

# A horizontal merger in the iron ore industry: An event study approach

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## Abstract

The purpose of this paper is to analyse the competitive and efficiency impacts of a large merger in the world iron ore industry, using an event study approach. This method builds on an analysis of stock market reactions of the merging firms as well as close rivals at the time of the merger announcement. The event study method allows for the possibility to assess both the motivations behind as well as the welfare effects of the merger. The event study results for the merger announcement of Rio Tinto and North Ltd. show that, according to the market reactions, the main motive behind the merger was either the market power or the efficiency hypothesis. When adjusting the analysis to include several information releases about the merger, the overall result indicates that efficiency improvements were the predominant motives behind the merger. Thus, the event study results suggest that there are positive welfare effects to expect and the European Commission's decision to allow the merger is supported.

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## Introduction

The mining industry has experienced a strong consolidation trend during the last decade through a number of mergers and acquisitions. Fig. 1 presents the total annual amount spent on mergers and acquisitions (M&As) in the mining industry over the time period 1995–2006. Fig. 1 also shows the percentage share of mining M&As compared to total amount spent on M&As worldwide for each year. During 2006, 140 billion US dollars were spent on mergers, which is about 5–6 times more than the average amount spent on mergers during the entire time period. Before 2006, the largest merger activity (measured in financial terms) took place in 2001 when almost 40 billion US dollars were spent on merger and acquisitions (Ericsson, 2007).

The iron ore industry provides a good example of a mining industry with intense merger activities. Examples of large mergers in the iron ore industry are Rio Tinto–North Ltd. (2000), CVRD–Ferteco (2001), CVRD–Caemi (2001),

and Anglo American and Kumba Resources (2002). All these large-scale mergers have increased the concentration in the iron ore industry, but none of them have been rejected by the relevant competition authorities.<sup>1</sup> However, without a thorough analysis of the consequences of the relevant mergers it is difficult to assess the competitive effects, as well as to identify the motivation behind the mergers. Have these mergers led to increased efficiency, i.e., are the combined entities able to exploit synergies and lower their operating costs? Or will the new firm be able to increase consumer prices? Moreover, it is not always certain that the merger has had a positive impact on the combined entity; there exists evidence showing that not all mergers are profitable.<sup>2</sup> In such cases, what can be the explanation behind the mergers? These are some of the issues that this paper addresses.

<sup>1</sup>The merger between CVRD–Caemi in 2001 was not cleared until the parties agreed to dispose Caemi's 50% interest in QCM Canada, which removed the possibility of the new entity to become dominant in the market for iron ore lump (European Commission, 2001).

<sup>2</sup>For an extensive review of the effects of mergers on profitability, both positive and negative, see Roller et al. (2000).

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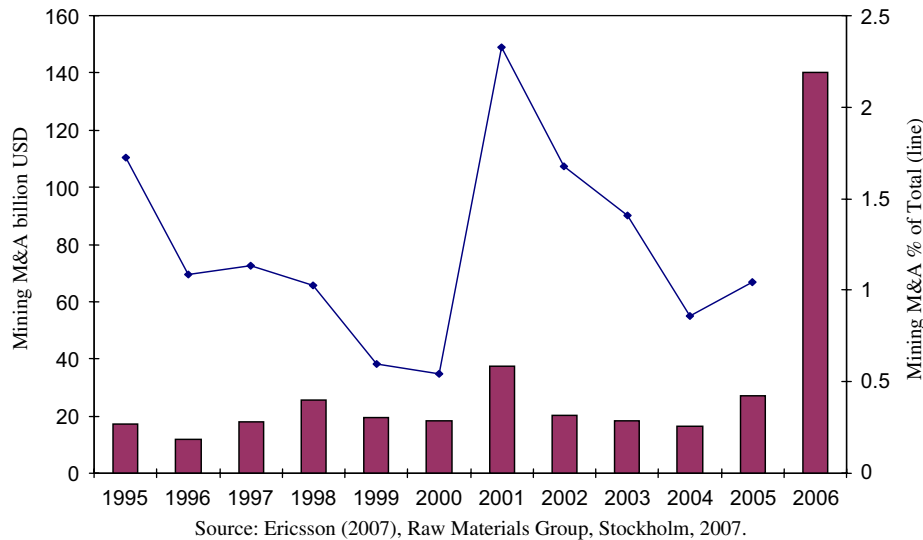


Fig. 1. Mining mergers and acquisitions, 1995–2006. Source: Ericsson (2007), Raw Materials Group, Stockholm, 2007.

Two types of methods are commonly used to investigate the causes and the consequences of mergers and acquisitions, (a) *profit flow studies* which are ex-post analyses based on accounting data of the performance of the merged firm, compared to what we believe would have been the performance if the firms had continued as separate entities, and (b) *event studies* based on market reactions at the time of the merger announcement (Roller et al., 2000). The first method has the advantage of estimating actual performance but suffers from the fact that firm performance after the merger may be the result of other, non-merger factors (e.g., changes in broader market conditions). The event study method estimates the market's expected consequence of the merger and the market's inferred motive behind the merger, and has the advantage of providing an independent view of the expected outcome of the merger.

This paper uses the event study method, and builds on an analysis of the market reactions of the merging firms as well as their closest rivals. The maintained hypothesis is that these reactions indicate whether the merger has had a positive or negative impact on the value of the firms, and also the possible welfare impacts on consumers. The event study relies upon the semi-strong Efficient Market Hypothesis (EMH), which assumes that all publicly available information is incorporated in the stock prices.<sup>3</sup> The EMH allows analysts to evaluate new public information, such as a merger, by analysing the reaction to the firm's stock prices.<sup>4</sup> The difference between the actual stock price and the estimated normal return for the firm (i.e., if the event had not occurred) is used in order to quantify the effects of the announcement. The event study method has been

commonly used when analysing the effect from an event, such as a merger, aggregated for many firms in a single or several industries.<sup>5</sup> However, several studies have also performed event studies when analysing specific case studies.<sup>6</sup> When focusing on single cases it is possible to go into more detail and analyse information releases relevant to the case. This provides a more in-depth analysis and a broader understanding for the underlying motivations for the merger in question. Obviously, no general conclusions can be made when studying single cases.

The purpose of this paper is to evaluate the competitive and efficiency impact of the merger between Rio Tinto and North Ltd. in 2000, using an event study approach. The chosen case is one of the largest deals in the iron ore industry during the last decade. This merger is also interesting because it united two of the top four players at the time. The paper proceeds with a background to the iron ore industry and to the specific merger case. Section "Theoretical predictions of a merger announcement" discusses the theoretical predictions that can be made following the announcement of a merger. These predictions will then be useful in order to evaluate the effect of the merger on shareholders and consumers, and also to try to pinpoint the main motivation behind the merger. Section "Event study methodology" presents the event study methodology. Section "Event study of the Rio Tinto and North Ltd. merger" presents the results from the event study performed on the Rio Tinto and North Ltd. merger. In the last section some concluding remarks will be made.

<sup>3</sup>Examples of multi-case studies applying the event study methodology are Bradley et al. (1988), Healy et al. (1992), Weston et al. (2001), and Duso et al. (2006b).

<sup>4</sup>The first study using the event technique on a merger case is Ruback (1982). After this paper the method applied on case studies have been relatively frequent. Examples include Ruback (1983), Cox and Portes (1998), Weston et al. (1999), Weston (2002), and King et al. (2002).

<sup>3</sup>The strong form of the EMH assumes that even so-called inside information is incorporated in the stock price. However, the empirical evidence suggests that the semi-strong form of the EMH is dominating in most stock markets (Cox and Portes, 1998).

<sup>4</sup>In order to apply the event study methodology the firms under investigation must be publicly traded on a stock market.

