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Fraud and Financial Markets: The 1997 Collapse of the Junior Mining Stocks

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Abstract

The Vancouver Composite Index fell by over 25% in less than six weeks during spring 1997 as the junior mining sector collapsed. We argue that this market collapse was triggered by the failure of Bre-X Minerals when that company's Indonesian claims, previously believed to contain the world's largest gold deposit, were shown to be pure fraud. Our event study, based on market returns for the Vancouver Composite Index and for a portfolio of 59 gold stocks, shows the effects of the Bre-X scandal to be both sizeable and significant. There is also some evidence that smaller exploration companies were hardest hit.

Keywords: Bre-X; Event Study; Fraud; Gold; Mining

JEL code: G14

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Fraud and Financial Markets: The 1997 Collapse of the Junior Mining Stocks

One plan of acquiring sudden wealth was to “salt” a wildcat claim and sell out while the excitement was up. The process was simple. The schemer located a worthless ledge, sunk a shaft on it, bought a wagon-load of rich “Comstock” ore, dumped a portion of it into the shaft and piled the rest by its side above-ground. Then he showed the property to a simpleton and sold it to him at a high figure.

(Twain, 1913, pp. 21-22)

For the mining industry, where salting is viewed as the stratagem of scoundrels, Bre-X was a mammoth embarrassment, not only because it overshadowed the good work carried out by honest geologists and engineers, but because it had become one scam too many. Mining, particularly junior mining, is an industry that needs public support to survive. The trust built up over decades by honest mining men had been undermined too often ... Enough had become enough.

(Danielson and Whyte, 1997, p. 9)

1. Introduction

While 1997 was a very good year for most major Canadian and US stock market indices, it was a disastrous year for investors in Canadian junior mining stocks. The Composite Index of the Vancouver Stock Exchange, home to most smaller mining companies, collapsed in the spring of 1997 falling by more than 25% in less than six weeks. Interestingly, while this crash predated the major weakness in gold prices that set in later in 1997, its onset coincides precisely with the well-publicized failure of a mining company known as Bre-X. Bre-X rose from a minor penny stock to a company with a market cap of more than 6 billion Canadian dollars on the strength of a reputedly-enormous gold deposit in Indonesia. It is hardly surprising that, when it became clear that the company’s claims were fraudulent, Bre-X stock plunged in value. What is more remarkable is the way that Bre-X seemed to carry the whole junior mining market with it. On March 20, 1997, just prior to the first reports that independent tests did not confirm Bre-X company claims, the Vancouver Composite Index stood at 1307.99. By May 5, 1997, when Strathcona Mining Services Ltd. -- an

independent consulting firm hired to assess the veracity of Bre-X's findings -- issued its final report concluding that the Bre-X claims were a fraud "without precedent in mining history," the index had fallen to 1003.53.¹

In this paper, we address the impact of the Bre-X factor on a sample of 59 gold mining companies. These companies range from behemoths like Barrick Gold with numerous operating mines to smaller, junior companies with no production that are valued solely for the potential success of their exploration activities. We show that not only does news of the Bre-X fraud significantly lower excess returns across the board but also there is some evidence that the negative effects are higher for junior mining companies. We cannot be sure whether these market declines reflected a collapse of confidence in all exploration companies, fears that other junior companies were as fraudulent as Bre-X, forced selling to make good losses and/or margin calls on Bre-X holdings, or some combination of all these things. However, the massively negative impact is clear. The results show how important reputation and full disclosure can be to asset markets where prices are based on high-value, low probability events.

2. The Bre-X Fraud, the Gold Price and Mining Stock Prices

Previous research has concluded that gold mining stocks are highly sensitive to gold price movements. Blose and Shieh (1995) find a gold price elasticity significantly greater than one. Tufano (1998) derives an average elasticity of two, but also notes that this average is subject to considerable variation across time and across firms. Tufano's results also indicate that firms with larger reserves, larger production, and larger market values are more sensitive to changes in gold prices. The common equity of junior gold mining stocks with few or any proven reserves is rather like an out of the money option. With a small probability of finding a large amount of gold that is economically feasible to mine, the value of the option is likely to be more sensitive to changes in the probability of finding a minable deposit than it is to changes in the gold price. Take, for example, Bre-X prior to its claims of a massive gold deposit at "Busang" in Indonesia. The

only reason that the stock had a positive value in the pre-Busang days was the hope that the company would be able to find gold or other valuable mineral deposits before it ran out of money. Were the company to find such a deposit, the stock price stood to rise substantially regardless of the then current gold price. While none of this is meant to imply that gold prices are irrelevant to junior mining stocks, it does indicate that such stocks are also sensitive to investor perceptions of the chances of “hitting the mother lode” with their exploration activities.

