
19. Backward movements	92	–92	
20. Subtotal		–92	758
IV. Other Issues			
21. Project in "Completion" or "Deleted" states in 2001:1	13	–13	
22. Subtotal/Final number of projects		–13	745

Note: This table is from Clements et al. (2014a).

TABLE A2

NUMBER OF ANNOUNCEMENTS BY TYPE OF EVENT

Year	Government approvals				Feasibility studies				Changes in Status					
	Exploration	Environmental	Development	Total	Scoping	Pre-Feasibility	Definitive feasibility	Total	Possible	Consideration	Committed	Under construction	Completion	Total
2001	6	2	2	10	4	0	1	5	6	7	7	4	3	27
2002	1	0	6	7	1	2	3	6	2	3	4	4	5	18
2003	2	1	9	12	2	4	1	7	4	6	7	2	4	23
2004	6	2	8	16	2	1	3	6	3	6	11	3	5	28
2005	9	4	11	24	5	2	6	13	8	13	8	11	7	47
2006	21	10	11	42	4	5	1	10	3	24	4	10	8	49
2007	39	11	18	68	5	4	4	13	10	7	11	6	11	45
2008	26	10	20	56	5	9	3	17	6	5	8	6	6	31
2009	26	11	14	51	3	4	5	12	1	7	1	3	5	17
2010	29	11	27	67	15	13	16	44	1	3	2	2	1	9
2011	51	16	31	98	21	12	15	48	1	1	1	-	2	5
2012	55	15	38	108	46	19	23	88	-	1	-	-	-	1
Total	271	93	195	559	113	75	81	269	45	83	64	51	57	300

TABLE A3

AVERAGE ABNORMAL RETURNS BY TYPE OF EVENT

Day relative to announcement day	A. Government Approvals							
	Total (N=559)		Exploration (N=271)		Environment (N=93)		Development (N=195)	
(1)	(2)		(3)		(4)		(5)	
–5	0.27	(1.05)	0.39	0.90	-0.14	(-0.28)	0.31	0.81
–4	–0.16	(–0.60)	–0.11	(–0.27)	0.20	0.41	–0.39	(–1.00)
–3	0.72	(2.68)	0.78	1.75	0.36	0.74	0.79	2.04
–2	0.16	(0.58)	0.06	0.11	0.17	0.36	0.29	0.75
–1	–0.15	(–0.53)	–0.15	(–0.34)	–0.65	(–1.29)	0.11	0.28
0	4.03	(15.22)	4.41	10.05	2.19	4.45	4.39	11.30
+1	0.16	(0.60)	0.10	0.21	1.29	2.63	–0.29	(–0.75)
+2	–0.38	(–1.43)	–0.59	(–1.35)	0.15	0.32	–0.35	(–0.87)
+3	–0.43	(–1.64)	–0.65	(–1.50)	–0.28	(–0.56)	–0.20	(–0.52)
+4	–0.09	(–0.33)	–0.07	(–0.19)	0.09	0.21	–0.19	(–0.47)
+5	–0.05	(–0.21)	–0.06	(–0.18)	0.09	0.20	–0.11	(–0.26)
Day relative to announcement day	B. Feasibility Studies							
	Total (N=259)		Scoping (N=113)		Pre-feasibility (N=75)		Definitive feasibility (N=81)	
–5	–0.21	(–0.64)	–0.19	(–0.34)	0.03	(0.06)	–0.45	(–0.88)
–4	–0.19	(–0.59)	0.13	(0.22)	–0.50	(–0.88)	–0.35	(–0.68)
–3	–0.15	(–0.45)	–0.94	(–1.66)	0.47	(0.82)	0.38	(0.74)
–2	0.34	(1.02)	0.20	(0.35)	0.79	(1.37)	0.10	(0.20)
–1	0.97	(2.95)	1.52	(2.67)	0.37	(0.64)	0.74	(1.44)
0	2.06	(6.33)	3.30	(5.79)	0.88	(1.55)	1.45	(2.82)
+1	–0.86	(–2.63)	–0.36	(–0.64)	–1.28	(–2.22)	–1.16	(–2.26)
+2	–0.38	(–1.17)	–0.38	(–0.67)	0.33	(0.57)	–1.04	(–2.01)
+3	–0.32	(–0.99)	–0.60	(–1.06)	–0.24	(–0.42)	–0.01	(–0.02)
+4	–0.91	(–2.76)	–0.76	(–1.34)	–1.14	(–1.98)	–0.88	(–1.70)
+5	–0.50	(–1.51)	–0.67	(–1.19)	0.11	(0.18)	–0.80	(–1.54)
Day relative to announcement day	C. Changes in Status							
	Total (N=300)		Before committed (N=128)		Committed (N=64)		Post committed (N=108)	
–5	0.20	(0.88)	0.24	(0.57)	0.34	(0.86)	0.07	(0.24)
–4	–0.15	(–0.70)	0.01	(0.01)	0.19	(0.47)	–0.55	(–1.80)
–3	0.15	(0.66)	0.35	(0.86)	0.41	(1.03)	–0.25	(–0.81)
–2	0.35	(1.54)	0.12	(0.30)	0.42	(1.05)	0.58	(1.87)
–1	0.09	(0.38)	–0.23	(–0.57)	0.33	(0.83)	0.32	(1.04)
0	2.07	(9.08)	3.32	(8.04)	0.71	(1.78)	1.38	(4.48)
+1	0.21	(0.92)	–0.37	(–0.90)	0.29	(0.73)	0.85	(2.75)
+2	0.07	(0.33)	–0.01	(–0.01)	0.00	(0.02)	0.21	(0.69)
+3	–0.12	(–0.54)	–0.33	(–0.80)	0.22	(0.56)	–0.08	(–0.26)
+4	–0.25	(–1.09)	–0.34	(–0.81)	0.04	(0.10)	–0.31	(–1.01)
+5	–0.18	(–0.78)	–0.38	(–0.92)	–0.42	(–1.06)	0.21	(0.67)