## The merger case and its relevant background

After aluminium, iron ore is the metal that occurs most often and it covers about 4.6% of the earth's outer layer (European Commission, 2001). Financially, in 2000 iron ore accounted for almost 20% of the total value of the production of non-fuel minerals in the mining industry, which makes it one of the most important commodities in the mining industry. Demand for iron ore comes almost exclusively from the steel industry, and the prices are negotiated yearly between major iron ore producers and steel producers in the dominating regions, Western Europe and East Asia.<sup>7</sup> The largest producers in the iron ore market are the multinational corporations: CVRD, Rio Tinto, and BHP (European Commission, 2001). Regarding the corporate control in the iron ore industry, Table 1 illustrates the 10 leading iron ore companies in 1990 and 2000, respectively. North Ltd. is not included in the table since it in 1990 was considered to be a diversified metal producer (Ericsson, 2002). Moreover, 2000 presents post-merger production, which implies that North Ltd.'s iron ore production is part of Rio Tinto's production.

It is noticeable that the active companies have varied over the decade but the top three companies, CVRD, BHP, and Rio Tinto, have manifested their position as large iron ore players. Rio Tinto moved from third to second position in the 1990s, almost doubling their share of production in the western world. This was largely due to the merger with North Ltd. in 2000. It is also apparent from Table 1 that the concentration in the iron ore market has increased during the 1990s. Considering the large mergers and acquisitions activity after the year 2000, it is also expected that this concentration has, and will continue to, increase further. The consolidation trend has created a situation where three large corporations have a large control over the iron ore industry. It is therefore of interest to analyse whether the higher concentration level has had a potentially negative effect on iron ore consumers, i.e., the steel producers.

In order to estimate the competitive and efficiency impacts of mergers in the iron ore industry an event study will be applied on a specific merger case. The chosen case is the merger between Rio Tinto and North Ltd. in 2000. Besides it being the largest deal during this period, it is also interesting because the two companies are active in the same country. Other interesting merger cases would have been the merger between CVRD and Caemi in 2001 or the merger between CVRD and Ferteco in the same year. However, it has proved difficult to find stock price data on the target firms Caemi and Ferteco. An additional reason

for the chosen case is that the merger had to be cleared by relevant Competition Commissions' in order for approval.

On June 30, 2000, Rio Tinto informed the European Competition Commission of its plan to pursue a public bid for all outstanding shares of North Ltd., giving Rio Tinto the sole control of North Ltd. Rio Tinto had to get clearance for the merger from the Australian Competition and Consumer Commission (ACCC), the Canadian Competition Bureau<sup>8</sup>, and the European Competition Commission (European Commission, 2000). The Canadian Competition Bureau revealed that they would not intervene in the proposed acquisition on July 19 (Rio Tinto, 2000). On August 4 the ACCC's decision to approve the merger was announced. The main reason for ACCC's conclusion was that they estimated that the merged firm's worldwide iron ore production would only be about 7%. The share of Australian iron ore production was expected to be significantly larger, but since almost all production is exported this was not seen as a problem. The ACCC thus decided that the acquisition of North Ltd. by Rio Tinto would be unlikely to result in a substantial decrease of competition in any Australian market (ACCC, 2000).

The European Competition Commission (henceforth the Commission) came to its conclusion regarding the approval on August 2. Regarding the definition of relevant product markets Rio Tinto suggested that there exists a single relevant product market, i.e., there is no distinction between the three different types of ores, fines, pellets and lump. However, the Commission was informed by a number of interested parties that fines, pellets and lump iron ore should be considered separate product markets. According to these parties the substitution possibilities between the three different ores are limited, since the switching between e.g., pellets and fines can significantly affect the efficiency of the steel mills. There is also limited substitution possibilities from a supply perspective given that not all mines can produce lumps, and also since the production of pellets requires a pelletising plant, which involves a large capital investment (European Commission, 2000).

There was also the concern that the relevant market should only include seaborne quantities, since it is only seaborne iron ore that normally is available for European importers. However, the Commission does not find it necessary either to establish separate product markets for pellets, fines and lump, or to only consider seaborne trade. The notified merger proposal "will not lead to the creation or strengthening of a dominant position" (European Commission, 2000, p. 3). Regarding the definition of the relevant geographic market the iron ore market has historically been separated in two regional markets, the European and the Asian markets. This separation is evident not least in the price negotiations, where prices still are negotiated in both regions. However, the Commission

<sup>7</sup>According to the Commission, the geographic market for iron ore should be considered as world-wide (see also discussion below). However, an alternative definition of the relevant geographic market could be more regional, e.g., separate markets for Europe and Asia. The degree of competition may be different in each market, and also most likely higher than when the market is broadly defined.

<sup>8</sup>The Canadian Competition Bureau was involved due to North Ltd.'s ownership of a large mine in the Lake Superior area in Canada.

Table 1  
Corporate control in iron ore mining 1990 and 2000\*

| 1990                | Company       | Country   | Prod (Mt) | Share % ww | 2000                | Company      | Country   | Prod (Mt) | Share % ww |
|---------------------|---------------|-----------|-----------|------------|---------------------|--------------|-----------|-----------|------------|
| 1                   | CVRD          | Brazil    | 85.44     | 15.4       | 1                   | CVRD         | Brazil    | 120.94    | 17.8       |
| 2                   | BHP           | Australia | 46.20     | 8.3        | 2                   | Rio Tinto    | UK        | 89.47     | 13.2       |
| 3                   | Rio Tinto     | UK        | 42.79     | 7.7        | 3                   | BHP          | Australia | 66.91     | 9.9        |
| 4                   | State India   | India     | 32.07     | 5.8        | 4                   | Mitsui & Co. | Japan     | 47.26     | 7.0        |
| 5                   | Caemi         | Brazil    | 23.03     | 4.1        | 5                   | State India  | India     | 42.76     | 6.3        |
| 6                   | State SA      | SA        | 22.23     | 4.0        | 6                   | Iscor Ltd.   | SA        | 24        | 3.5        |
| 7                   | State Venez.  | Venezuela | 20.12     | 3.6        | 7                   | State Sweden | Sweden    | 20.5      | 3.0        |
| 8                   | State Sweden  | Sweden    | 19.74     | 3.6        | 8                   | ThyssenKrup  | Germany   | 20.0      | 2.9        |
| 9                   | State Luxemb. | Luxemb.   | 18.09     | 3.3        | 9                   | State Venez. | Venezuela | 17.0      | 2.5        |
| 10                  | IOC of Canada | Canada    | 14.25     | 2.6        | 10                  | USX Corp     | USA       | 16.30     | 2.4        |
| Total 10 largest    |               |           | 323.96    | 58.3       | Total 10 largest    |              |           | 465.14    | 68.5       |
| Total western world |               |           | 555.62    | 100        | Total western world |              |           | 679.16    | 100        |
| Total world         |               |           | 977.0     |            | Total world         |              |           | 1060.0    |            |

Source: Ericsson (2002).

acknowledges that metals and minerals are commonly traded on a global basis, and thus the relevant geographic market should be considered worldwide. This is supported by the fact that European consumption of iron ore constitutes of 90% imports. In addition, the prices in the two main importing areas, Europe and Japan, are highly correlated, and the major producers in Australia and Latin America export their iron ore to steel mills both in Europe and Asia (European Commission, 2000).

The Commission finds that the worldwide iron ore market share of the merged firm would be about 9% (calculated from the estimated worldwide supplies) and would thus not be of any competitive concern. The Commission also analyses concentration levels for the separate markets for pellets, fines and lump, only considering seaborne supplies. Regarding pellets there is no horizontal overlap in Rio Tinto and North Ltd.'s production and a merger would thus not lead to a dominant position in that market. For fines and lump the Commission finds that the market shares of the merged firm, based on seaborne supplies, would be 25–30% for both products. Considering that other firms in the industry have similar shares, the Commission concludes that there would still be a significant degree of competition in these markets.<sup>9</sup> The Commission notes that there presently is excess capacity for iron ore production, and thus the merged firm could not be able to raise prices profitably for its fines or lump supplies. The increased concentration in the markets would thus not lead to a dominant position for the merged firm (European Commission, 2000).