Before the Bre-X fraud was unearthed, Bre-X stock rose from pennies per share in 1994 to 201.75 Canadian dollars on May 10, 1996 when shareholders approved a 10-for-1 stock split. Early shareholders selling at peak valuations after the stock split stood to enjoy a more than 500 fold profit. This rise reflected ever expanding estimates of the size of the company’s Busang gold deposit based on assays taken from the company’s drill samples. By May 1997, however, Bre-X stock reverted to pennies and ceased trading when these drill samples were found to have been “salted” by gold added to the rock samples after they had been taken out of the ground. While the methods were sophisticated enough to fool many mining analysts who recommended purchase of Bre-X shares, the fraud came to light after Freeport-McMoran sought independent confirmation of Bre-X company drill results before proceeding with their planned joint venture with Bre-X. Under the deal announced on February 17, 1997, Freeport was to operate the mine and fund mine development in return for a 15% share of the pie, leaving Bre-X with 45% and various Indonesian interests with the remainder.² But when neither Freeport nor independent consultants Strathcona was able to confirm the existence of an economically-significant gold deposit of any kind on Busang -- let alone an enormous deposit that Bre-X officials had claimed might run to 200 hundred million ounces of gold -- the salting fraud was uncovered, the deal was null and void, and Bre-X and their remaining shareholders were left with 100% of nothing.

The meteoric rise of Bre-X stock in 1995-1996 had been accompanied by a similar run-up in the junior company Diamond Fields that discovered an enormous -- and genuine -- nickel deposit in

Newfoundland's Voisey's Bay. Diamond Fields eventually was bought out by major nickel producer Inco for 4.5 billion Canadian dollars in August 1996. In the same month, Arequipa completed another rags to riches story when it was bought out by Barrick Gold for 1.1 billion Canadian dollars on the strength of Arequipa's drill results on its "Pierina" gold deposit in Peru. As with Bre-X, these drill results had not even yet been confirmed by an independent feasibility study.³ Besides rapidly enriching Diamond Fields and Arequipa shareholders, these strikes undoubtedly helped fuel investor interest in the junior mining sector in general. As interest in Bre-X itself reached fever pitch in 1996, junior company after junior company sought "contracts of work" from the Indonesian government so that they could look for a Bre-X-type deposit of their own. Indeed, former Diamond Fields Chairman Robert Friedland himself founded such a company, Indochina Goldfields, to explore for gold near Bre-X's Busang property. Investor interest was such that he was quickly able to raise \$200 million dollars for this venture in June 1996 (Francis, 1997, p. 101). Before the Bre-X collapse, the junior mining sector was riding a wave of optimism about the prospects of finding more large mineral deposits.

It is important to note that most companies participating in this Indonesia "land rush" had no proven reserves at all, but merely land acreage that they planned to explore in the hope of discovering something valuable under the surface. Their share prices accordingly rose on the basis of their potential for future success rather than reflecting any actual claim on known gold reserves. If confidence in this potential were to collapse, there would be little or nothing to support the value of the stock. Hence the vulnerability of this sector to the effect of the Bre-X fraud in lowering confidence not only in companies involved in Indonesia but also in those exploring elsewhere.⁴ Indeed, just two weeks after Strathcona's final report applied the *coup de grace* to Bre-X, shareholders in another junior company, Delgratia, learned that they were the victims of a salting scam in Nevada. Even positive drill results were now likely to be greeted with considerable scepticism. And lack of investor interest meant increased difficulty in funding exploration, which in turn

meant less chance for the company to find something that could boost the stock price, in turn leading shareholders to sell now ... The continued decline in the Vancouver market index in the year and a half following the Bre-X scandal, while certainly not helped by the weak price of gold, may well also reflect an enduring vicious circle of this type.