TABLE A4

CUMULATIVE ABNORMAL RETURNS,

DIFFERING WINDOW LENGTH

Statistic	Type of Event			
	Total (N=1,128)	Government approval (N=559)	Feasibility study (N=269)	Change in status (N=300)
(1)	(2)	(3)	(4)	(5)
		A. CAR (–1,1)		
Mean (%)	3.15	4.05	2.18	2.36
t-statistic	11.82	9.46	4.02	6.39
Median (%)	1.12	1.60	0.34	1.03
p-value	<0.0001	<0.0001	0.01	<0.0001
% Positive	59	61	51	61
		B. CAR (–1,0)		
Mean	3.22	3.89	3.03	2.15
t-statistic	14.59	10.96	6.81	9.03
Median	1.15	1.29	1.22	0.92
p-value	<0.00	<0.00	0.00	<0.00
% Positive	61	63	57	60
		C. CAR (–2,+2)		
Mean	3.14	3.83	2.13	2.79
t-statistic	17.07	13.28	5.45	6.93
Median	1.18	1.59	0.14	1.37
p-value	<0.00	<0.00	0.04	<0.00
% Positive	57	58	50	61
		D. CAR (–5,+5)		
Mean	2.63	4.08	–0.15	2.43
t-statistic	27.60	38.77	–0.53	14.02
Median	1.16	1.69	–0.75	1.33
p-value	<0.01	<0.00	0.03	<0.01
% Positive	54	56	46	58