In sum, even if all of the involved competition agencies find that there are no competitive concerns due to the merger, it is still of interest to analyse the market reaction to the merger announcement. In particular, an event study

can provide useful information in assessing the competitive effects of the merger given that they predict future profitability, and thus are forward looking. This is important in merger assessment since this task aims at predicting future behaviour of involved firms.

### Theoretical predictions of a merger announcement

By analysing the reactions on the stock market to a merger announcement, *ex ante* the merger is realised, a competition authority is provided with a good indication on how the market perceives the merger under investigation. The event study approach can therefore be seen as a *post announcement–pre merger* study, which is useful when assessing whether or not to accept a certain merger (Boonpramote, 2004). In order to use this methodology it is necessary to define the theoretical predictions of the possible outcomes of the stock market reactions to the merger announcement. This paper classifies the merger outcomes into two broader categories; neoclassical theories and managerial theories. The classification in this paper follows Archbold (2000) and Boonpramote (2004). By classifying the merger outcomes into different groups it is possible to empirically test the merger outcome.<sup>10</sup>

#### Neoclassical theories

The main assumption in the neoclassical approach is that all firms aim to maximise their profits. In other words, these theories assume that the merger will lead to increased profit for the combined unit otherwise the mergers would not have been justified in the first place. The predicted

<sup>9</sup>CVRD has market shares of approximately 20–30% for seaborne fines and 15–20% for seaborne lump. BHP has market shares in the range of 15–20% for seaborne fines and 15–25% for seaborne lump.

<sup>10</sup>Using event studies in order to evaluate welfare effects resulting from mergers were first introduced by Eckbo (1983) and Stillman (1983). The ability of event studies to detect anticompetitive mergers has also been criticized by McAfee and Williams (1988). Duso et al. (2006a) did, however, find empirical evidence that event studies are useful in merger analysis.

effect on the stock prices is an increase given that the new positive information, expected higher future earnings, will be reflected in the price. Profitability due to a merger could be the result of either increasing *efficiency* or of *market power*.

The increased *efficiency* theory expects that the new combined firm will be more efficient than the previously separated units. These efficiencies arise from synergies, where the merged firm is expected to have lower production costs than the separate firms. By combining the assets, either combined production or combined administration/management, the new entity is expected to increase efficiency. Given that you cannot physically merge two iron ore deposits the synergy effects in the iron ore industry will mainly arise from administration, management, or shared transportation facilities. The expected effect on the merged firms' stock prices is that they will increase due to expected higher profitability. In addition, there is an expected positive effect for consumers given that the increased efficiency, and hence expected lower marginal costs, should lead to lower prices. However, the expected effects on the stock prices of rival firms are most likely the opposite, i.e., since there is a new and more efficient competitor on the market, the rivals' stock prices are expected to decrease. However, the impact on rivaling firms is not clear-cut. The merger announcement can indicate the possibility of efficiencies to non-merging firms as well, i.e., a positive information signalling effect (Eckbo, 1989). Regarding the iron ore industry it is though likely that the information signalling effect is low, given that merger and acquisitions for a long time have been a common way to expand firms' assets. The overall welfare effect from a merger that creates efficiencies is thus here most likely to be positive.

Moreover, profitability could be the result of increased *market power*. Increased market power implies that the new firm will have a higher possibility to control, and therefore raise, the prices of the product produced on the market. This hypothesis thus expects that it is the effect from increased consolidation on the market that is dominant in response to the merger. The price increase is expected to produce higher profitability for the acquiring firm, and therefore the stock price is also expected to rise. The stock prices of the rival firms are also expected to increase given the higher prices in the market, and thus increased profitability for them as well. However, the expected increase of the market price will have a negative effect on consumers, and the market hypothesis is therefore typically the main worry for competition authorities investigating the announced merger.<sup>11</sup>

### *Managerial theories*

Unfortunately, empirical evidence shows that it is not always the case that the merger results in an increased profitability for the merging firms (Roller et al., 2000). These unsuccessful mergers are difficult to explain when using traditional neoclassical theories. However, there are more modern microeconomic theories, such as transaction costs economics and principal–agent theories, which can be used to explain this result. These non-wealth maximizing theories have here collectively been named managerial theories. Under this category another non-wealth maximizing theory will also be presented; the *hubris* theory.

The *managerial* hypothesis is founded upon the well-known principal–agent theory (Jensen and Meckling, 1976). The principal is in this case the shareholders who 'hires' an agent, the manager, to perform a task, i.e., run the company. In the principal–agent theory there are no perfect contracts, i.e., the owners cannot perfectly control how the manager performs due to asymmetric information. Also, the interests of the owners and the manager might differ, i.e., it is in the owner's interest to maximise profit, but in the manager's interest to maximise his/her own interest. The manager's self-interest is likely to be related to issues such as increased salary levels, their power position, and satisfaction in the job, and also to decrease the risk of losing their job. Many of these incentives are in turn positively related to a larger size of the company (Shinn, 1999). Since the interest of owners and managers are likely to differ an acquisition might be pushed for the wrong reasons. Thus, this may provide one explanation to why some mergers reduce both efficiency and profitability.

The other hypothesis with a likely non-positive effect is the so called *hubris* hypothesis (Roll, 1986). This hypothesis assumes that the manager miscalculated the valuation of the acquisition target, and as a result pays more for the acquired shares than the market valuation of the expected gains resulting from the merger. According to the hypothesis this implies that the target shareholders gain, but the acquirer's shareholder loses. However, the overall effect in the hubris hypothesis is non-positive, which is the assumed effect if there are no synergies to expect from the merger. However, the hubris hypothesis expects that the combined value of the target and acquirer firms only fall slightly. This hypothesis thus assumes that the manager is overconfident in valuing the acquired target, and as a consequence pays too much and faces what is called the 'winner's curse'. The main difference from the managerial hypothesis is that in this hypothesis it is not assumed that the manager acts against the owner's interests, and also that the overall effect is non-positive, but close to zero. In order to make a distinction between this hypothesis and the managerial one, it is here assumed that the overall effect from the hubris hypothesis is zero (see Table 2).

<sup>11</sup>Note that the efficiency and market power effects are not mutually exclusive rather they often operate side by side. The question for a competition authority then regards which effect dominates. Luckily the event study methodology, when also studying the effect on rival's stock prices, will indicate which effect that the market is expecting to dominate.

Table 2  
Predicted effects from hypotheses for M&As

|              | Gains to target | Gains to acquirer | Combined gains | Gains to rivals  | Welfare effects |
|--------------|-----------------|-------------------|----------------|------------------|-----------------|
| Efficiency   | +               | +                 | +              | –                | +               |
| Market power | +               | +                 | +              | +                | –               |
| Managerial   | +               | –                 | –              | n/c <sup>a</sup> | n/c             |
| Hubris       | +               | –                 | 0              | n/c              | n/c             |

<sup>a</sup>n/c implies that gains to rivals, and thus welfare effects, is not considered under this hypothesis.

### Predicted effects of the merger hypotheses

The theoretical predictions from merger announcements have been classified into four different hypotheses that all can be helpful in determining both the welfare effect from the merger, and from a firm perspective, the underlying motive for the merger. This classification thus helps to answer questions posed earlier such as whether these mergers have led to increased efficiency, or if it is the market power effect that dominates the merger intentions. Moreover, if the merger has not had a positive impact on the combined entity, what could have been the motivation for such a merger? Is it the self-interest of managers, or a miscalculation of the valuation of the target? The predicted effects from the four hypotheses presented above are summarised in Table 2.