3. Testing the Importance of the Bre-X Effect

A. The Sample

We begin by documenting the overall effect of the Bre-X debacle on the Vancouver Stock Exchange (VSE) Composite Index, probably the most readily-available proxy for the universe of junior mining stocks. While the VSE has expanded to include technology companies in recent years, the majority of listed firms are still natural resource firms. It is important to note that the VSE bills itself as a “venture capital marketplace” and as a home to companies that are unable to meet the listing requirements of exchanges specializing in more established companies. The exchange has historically listed junior mining and natural resource exploration companies with claims located throughout the world. After controlling for gold price movements, there is a striking, and statistically significant, correlation between dips in the index and the release of negative news about Bre-X.

We then turn to a portfolio of individual gold mining companies for which returns data was available. We are handicapped here in that financial information on the very smallest firms that stood to suffer most from the Bre-X scandal was either non-existent or not readily available from standard sources. We did, however, compile a sample of 59 firms ranging from large, established gold producers like Barrick and Placer Dome to junior mining firms, 18 of which at least had no proven reserves. The firms are weighted equally in the creation of the portfolio in order to prevent the large firms from dominating the returns.

To be included in the sample the firm had to: (i) be included in *Compustat* with a Primary SIC Code of 1020 (Gold/Precious Metals Mining) or SIC Code 1060 (Metals Mining) and prove to be primarily

involved in exploring for and/or mining gold, (ii) have stock price returns available from the web site of “Canada Stockwatch,” and (iii) have an annual report or 10-K statement available for the fiscal year ended prior to the Bre-X scandal. The 59 firms are detailed in Table 1, which includes each firm’s proven reserves and yearly gold production as reflected in financial information available at the time of the Bre-X debacle in spring 1997. Information contained in the financial statements allows us to classify firms into different groups based on reserve levels, production amounts, and reserve location. We test for significant differences between the effects on large firms vs. small firms and for differential effects on firms with assets only in Australia, Europe and North American vs. those with assets in less developed countries (LDCs).

B. Methodology and the Choice of Event Dates

We employ the standard event study methodology and use a multifactor market model that includes the daily gold price return. As in Tufano (1998) we use the daily closing spot gold prices from the COMEX exchange which closes at 2:30 P.M. Eastern Time, earlier than the closing times of the security exchanges. In addition, many of the smaller firms in our sample trade infrequently, producing potential non-synchronous trading problems in some of the smaller portfolios used in our analysis. We use the approach of Dimson (1979) and Fowler and Rorke (1983) to correct for such problems in our estimation of the effects of the Bre-X fraud on the market value of other mining firms.⁵ The model for our 59 firm portfolio and the Vancouver Stock Exchange portfolio is as follows:

$$R_{pt} = \alpha_p + \beta_{1pt} R_{mt} + \beta_{2pt} R_{mt-1} + \beta_{3pt} R_{mt+1} + \beta_{4pt} R_{gt} + \beta_{5pt} R_{gt-1} + \beta_{6pt} R_{gt+1} + \epsilon_t \quad (1)$$

where R_{pt} is the return on the portfolio, R_{mt} , R_{mt-1} , R_{mt+1} , and R_{gt} , R_{gt-1} , R_{gt+1} are the current period, one period lagged, and one period lead daily returns from the S&P 500 and the spot gold price, and ϵ_t is a white-noise error term.⁶ The daily closing values for the S&P 500 and the gold price were obtained via the internet from “Quote.com.”

The choice of the Bre-X event dates is not straightforward. The first hint that something was amiss at Bre-X came on March 19, 1997, when Michael De Guzman, Bre-X’s chief geologist at the Busang site,

was reported to have “fallen” from a helicopter en route to the Busang property. On March 21, an Indonesian paper announced that Freeport-McMoran’s tests appeared to contradict Bre-X’s assay results. On March 26, Bre-X announced that the potential reserves at Busang may have been “overstated” and that independent consulting firm Strathcona had been hired to review the results. In a separate statement, Freeport-McMoran announced that they had been unable to confirm the assays from Bre-X’s drill cores. On March 27 Freeport released full assay results that were fundamentally inconsistent with Bre-X’s claims. Shares of Bre-X were not traded on March 26 but lost approximately 84% of their value on March 27. We use March 26, 1997 as event day zero with the recognition that, while much of the important information did not reach the market until March 27, some information was available earlier.⁷