TABLE A5

CUMULATIVE ABNORMAL RETURNS AND FIRM CHARACTERISTICS, ALTERNATIVE 5-DAYWINDOW

Model	Intercept	Firm size	Free cash flow	Book-to-market ratio	Capex	Type of event	
						Feasibility study	Change in status
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				A. Total			
1.	8.29 (3.05)	–0.35 (–2.37)	–0.03(–4.30)	–	–	–	–
2.	15.02 (5.18)	–0.64 (–3.27)	–	–0.01 (–2.14)	0.01 (0.64)	–	–
3.	2.51 (4.38)	–	–0.04 (–5.54)	–0.01 (–0.38)	–0.05 (–2.26)	–	–
4.	9.87 (2.96)	–0.36 (–2.01)	–0.04 (–4.17)	–0.01 (–1.32)	–0.04 (–1.74)	–1.68 (–2.16)	–0.61 (–0.71)
				B. Government Approvals			
5.	11.56 (2.17)	–0.50 (–1.64)	–0.03 (–2.69)	–	–	–	–
6.	20.21 (3.52)	–0.90 (–2.82)	–	–0.01 (–1.90)	0.01 (0.34)	–	–
7.	3.68 (4.37)	–	–0.04 (–3.36)	–0.01 (–0.70)	–0.05 (–1.58)	–	–
8.	14.41 (2.34)	–0.60 (–2.34)	–0.03 (–2.53)	–0.01 (–1.35)	–0.04 (–1.19)	–	–
				C. Feasibility Studies			
9.	10.07 (1.23)	–0.55 (–1.21)	–0.05 (–3.45)	–	–	–	–
10.	20.96 (2.30)	–1.05 (–2.14)	–	–0.02 (–1.16)	0.04 (1.11)	–	–
11.	0.29 (0.21)	–	–0.07 (–3.63)	0.01 (0.38)	–0.05 (–1.05)	–	–
12.	10.19 (1.06)	–0.53 (–1.04)	–0.06 (–3.08)	–0.01 (–0.10)	–0.05 (–0.92)	–	–
				D. Changes in Status			
13.	7.29 (2.22)	–0.28 (–1.73)	0.01 (0.51)	–	–	–	–
14.	8.19 (2.42)	–0.29 (–1.93)	–	–0.01 (–0.92)	–0.01 (–0.43)	–	–
15.	1.89 (2.26)	–	–0.01 (–0.44)	–0.01 (–0.22)	–0.01 (0.27)	–	–
16.	0.62 (2.44)	–0.36 (–2.00)	0.02 (0.71)	–0.01 (–1.05)	0.01 (0.03)	–	–

Note: Firm size is the logarithm of capitalisation; free cash flow and capital expenditure (capex) are measured as ratios to total assets; and the type-of-event variables are dummies taking a value of 1 if the announcement of the event is of the relevant type, and 0 otherwise, with government approvals as the base. Figures in parentheses are t-values.

TABLE A6

CUMULATIVE ABNORMAL RETURNS AND PROJECT CHARACTERISTICS,

ALTERNATIVE 5-DAY WINDOW

Model	Intercept	Firm size	NPV	Project cost	Production life of project	Type of product (dummies with iron ore as the base)			
						Coal	Gold	Copper	Other
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
1.	–5.73 (–0.95)	–	0.35 (0.22)	–1.39 (–1.06)	5.40 (1.69)	–	–	–	–
2.	–3.82 (–0.61)	–1.05 (–1.10)	0.85(0.52)	–1.28 (–0.97)	4.83 (1.49)	–	–	–	–
3.	–7.10 (–0.84)	–	0.42 (0.26)	–1.38 (–1.01)	5.43 (1.53)	–1.36 (–0.18)	1.85 (0.39)	–0.83 (–0.18)	1.80 (0.44)
4.	–5.45 (–0.64)	–1.16 (–1.18)	1.01 (0.58)	–1.25 (–0.91)	4.84 (1.35)	–0.82 (–0.12)	2.44 (0.51)	–0.91 (–0.19)	1.98 (0.49)

Note: Firm size is the logarithm of capitalisation; NPV is the logarithm of project NPV (NPV measured in $m); project cost is the logarithm of project capital investment ($m); production life of project is the logarithm of life of project once in production (years); and dummy variables for type of product take a value of 1 if the project product is of the relevant type, and 0 otherwise, with iron ore as the base. Figures in parentheses are t-values. Abnormal returns refer to announcements of feasibility studies.

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