We can see that for the efficiency hypothesis there are expected positive effects on both target firm's share prices and acquirer firm's share prices, as well as expected positive combined gains.<sup>12</sup> However, under this hypothesis the expected effect on the rivals' share prices is negative since it is expected that the merged entity will be more productive than before. Regarding the market power hypothesis there is also expected positive effects on target and acquirer firm's share prices, but compared to the other positive effect hypothesis it is also expected to be positive gains to the rivals. This since the merged firm is likely to take action towards increasing market prices, something which other firms in the market also will benefit from. The effect on rivals share prices is thus important for determining the overall welfare effects resulting from the merger, since it determines whether the positive effect on merging firms share prices result from synergy or market power effects. The use of rivals share prices in determining welfare effects from mergers were first introduced by Eckbo (1983) and Stillman (1983).<sup>13</sup>

<sup>12</sup>Combined gains refer only to effects on the market valuations of both the target and acquiring firms together. Welfare effect refers to the net gain or loss of economic surplus, which is found from studying the effect from the merger on rival firms.

<sup>13</sup>Other studies that have used rival firms stock price reactions in order to analyse potential anticompetitive effects resulting from a merger are e.g., Knapp (1990), Mullin et al. (1995), and Cox and Portes (1998). This approach is sometimes referred to as the Eckbo–Stillman event study methodology.

Regarding the hypotheses expecting non-positive effects there are expected gains to the target firm, but expected losses to the acquirer firm. This implies that there is an expected wealth transfer, from the acquirer firm shareholders to the target firm shareholders. The main difference between these hypotheses is that the managerial hypothesis assumes that there are overall losses to be expected from the merger, while the hubris hypothesis expects that the combined gains for the merging firms are close to zero.<sup>14</sup>

### Event study methodology

The basic event study methodology is relatively simple and straightforward. At the time of a merger announcement, the reaction to the stock's price performance will be measured against an estimate of the expected normal returns. The normal returns are based on prior stock price performance. An assessment of the effect from the event is achieved by the measurement of the abnormal return ( $Ar$ ).  $Ar_{it}$  is defined as the firm's abnormal return, at time  $t$ , which is the actual return ( $r_{it}$ ) of security  $I$  minus the normal return ( $E[r_{it}|x_t]$ ), measured over the event window. The normal return is an estimation of what the return of the stock would have been if the event, i.e., the merger announcement, did not occur. This can thus be expressed as:

$$Ar_{it} = r_{it} - E[r_{it}|x_t], \quad (1)$$

where  $Ar_{it}$ ,  $r_{it}$ , and  $E(r_{it})$  are the firm's abnormal, actual, and normal returns respectively, at time  $t$ , and  $x_t$  is the conditioning information for the normal performance model (MacKinlay, 1997).

The step-by-step procedure for applying the event study methodology is outlined by Henderson (1990) and MacKinlay (1997). *First*, identify the date when the first announcement of the merger was made. *Second*, estimate the normal returns of the stocks of interest, based on earlier price observations. This is the appreciation of the stock movement without the event occurring. When this is found, take the difference between the actual return and the

<sup>14</sup>Note that the gains/losses to rivals do not need to be analysed in order to detect which of these hypotheses that is behind the merger, since it is given by the combined gains to the new merged entity. As well, there should be no anti-competitive concerns regarding mergers that have non-positive effects since there are no evidences that this leads to increased market power.

normal return for the firms under investigation in order to find the abnormal return. *Third*, aggregate the abnormal return over time for each firm to find the cumulative abnormal return (*Car*) over the event window. *Fourth*, perform tests to determine whether or not the abnormal returns are statistically and economically significant. For a more detailed review of the event study procedure, see e.g., MacKinlay (1997); Armitage (1995); Henderson (1990), and Cox and Portes (1998).

In order to estimate the normal return, a market index must be chosen. Differences between market indices regard how many securities are included, their weight in the portfolio, and what these securities entail. In event studies it is common to use a broad market index, such as the S&P 500 Index at the US stock market, and the All Ordinaries at the Australian stock market (MacKinlay, 1997). These indices represent large indexes in each market, and the trade volume is as a consequence high. An industry-specific index could also be used when estimating the normal return. However, this will not be used in this study given that the Australian stock market, at the time for the merger, did not have a mining-industry index. This paper will thus use the Australian All Ordinaries index when estimating the normal returns, i.e., the largest index for the market that the firms under investigation are listed on.

The approach of the event study in this paper follows the studies made by Ruback (1982, 1983), Kryzanowski (1986), and Cox and Portes (1998). All these articles analyse merger announcements in a case study type of fashion. The paper thus uses historical stock prices of the merging firms, as well as their rivals, in order to measure the abnormal returns around the merger announcement. The event study methodology requires that the involved firm's stock prices are listed on a stock exchange. The stock prices will mainly be obtained from Yahoo Finance website for Rio Tinto and BHP, listed on the Australian Stock Exchange (ASX). Given that North Ltd. is a so-called 'dead series'<sup>15</sup> it was no longer recorded on the Yahoo Finance website. This posed a potential problem, but since all financial data is recorded and stored it was possible to obtain the North Ltd. stock price series for 1.5 years before the merger announcement.<sup>16</sup>

The merger announcement date, as well as information about the merger and other financial information, was mainly collected from business journals (e.g., Metal Bulletin and Mining Journal) and press releases on the involved firm's websites. Other company information, such as annual reports, can also be found on the companies' websites. For more detailed information of past owner structures, and market shares, the Raw Material Group (RMG) Database is used.

### Event study of the Rio Tinto and North Ltd. merger

On June 23, 2000, Rio Tinto announced that it had made a cash offer for all outstanding shares of North Ltd. at 3.80 Australian dollars (A\$) per share.<sup>17</sup> Rio Tinto announced as well that they already had acquired 14.5% of North Ltd. at that price. The deal values North Ltd. at A\$ 2.8 billion, which the directors of North Ltd. has declared as unacceptable. North Ltd. held a majority position (53%) in the world's second largest iron ore mine, Robe River in Western Australia. This implies that Rio Tinto would, as a consequence of the merger, almost double their iron ore production, and become the second largest iron ore producer in the world.

The proposed take over of North Ltd. by Rio Tinto was of concern for Japanese iron ore consumers. Japanese steel mills even threatened not to renew contracts with Rio Tinto's iron ore subsidiary Hammersley Iron, as an attempt to block the merger between Rio Tinto and North Ltd. In addition, Mitsui & Co. (with a 33% share of Robe River Iron Associate) also opposed the takeover of North Ltd. and wrote a letter to the Western Australian Government voicing their concerns regarding an initiated project for the mine in the West Angela region. Nippon Steel, one of Japan's dominant steel makers, with a 10.5% holding in Robe River threatened to use its veto powers in the Robe River Iron Associate. The main concern for the Japanese steel mills is that the major Australian producers are reduced from three to two, damaging their bargaining power in future price negotiations. On July 21, 2000, Anglo-American announced a A\$ 4.20 per share counter-bid for North Ltd. This announcement was welcomed both by North Ltd.'s directors and the Japanese iron ore consumers. However, on August 3 Rio Tinto increased their offer to A\$ 4.75 per share, and since Anglo American announced on August 4 that they would not offer a counter bid the deal was more or less sealed. On August 11, Rio Tinto had gained 54.2% of North Ltd., and a week later 91.5% was in the hands of Rio Tinto.