C. Empirical Findings

The model given by equation (1) above is estimated for the -140 to +140 day interval surrounding the event window, excluding day zero and the forty day window surrounding the event. The following results are obtained for the Vancouver Composite Index and the 59 firm portfolio:⁸

$$R_{VCI} = -0.0013 + 0.1164R_{mt} - 0.0677R_{mt-1} + 0.0664R_{mt+1} + 0.1728R_{gt} + 0.1428R_{gt-1} + 0.3219R_{gt+1} \quad (2)$$

(-2.13)** (1.78)* (-1.02) (1.01) (1.69)* (1.39) (3.15)***

$$R_{59 \text{ firms}} = 0.0010 + 0.0112R_{mt} + 0.0040R_{mt-1} + 0.1283R_{mt+1} + 0.8325R_{gt} + 0.0046R_{gt-1} + 0.8332R_{gt+1} \quad (3)$$

(1.27) (0.13) (0.05) (1.45) (6.07)*** (0.03) (6.07)***

where t-statistics are in parentheses and *, **, and *** denote significance at the 10%, 5 %, and 1% levels, respectively. As with Tufano (1998) gold price movements play a more significant role in the movement of gold stocks than does the market portfolio represented by the S&P 500. The total effect of gold price changes on returns on the Vancouver Index is 0.6375 and the total effect on the 59 firm portfolio is 1.6703. Stronger gold price effects on the 59 form portfolio are to be expected since all 59 are gold stocks whereas

the Vancouver Index includes non-gold stocks. The total gold price effect on the 59 firm portfolio is in line with Blose and Shieh's (1995) and Tufano's (1998) findings of a gold price elasticity greater than one.

Table 2 presents abnormal and cumulative abnormal daily returns (CARs) associated with the event. The Vancouver index and our 59 firm portfolio both experience negative abnormal returns for the period March 19 - March 21 -- which includes De Guzman's death and the rumors about Freeport-McMoran's negative findings as reported in the Indonesian press. The abnormal returns are negative for both portfolios on March 26 and the cumulative abnormal returns are -1.53% (t-value = 1.62) and -3.21% (t-value = 2.45). On March 27, the day Bre-X lost 84% of its market value, both the index and the portfolio drop significantly by over 4.0%. The value of the index and the portfolio continue to fall over the event window in the face of further rumors and accusations of fraud and lack of gold at Busang. The CARs for day +20 are -11.56% and -18.70% , which are very large decreases. The Bre-X fraud did have a significant effect on other gold mining firms. On May 5, the day of the final Strathcona report confirming only trace amounts of gold at Busang, the index dropped another 2.7% and the portfolio increased by 0.2%.

We also estimate the model for each portfolio while including a dummy variable for event windows of various lengths. The results presented in Table 3 show that in all cases except the (-1,1) window for the 59 firm portfolio the event dummy is significantly different from zero. The returns are more negative for the Vancouver index in each case. Given that the Vancouver Index includes non-gold stocks, this result may seem surprising. The Bre-X fraud likely lowered confidence in junior resource stocks generally, however. Moreover, the index includes many tiny junior mining companies that had to be left out of our 59 firm portfolio because of lack of data. And it is larger, more established firms that apparently are more sensitive to gold prices (Tufano, 1998). Taken together, our results suggest that the Vancouver index is less gold-price sensitive than our 59 firm portfolio but at the same time is more damaged by the confidence-reducing effects of the Bre-X fraud.

As a final step we break our 59 firm portfolio down according to size and location of reserves. Junior mining firms may well have been more dramatically affected by the Bre-X fiasco because their market value is mainly a reflection of the probability of finding a large deposit. The larger firms with proven reserves and producing properties have a large portion of their value backed by known assets. In general the results shown in Table 4 indicate that the smaller firms, whether measured by ounces of production or levels of gold reserves, experience more negative effects as a result of the Bre-X fiasco for the immediate window surrounding the event.

In all cases, regardless of the size measure, the returns are significantly more negative for the portfolio of smaller firms for the (0,1) event window. However, as the event window widens the differences between small and large firm effects become insignificant for (-1,1) and (-3,3). At the (-5,5) window, firms with production less than 100,000 ounces or reserves below 5,000,000 ounces again show significantly more negative effects than larger firms. But, if the cutoff is drawn at *any* positive level of production or *any* positive level of proven reserves, the larger firms appear to be the ones harder hit, which is opposite to out priors. This implies a pivotal role for the 28 firms with reserves greater than zero but below 5,000,000 ounces and the 14 firms with production greater than zero but less than 100,000 ounces. Overall, we have quite strong evidence that news of the Bre-X fraud initially affected small firms more than large firms but little evidence that the differential effects persist as the window is widened. There is also consistency in the findings for the (0,1) and (-5,5) windows only when minimum production and reserve cutoffs are imposed. It may be added that the consistent pattern with the minimum 5,000,000 ounce reserve level is maintained if we re-calculate our portfolios on a value-weighted basis.