### Event study results

The event date is defined as June 23, when the first announcement of Rio Tinto's offer for buying North Ltd. was made. The next step in the event study methodology is to calculate normal returns.<sup>18</sup> The market model is applied, using the Australian All Ordinary index as the market return. Table 3 presents the market model regression coefficients estimated over the period January 7–December 30, 1999 for the merging firms as well as their closest

<sup>15</sup>The series 'died' when the firm merged with Rio Tinto, and since this was more than 5 years ago the information was no longer provided.

<sup>16</sup>The stock price series from North Ltd. was kindly supplied from a Swedish stock broking firm, Carnegie Investment Bank AB. All help from Lars Palo at Carnegie is much appreciated.

<sup>17</sup>The detailed information in the case was collected from Mining Australia (2005) and press releases at Rio Tinto's web page (Kirk, 2000; Rio Tinto, 2005).

<sup>18</sup>The estimated market model is  $r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it}$ , where  $r_{it}$  is the stock return of firm  $i$  on day  $t$ ,  $r_{mt}$  is the return to Australian All Ordinary index on day  $t$ , and  $\alpha$  and  $\beta$  are to be estimated.

Table 3  
Estimation of market model July 1–December 30, 1999<sup>a</sup>

|                 | $\hat{\alpha}$     | $\hat{\beta}$      | $R^2$  | Durbin–Watson |
|-----------------|--------------------|--------------------|--------|---------------|
| Rio Tinto (ASX) | 0.00076332 (1.614) | 1.04709960 (7.406) | 0.1811 | 1.62          |
| North (ASX)     | 0.00053059 (0.823) | 0.91866112 (4.763) | 0.0838 | 1.57          |
| BHP (ASX)       | 0.00071109 (1.413) | 0.97665844 (6.575) | 0.1484 | 1.59          |

<sup>a</sup>There are 250 daily observations over this estimation window period. *t*-statistics is presented in parenthesis.

Table 4  
Percentage abnormal returns of merger announcement

| Date       | Days from event | Rio Tinto     | North Ltd.    | BHP           |
|------------|-----------------|---------------|---------------|---------------|
| 30/6/00    | +5              | 0.98 (1.31)   | -0.81 (-2.49) | 0.24 (0.30)   |
| 29/6/00    | +4              | -0.03 (-0.03) | -0.55 (-1.71) | -1.38 (-1.75) |
| 28/6/00    | +3              | 0.06 (0.08)   | -0.23 (-0.71) | -0.26 (-0.34) |
| 27/6/00    | +2              | -1.34 (-1.80) | -0.12 (-0.38) | -0.48 (-0.61) |
| 26/6/00    | +1              | 1.06 (1.42)   | 0.37 (1.15)   | 1.07 (1.37)   |
| 23/6/00    | 0               | 1.21 (1.63)   | 12.33 (38.35) | -0.12 (-0.15) |
| 22/6/00    | -1              | 0.67 (0.90)   | -0.24 (-0.73) | 1.04 (1.32)   |
| 21/6/00    | -2              | -0.61 (-0.82) | 1.25 (3.87)   | -0.33 (-0.43) |
| 20/6/00    | -3              | -2.08 (-2.78) | -0.53 (-1.66) | 0.19 (0.25)   |
| 19/6/00    | -4              | -0.19 (-0.25) | -1.35 (-4.18) | -0.87 (-1.10) |
| 16/6/00    | -5              | 1.52 (2.04)   | -0.58 (-1.81) | 0.81 (1.04)   |
| <i>Car</i> |                 | 1.20          | 9.22          | -0.12         |

competitor on the Australian market, BHP.<sup>19</sup> The  $R^2$ 's are relatively low and indicates that the relationship explains between 8.4% and 18.1% of the variability of the firms' stock returns. The  $\hat{\beta}$ 's are statistically significant for all firms, implying that there is a relationship between the return of the market index and the firm's stock return. An interpretation of the  $\hat{\beta}$ 's is that if the return from the Australian All Ordinary index increases with 1% over the estimation period (July 7, 1999–December 30, 2000), the corresponding increase in, e.g., Rio Tinto's share price is 1.05%. The *Durbin–Watson* statistics show no direct indication of serial correlation in the estimations for all firms.

When the normal returns have been estimated, the abnormal returns are of interest.<sup>20</sup> The abnormal returns for the participating firms, as well as for BHP, are presented in Table 4.<sup>21</sup> For a graphical presentation of

<sup>19</sup>The normal return is calculated for 1999, i.e., the year before the event-year, since 2000 represent a year with an unusual high rate of mergers in the industry.

<sup>20</sup>Considering the normal return model, let  $\hat{\alpha}$  and  $\hat{\beta}$  be the estimates of  $\alpha$  and  $\beta$ , the abnormal return model can then be estimated as follows:  $Ar_{it} = r_{it} - \hat{\alpha}_i - \hat{\beta}_i r_{mt}$ .

<sup>21</sup>The abnormal return has been calculated for an 11-day event window, i.e., 5 days before and 5 days after the event took place, in order to capture all movements from the event. In many studies an event window of 21 days, i.e. 10 days before and 10 days after the event have been applied (Weston, 2002). The downside with a long event window is though that new information, i.e., a new "event", can interfere with the results. Thus, this study has chosen a shorter event window of 11 days, following the study presented by Cox and Portes (1998).

these returns see Appendix A. On the merger announcement date, the abnormal return for Rio Tinto is moderate, 1.21%, and statistically insignificant. However, we can see a significant and substantial increase in the stock price of North Ltd. on the day of the merger announcement, given the abnormal return of 12.33%. This is expected given that the offer for North Ltd. was higher than the stock price on the event day. It also indicates that the event day is specified correctly. The merger announcement thus seems to increase the value of the target firm (North Ltd.) but not significantly for the acquiring firm (Rio Tinto).<sup>22</sup>

However, given that the abnormal return for Rio Tinto on the announcement day is positive (which can be confirmed at a roughly 15% significance level) the probability that the merger is creating wealth is thus larger than the probability of zero or negative wealth created. Positive returns for both target and acquiring firms indicate that either the market power or the efficiency hypothesis dominates the merger. When looking at the cumulative return over the event window (*Car*), the above results are confirmed.<sup>23</sup> Rio Tinto still shows a small positive return over the event window, and North Ltd. shows a larger positive effect as is indicated by the 9.22% growth of their stock over the 11-day window. The cumulative abnormal return is thus slightly lower than the effect on the event day, which implies that the stock return was adjusted downwards the days around the merger announcement.

When turning the attention to the abnormal return for BHP, the closest competitor to Rio Tinto and North Ltd. on the Australian iron ore market, it is evident that the stock reaction is not very large on the event day. The abnormal return is moderately negative 0.12%, and it is not statistically significant. Even if it is difficult to say anything definite based on this, it still cautiously indicates that the stock price effect is close to zero, and that it is to

<sup>22</sup>According to Salinger (1992), statistical tests on abnormal returns are performed by finding the variance,  $\text{var}(Ar_{it}) = \sigma_{ei}^2 \left[ 1 + \frac{1}{\tau} + \frac{(r_{mt} - r_m)^2}{(\tau - 1) \text{var}(r_m)} \right]$ , where  $\sigma^2$  is residual variance from the market model regression,  $\tau$  is the number of observations used to estimate the market model,  $r_{mt}$  is market return on day  $t$ , and  $r_m$  is the average daily market return over the estimation period. Then calculate the *t*-statistics as:  $t = \frac{Ar_{it}}{\sqrt{\text{var}(Ar_{it})}}$ .

<sup>23</sup>The estimated *Car* aggregates the estimated  $Ar_{it}$  over the event window:  $Car_{it} = \left[ \prod_{t=t_1}^{30/6/00} (1 + Ar_{it}) \right] - 1$ , where  $t_1$  is the first day of the event window.



Table 5  
Major events around the takeover of North Ltd. and corresponding percentage abnormal returns of participating firms

| Event  | North Ltd. <sup>a</sup> | Rio Tinto            | BHP           |
|--|-------------------------|----------------------|---------------|
| June 23, 2000: Rio Tinto announced a cash offer of A \$3.80/share for all shares outstanding of North Ltd., after taking a 14.5% stake in North. North's directors declared the offer of A \$2.8 billion inadequate. | <b>12.33</b> (38.35)    | 1.21 (1.63)          | -0.12 (-0.15) |
| June 30, 2000: Mitsui & Co. (a 33% holder of Robe River) has voiced their concern to the takeover of North Ltd. to the Australian government.  | <b>-0.81</b> (-2.49)    | 0.98 (1.31)          | 0.70 (0.30)   |
| July 7, 2000: Rio Tinto has concluded that the conditions of its bid for North Ltd. have been breached.  | <b>-0.83</b> (-2.57)    | <b>1.37</b> (1.84)   | 0.11 (0.14)   |
| July 13, 2000: Japanese steel mills are threatening not to renew contracts with Rio Tinto in an effort to block the takeover of North Ltd.   | 0.19 (0.60)             | 0.51 (0.68)          | 0.01 (0.02)   |
| July 21, 2000: Rio Tinto announced that it has noted Anglo American's A \$4.20 counter offer for North Ltd.  | <b>3.33</b> (10.33)     | <b>-2.02</b> (-2.70) | 0.44 (0.56)   |
| August 2, 2000: The European Commission announced that they accept the merger.   | -0.04 (-0.12)           | -0.04 (-0.05)        | -0.32 (-0.41) |
| August 3, 2000: Rio Tinto announced an increase in its offer for North Ltd. to A \$4.75/ share. The offer is unconditional and ends August 13.   | <b>1.24</b> (3.87)      | -0.56 (-0.75)        | 0.12 (0.15)   |
| August 4, 2000: Anglo American announced that they will not proceed with their offer for North Ltd. ACCC gave their approval to the merger. Deal is practically finalized.   | <b>3.00</b> (9.34)      | <b>-1.84</b> (-2.47) | 0.07 (0.09)   |

Source of events: Kirk (2000), Rio Tinto (2005) and Mining Australia (2005).

<sup>a</sup>The bold numbers indicate that the estimates are statistically significant at the 5% significance level.

some extent negative. This result is reinforced by the *Car* which is also very close to zero, also negative at 0.12. When comparing the above results to the predicted effects from merger hypotheses the abnormal returns so far suggest that the efficiency hypothesis dominated the merger between Rio Tinto and North Ltd. However, this result is not significant and to be able to confirm this more information about the merger needs to be included in the analysis.

#### Adjusting the event window

Considering that the takeover bid for North Ltd. was followed by several distinct information releases, it is of interest to also examine the abnormal returns between the merger announcement and the completion of the bid. The procedure of a detailed examination follows the Ruback (1982) study of the Conoco takeover. The time period of interest in the Rio Tinto–North Ltd. merger is between June 22 and August 8 (1 day before and 2 days after relevant information releases were made). Table 5 presents the major events in the merger deal and the corresponding abnormal returns of participating firms.<sup>24</sup> Separate discussions for the stock market reactions to the events that followed the merger announcement will be presented in order to see if this information reinforces the above conclusions regarding the major motive behind the merger.

The abnormal returns for the merger announcement day are the same as in Table 5, showing a strong positive effect for the target firm, and a smaller positive effect for the acquiring firm. Thus, the abnormal returns indicate that the merger would create wealth for the participating firms. On June 30, when Mitsui & Co. voiced their concern about

the takeover of North Ltd. by Rio Tinto, the estimate of the abnormal return for North Ltd. is statistically significant and slightly negative. This indicates that North Ltd.'s stockholders might have had some concern that the deal would not be completed. However, both Rio Tinto and BHP's abnormal returns for this date are slightly positive, but none of them can be confirmed on statistical grounds. On July 7, Rio Tinto announced that the conditions of its bid had been breached. This news incurred a negative effect on North Ltd.'s stock price, but a positive effect on Rio Tinto's stock price. A possible explanation for this is that North Ltd.'s stockholders once again were concerned that the deal would not be realised, while the stockholders of Rio Tinto might have been concerned by the strong opposition against the deal and thus relieved that it is breached. However, the threat made by Japanese steel mills on July 13 seems not to have had any impact on the stock prices of any of the firms included. A possible explanation is that this information had already been anticipated by the stockholders.

The counter-bid by Anglo American July 21 did have a statistically significant impact on both North Ltd.'s and Rio Tinto's stock prices. A significant negative abnormal return for Rio Tinto indicates that the information was not well received by Rio Tinto's stockholders. North Ltd.'s stockholders, on the other hand, reacted positively to this news. This is expected since the value for the share holders increased by 0.40 A\$ per share directly by Anglo American's counter offer. BHP's abnormal return is not statistically significant, but it is moderately positive on this day. A likely explanation for this is that stockholders of firms competing in the same market believe that a higher valuation of the target firm is positive since it reflects a higher valuation of their own firm.

The European Commission announced that they accepted the merger proposal between Rio Tinto and North

<sup>24</sup>It should be noted that the term 'relevant information releases' is somewhat arbitrary since many information releases from the companies involved in the case have been made. However, information releases that can be directly related to the merger case have been judged to be relevant.

Ltd. on August 2. This information seems to have been already anticipated by the involved firm's stockholders given that there are no significant movements due to this information. On August 3, the news of Rio Tinto's offer of 4.75 A\$ per share was well received by North Ltd.'s stockholders. However, the abnormal return of Rio Tinto was slightly negative (this cannot be statistically confirmed though). The next day, August 4, the information that Anglo American will not proceed with its offer for North Ltd. had reached the stock markets. In practice this implies that the deal is secured and will go ahead. Also on this day the ACCC announced their approval of the merger. North Ltd.'s stock price rose significantly due to this information, but the effect on Rio Tinto's stock price was significantly negative. This can be interpreted as showing that Rio Tinto's stockholders believe that the price for North Ltd.'s shares (which has increased by almost A\$ 1 since the initial offer) is overpriced. According to this reaction the merger deal is not well received by Rio Tinto's stockholders.<sup>25</sup> The stock price for BHP was not significantly affected due to this information.

It is also of interest to study the *Car*'s for the longer time interval, see Table 6 for a summary (for a complete list of daily abnormal returns and a graphical presentation see Appendices B and C). It is interesting to note that the *Car* for North Ltd. is almost doubled over the entire event-period, as is indicated by the 17.82% abnormal return compared to 9.54% for the 11-day event window. This result thus reinforces the conclusion that the stock market expected the merger deal to be positive, at least for the shareholders of North Ltd. Rio Tinto's cumulative abnormal return for the whole event-period is negative 2.10%, which most likely indicate that the stock market believed that Rio Tinto paid an over-price for North Ltd.<sup>26</sup> The negative cumulative return for Rio Tinto thus points towards that either the hubris or managerial hypotheses support the merger. However, if the overall effect for both the merged entities are positive (that the increase in North Ltd.'s share outweighs the slight decrease in Rio Tinto's share) the result indicates that the overall effect is positive, and thus that either the efficiency or market power effect dominated the merger case.<sup>27</sup>

In order to find out which of these effects that dominated, the largest rival's (BHP) cumulative abnormal return is of interest. The *Car* for BHP over the whole event

Table 6  
Summary of abnormal returns

| Firm             | Time period | Cumulative AR (%) |
|------------------|-------------|-------------------|
| Rio Tinto (ASX)  | 22/6–8/8    | –2.10             |
| North Ltd. (ASX) | 22/6–8/8    | 17.82             |
| BHP (ASX)        | 22/6–8/8    | –4.59             |

period is –4.59%. Thus, the negative stock market reaction for the closest rival over the whole event window indicates that the merger is supported by the efficiency motive. According to Table 2 this is the only hypothesis that is consistent with a negative rival reaction, something which thus seems to rule out the hubris or managerial hypotheses for the merger. It is interesting to note that when adjusting the event window to include several information releases in the merger case, BHP's cumulative abnormal return becomes significantly larger, which makes it possible to draw conclusions regarding the motive for the merger.