We had expected that firms with reserves located in LDCs outside of the Australia, Canada, Europe, and the United States would be influenced more by the Bre-X scandal. In general, mines in these areas are less accessible to investors and are less likely to be located in areas where previous mining and exploration has or is currently taking place. This makes it more difficult for investors to evaluate the deposits and check

the reliability of the claims made by the mine owners. In addition, the Bre-X experience also made it clear that, even if the resources claimed were present, investors would have a difficult time protecting their investments in countries without well-established rules governing property rights. While the results do indicate that firms with assets outside Australia, Europe, and North America have significantly higher negative returns for the (0,1) event windows the opposite is true at the (-5,5) window). The only case in which the reversal does not occur is when a minimum production threshold of 100,000 ounces is imposed -- as here the difference at the (-5,5) window is not statistically significant. Nevertheless, the apparent contradictions between the results for the (0,1) and (-5,5) windows mean that we cannot convincingly establish that firms with resources in LDCs were affected more by the Bre-X events. To the extent that such a phenomenon is present at all in our data, it is limited only to the initial (0,1) effects.

The empirical findings show that the events associated with Bre-X had significant effects, in both a statistical and economic sense, on the value of firms involved in gold exploration and mining. Our results also indicate that smaller firms may have been hit harder than larger firms. There is less support for more adverse effects on firms with assets located outside Australia, Europe, and North America as the differential effects tend to reverse with a longer event window. We should acknowledge, however, that most smaller firms with primarily foreign claims -- and the entire group of junior firms that had rushed to Indonesia in 1997 -- are not included in our analysis due to lack of financial data. A more detailed study of the large collection of small junior mining firms located primarily on the Vancouver Stock Exchange would be needed to fully address the geographical location issues.

4. Conclusion

During the spring of 1997, Bre-X's failure destroyed nearly 6 billion Canadian dollars in paper wealth. However, the losses incurred by Bre-X shareholders proved to be just the tip of the iceberg. Our event study suggests that the Bre-X scandal triggered a collapse in confidence in the whole mining sector, with smaller, exploration-type companies being hit particularly badly. Perceptions, and sector valuations,

plummeted almost overnight and financing possibilities dried up in the wake of the Bre-X fraud. The collapse of the junior mining stocks serves as a reminder that a whole sector can be brought down by a single, precipitating event. Investor confidence is especially important in asset markets that rely heavily on uncertain future events. Fraud and misinformation in one instance leads investors to re-evaluate the quality of the information provided by similar firms. In markets where reputation plays a critical role in assessing the quality of information, such events often lead investors to assume the worst for the remaining firms as well.

Footnotes

- * The authors are grateful to Charles Hu, Pierre Siklos and an anonymous referee for helpful comments and suggestions.
1. While Bre-X was listed on the Toronto, NASDAQ, Montreal and Alberta stock exchanges, neither Bre-X nor its "sister" companies Bresea and Bro-X traded on the Vancouver exchange. Therefore the drop in the Vancouver index reflects only the declining fortunes of companies unaffiliated with Bre-X.
 2. The seemingly-vast size of the Busang find sparked a vicious bidding war involving not only Freeport but also fellow major mining companies Barrick and Place Dome plus various competing Indonesian interests (Danielson and Whyte, 1997; Francis, 1997).
 3. While favorable drill results showed strong gold mineralization in the holes tested by Arequipa, mine development requires proof that the gold mineralization is sufficiently widespread and consistent to make production profitable. A feasibility study, usually requiring many months to complete, determines whether the deposit can be the basis for a viable mine and only after this can any determination be made as to whether there are "proven" or "minable" reserves on the property. Up until this point, the actual value of the deposit remains uncertain.
 4. On June 8, 1998, the Mining Standards Task Force of the Toronto Stock Exchange (where Bre-X had been listed) and the Ontario Securities Commission proposed new stricter disclosure rules for mining companies. Whyte (1998, p.1) characterizes the task force's interim report as "as a response to the plunge in investor confidence that followed the Bre-X Minerals scandal in 1997."
 5. To be included in our sample, each mining firm had to have returns data for at least two-thirds of the days in the estimation period. Our data comes both Canadian and U.S. exchanges that are subject to different exchange holidays. If the U.S. exchanges are open and the Canadian exchanges are closed, then the Canadian firms receive a missing value on that date. If the Canadian exchanges are open

and the U.S. exchanges are closed, then the returns on the Canadian firms are added to the next trading day's returns. All results are very similar if we use the multifactor market model without the Dimson adjustment.