## Conclusions

The purpose of this paper has been to estimate the competitive and efficiency impacts of the merger between Rio Tinto and North Ltd. in 2000, using an event study approach. The results from the event study using an 11-day event window indicates that the merger between Rio Tinto and North Ltd. did create value for the stockholders, given positive effects on both Rio Tinto and North Ltd.'s stock prices on the announcement day. The market thus believed that the new company either would be more efficient, or would be able to increase prices due to the market power effect. When studying the stock price movements of the main competitor, BHP, the conclusion of whether the efficiency or the market power effect dominated the merger cannot be confirmed given that the abnormal returns are statistically insignificant on the relevant event days.

However, when adjusting the event window to include several relevant information releases for the merger case, the positive effect for North Ltd.'s stock price increases with almost the double. Moreover, the cumulative abnormal return for the acquirer, Rio Tinto, indicates that it is possible that the managerial or hubris hypotheses support the merger. However, given the much larger increase in North Ltd.'s stock price (which was one of the top four players on the iron ore market at the time of the merger) the overall effect on the new firm's stock price appear to be positive. When this is the case it is more likely that the efficiency or market power hypotheses supported the motive behind the merger, and that the negative stock price reaction for Rio Tinto during this period only reflects the price increases due to the Anglo American counter-offer. In order to investigate which effect supported the main motive behind the merger, BHP's stock price reaction was also analysed over the longer time period. The cumulative result shows that the closest rival's stock

<sup>25</sup>It is interesting to note that the following trading day (August 7) the stock price for Rio Tinto rose significantly. This might indicate that after the new information had time to 'sink in' the market adjusted its previously strongly negative reaction. The same adjustment, but in the opposite direction, was made for North Ltd. on this day.

<sup>26</sup>This conclusion is in line with the events that followed on July 21, when Anglo American proposed a counter offer for North Ltd. In the end this action pushed up the final price of the shares by 25%.

<sup>27</sup>This is also indicated when converting the percentage changes into A\$ (estimates based on outstanding shares times share price during the relevant time period for both Rio Tinto Ltd. and North Ltd.). The combined gains of both acquirer and target are positive, i.e. the monetary value of the increase in North's share outweighs the monetary value of the decrease in Rio Tinto's share (Rio Tinto, 2000).

market reaction was significantly negative, which indicates that the merger is supported by efficiency motives. Thus, according to the market reactions, there is no evidence showing that this large merger in the iron ore industry will have a negative impact on competition in the market. Given the efficiency motive, the expected welfare gains from the merger are positive. This result thus supports the Commission's decision to allow the merger between Rio Tinto and North Ltd.

This paper thus shows that an event study can be a fast and important tool for analysing merger proposals. Compared to a 'full-on' merger investigation, the event study is quick and easy to apply. It is though important to note that the EMH, which the event study methodology depends upon, has been criticised and it is therefore important to use more than one method when evaluating

the motive behind merger proposals. To conclude, all the above results hinge upon that the stock market has the ability to interpret new information accurately, implying that the efficient market hypothesis can be relied upon. However, it is beyond the scope of this article to provide a sufficient answer to whether or not this is the case.

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**Appendix A. Plots of 11-day window abnormal returns**

Fig. A1, Table A1 and Fig. A2

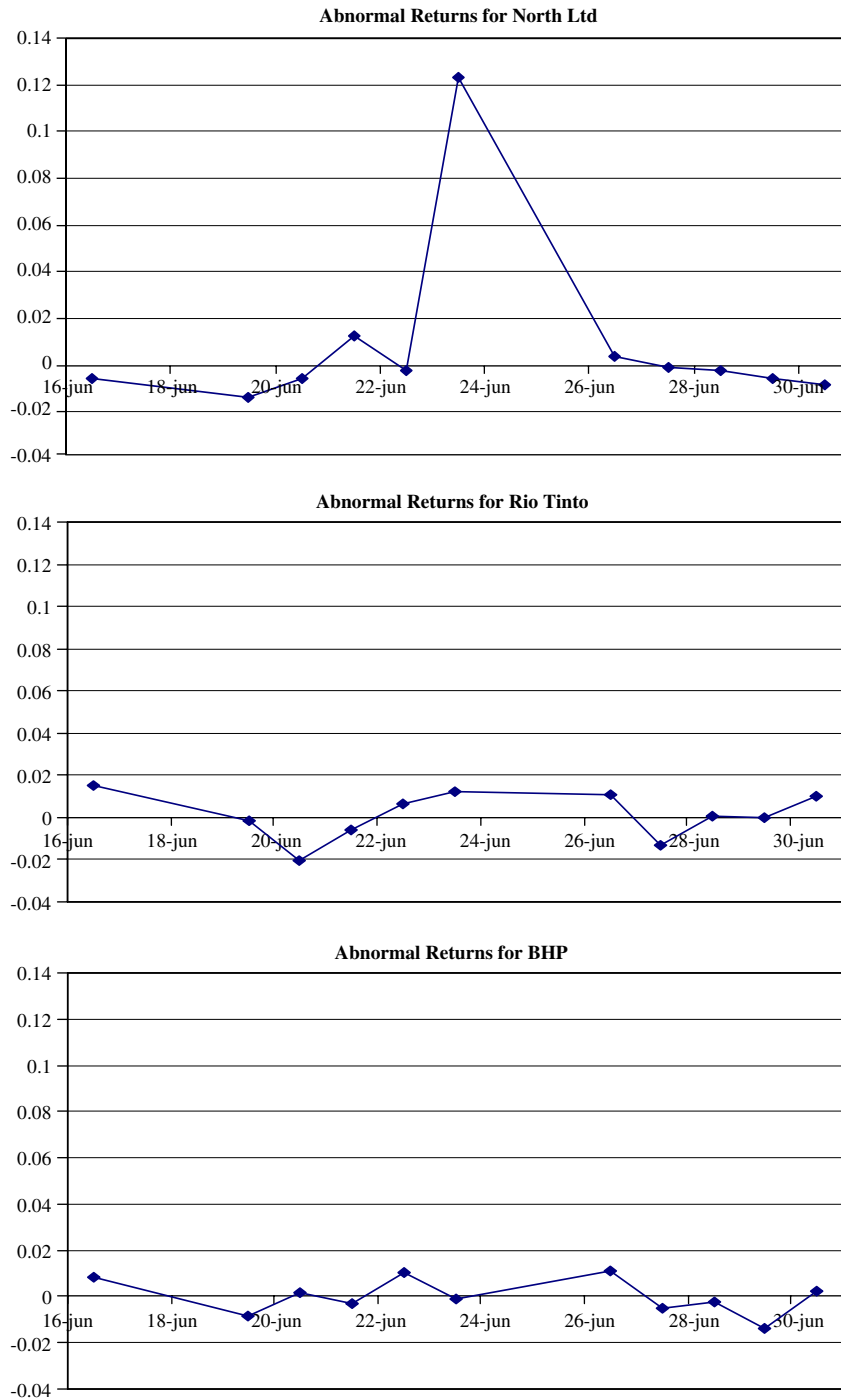


Fig. A1.

Table A1

| Date           | Rio Tinto            | North Ltd.           | BHP                  |
|----------------|----------------------|----------------------|----------------------|
| 8/8/00         | 0.24 (0.32)          | -0.02 (-0.06)        | -0.56 (-0.71)        |
| 7/8/00         | 1.93 (2.58)          | -2.17 (-6.74)        | 0.75 (0.95)          |
| <b>4/8/00</b>  | <b>-1.84 (-2.47)</b> | <b>3.00 (9.34)</b>   | <b>0.07 (0.09)</b>   |
| <b>3/8/00</b>  | <b>-0.56 (-0.75)</b> | <b>1.24 (3.87)</b>   | <b>0.12 (0.15)</b>   |
| <b>2/8/00</b>  | <b>-0.04 (-0.05)</b> | <b>-0.04 (-0.12)</b> | <b>-0.32 (-0.41)</b> |
| 1/8/00         | -0.45 (-0.61)        | -0.40 (-1.23)        | -0.42 (-0.54)        |
| 31/7/00        | 0.83 (1.11)          | -0.47 (-1.45)        | -0.12 (-0.15)        |
| 28/7/00        | -0.43 (-0.57)        | 0.39 (1.21)          | -0.48 (-0.61)        |
| 27/7/00        | -0.18 (-0.24)        | 0.23 (0.72)          | -0.98 (-1.24)        |
| 26/7/00        | -0.24 (-0.33)        | 0.04 (0.14)          | 0.27 (0.35)          |
| 25/7/00        | 0.42 (0.56)          | 0.87 (2.70)          | -0.61 (-0.78)        |
| 24/7/00        | 0.15 (0.19)          | 0.93 (2.90)          | 0.24 (0.30)          |
| <b>21/7/00</b> | <b>-2.02 (-2.70)</b> | <b>3.33 (10.33)</b>  | <b>0.44 (0.56)</b>   |
| 20/7/00        | -0.58 (-0.78)        | 1.72 (5.35)          | 0.04 (0.05)          |
| 19/7/00        | -0.36 (-0.48)        | -0.60 (-1.86)        | 0.12 (0.15)          |
| 18/7/00        | 0.10 (0.13)          | -0.12 (-0.38)        | -0.48 (-0.61)        |
| 17/7/00        | 0.13 (0.17)          | 0.17 (0.52)          | -0.82 (-1.04)        |
| 14/7/00        | 0.47 (0.63)          | 0.08 (0.26)          | -0.77 (-0.98)        |
| <b>13/7/00</b> | <b>0.51 (0.68)</b>   | <b>0.19 (0.60)</b>   | <b>0.01 (0.02)</b>   |
| 12/7/00        | -0.03 (-0.03)        | 0.11 (0.33)          | 0.64 (0.82)          |
| 11/7/00        | 0.25 (0.33)          | -0.05 (-0.17)        | 0.83 (1.06)          |
| 10/7/00        | -1.24 (-1.67)        | -0.28 (-0.88)        | -0.49 (-0.62)        |
| <b>7/7/00</b>  | <b>1.37 (1.84)</b>   | <b>-0.83 (-2.57)</b> | <b>0.11 (0.14)</b>   |
| 6/7/00         | -1.59 (-2.14)        | 0.29 (0.89)          | -0.23 (-0.30)        |
| 5/7/00         | -1.05 (-1.41)        | 0.02 (0.08)          | -1.13 (-1.44)        |
| 4/7/00         | -0.34 (-0.46)        | -0.43 (-1.32)        | -0.66 (-0.85)        |
| 3/7/00         | -0.03 (-0.04)        | -0.70 (-2.19)        | -0.33 (-0.42)        |
| <b>30/6/00</b> | <b>0.98 (1.31)</b>   | <b>-0.81 (-2.49)</b> | <b>0.24 (0.30)</b>   |
| 29/6/00        | -0.03 (-0.03)        | -0.55 (-1.71)        | -1.38 (-1.75)        |
| 28/6/00        | 0.06 (0.08)          | -0.23 (-0.71)        | -0.26 (-0.34)        |
| 27/6/00        | -1.34 (-1.80)        | -0.12 (-0.38)        | -0.48 (-0.61)        |
| 26/6/00        | 1.06 (1.42)          | 0.37 (1.15)          | 1.07 (1.37)          |
| <b>23/6/00</b> | <b>1.21 (1.63)</b>   | <b>12.33 (38.35)</b> | <b>-0.12 (-0.15)</b> |
| 22/6/00        | 0.67 (0.90)          | -0.24 (-0.73)        | 1.04 (1.32)          |
| <b>Car</b>     | <b>-2.10</b>         | <b>17.82</b>         | <b>-4.59</b>         |

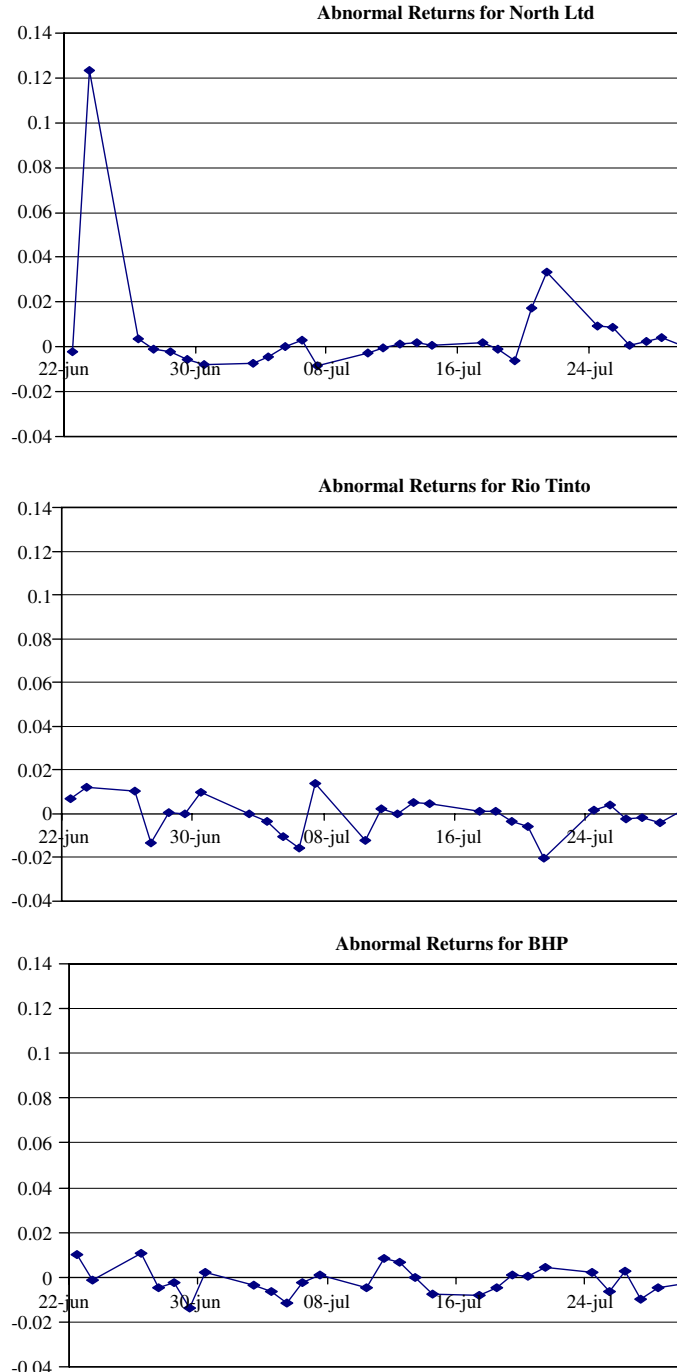


Fig. A2.

## Appendix B. Daily abnormal returns 22 June–8 August

## Appendix C. Plotted daily abnormal returns June 22–August 8

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