6. We use the S&P 500 as a benchmark instead of the Vancouver Composite Index or the Toronto Stock Exchange (TSE) 300 Index. The Vancouver Index is already used as a dependent variable. The broader-based TSE 300 is problematic because Bre-X is actually a component of this index during our sample period. Use of the TSE 300 would necessitate subtracting out the effects of the Bre-X price changes for each day of our sample (while correcting for daily changes in Bre-X's index weighting). For returns measured in Canadian dollars, the S&P 500 potentially introduces a problem of exchange rate risk between Canadian and U.S. markets, however. In order to address this concern we have re-estimated the model for the Vancouver Index using the larger-capitalization TSE 35 Index -- that did not include Bre-X -- in place of the S&P 500 as our market portfolio. Due to data limitations we were only able to estimate the model over a shorter (-110, 110) window. But the results with the TSE 35 (available from the authors upon request) are very similar to those reported here for the longer (-140, 140) window with the S&P 500.
7. All the dates used here are obtained from Danielson and Whyte (1997), Francis (1997), and the *Wall Street Journal*. All three sources give identical dates for each of the major events considered in our analysis.
8. All results reported in this paper are for an equally-weighted 59 firm portfolio that attempts to capture the effects on the smaller firms in the industry. If we convert our

portfolio to a value-weighted index, we find negative Bre-X effects similar to those shown in Tables 2 and 3 below. Value-weighting is less appropriate for our purposes, however, as the portfolio returns become dominated by a small number of relatively large firms. (Comparative results for a value-weighted portfolio are available from the authors upon request.)

References

- Blose, Laurence E. and Shieh, Joseph C. P. (1995) "The Impact of Gold Price on the Value of Gold Mining Stock," *Review of Financial Economics*, 4 (Spring), pp. 125-139.
- Danielson, Vivian and Whyte, James. (1997) *Bre-X: Gold Today, Gone Tomorrow*, Toronto: The Northern Miner.
- Dimson, Elroy. (1979) "Risk Measurement When Shares are Subject to Infrequent Trading," *Journal of Financial Economics*, 7 (June), pp. 197-226.
- Fowler, David J. and Rorke, C. Harvey. (1983) "Risk Measurement When Shares are Subject to Infrequent Trading: Comment," *Journal of Financial Economics*, 12 (August), pp. 279-283.
- Francis, Diane. (1997) *Bre-X: The Inside Story*, Toronto: Key Porter Books.
- Tufano, Peter. (1998) "The Determinants of Stock Price Exposure: Financial Engineering and the Gold Mining Industry," *Journal of Finance*, 53 (June), pp. 1015-1052.
- Twain, Mark. (1913) *Roughing It*, Volume II, New York: Harper & Brothers.
- Whyte, James. (1998) "Mining Standards Task Force Calls for Licensure, Tighter Rules," *The Northern Miner*, 84 (June 15-21), pp. 1, 14, 19 (*passim*).

Table 1

Size and Geographic Information for Portfolio Firms

	1996 gold ounces produced	1996 proven and probable reserves	% Reserves/Assets located in LDCs
AGNICO EAGLE MINES	159,558	987,000	0.00%
ALTA GOLD	49,486	1,045,056	0.00%
AMAX GOLD	210,880	6,408,000	0.00%
ANGLO SWISS INDUSTRIES	0	0	3.77%
ARMISTICE RESOURCES	0	0	0.00%
ASHANTI GOLDFIELDS LTD	860,384	24,200,000	100.00%
BARRICK GOLD CORP	3,149,000	51,117,000	0.00%
BATTLE MOUNTAIN	914,900	10,600,000	11.93%
BRUSH CREEK	0	0	0.00%
CALEDONIA	31,137	514,431	0.00%
CAMBIOR	502,065	4,251,050	0.00%
CAMPBELL RESOURCES CORP	124,800	659,500	49.61%
CANARC RESOURCE CORP	0	0	53.67%
CANYON RESOURCES CORP	6,724	635,000	0.00%
CASMYN CORP	0	1,020,322	100.00%
COEUR D'ALENE MINES CORP	214,130	3,396,000	0.00%
CONSOL. NEVADA GOLD MINES	45,271	597,722	0.00%
CORAL GOLD CORP	0	0	0.00%
CUSAC GOLD CORP	21,905	40,000	0.00%
DAKOTA MINING CORP	76,932	337,907	0.00%
ECHO BAY MINES	768,900	8,573,000	0.00%
FISCHER WATT	16,601	18,281	0.00%
FRANKLIN CONSOL. MINING	0	52,510	0.00%
FREEPORT-MCMORAN	1,695,200	55,300,000	100.00%
GETCHELL GOLD CORP	171,343	4,400,000	0.00%
GLAMIS GOLD CORP	121,591	2,453,705	0.00%
GOLD CORPORATION INC	130,572	1,487,000	0.00%
GOLD RESERVE INC	0	0	40.72%
GOLDEN GOOSE RESOURCES	0	0	0.00%
GOLDEN KNIGHT	30,416	0	76.82%
GOLDEN STAR RESOURCES INC	76,485	2,273,612	0.00%
GREAT CENTRAL MINES LTD	436,209	4,868,000	100.00%
GREENSTONE RESOURCES LTD	31,068	2,854,000	34.51%
HANOVER GOLD	0	0	0.00%
HECLA MINING CORP	169,376	787,249	0.00%
HERITAGE AMERICAN RESOURCES	0	0	0.00%
HIGHWOOD RESOURCES	0	0	0.00%
HOMESTAKE MINING	1,968,000	28,368,972	0.00%
INTL. PRECIOUS MINERALS CORP	0	0	0.00%
KINROSS GOLD CORP	524,795	4,449,000	12.88%
LEVON RESOURCES LTD	0	0	0.00%
LIHIR GOLD	0	14,600,000	100.00%
MERIDIAN GOLD	202,000	1,419,000	0.00%
METALLICA RESOURCES INC	0	1,496,000	0.00%
MIRAMAR MINING CORP	111,021	5,092,404	0.00%

MISTY MOUNTAIN GOLD LTD

0

0

0.00%

Table 1 (contd.)

MK GOLD CORP	53,945	138,000	0.00%
NEWMONT GOLD CORP	2,280,000	37,100,000	29.65%
NORTH LILY MINING CORP	0	0	53.21%
NORTHGATE EXPLORATION LTD	1,100	0	0.98%
PEGASUS GOLD	497,300	7,829,000	0.00%
PLACER DOME INC	1,914,000	26,518,000	38.36%
QSR LIMITED	0	0	0.00%
ROYAL OAK MINES	389,203	2,682,000	0.00%
SILVERADO GOLD MINES LTD	0	0	0.00%
SISKON GOLD CORP	9,561	445,844	0.00%
TVX GOLD INC	424,500	5,370,000	0.00%
VENGOLD	0	832,131	100.00%
VISTA GOLD	89,381	2,200,000	0.00%

Notes: All information comes from Annual Reports and/or 10-K reports. Firms may have positive production during 1996 but no proven reserves at the end of 1996 for several reasons. The most common causes are the exhaustion of proven reserves during the year, the sale of producing properties during the course of the year, or minor production from reclamation activities that do not involve proven or probable reserves. For firms without positive reserves, we use the percentage of the firm's total assets in LDC's as a proxy for the firm's LDC risk exposure.

Table 2

Abnormal Returns Surrounding Bre-X Event Date

Calendar Date	Event Date	59 firm portfolio CAR _t	59 firm portfolio AR _t	Vancouver Index CAR _t	Vancouver Index AR _t
19970226	-20	-0.0184	-0.0184	0.0076	0.0076
19970227	-19	-0.0092	0.0092	0.0215	0.0140
19970228	-18	-0.0061	0.0031	0.0471	0.0256
19970303	-17	-0.0150	-0.0089	0.0521	0.0050
19970304	-16	-0.0113	0.0037	0.0553	0.0032
19970305	-15	-0.0071	0.0042	0.0598	0.0045
19970306	-14	0.0106	0.0177	0.0763	0.0165
19970307	-13	0.0071	-0.0035	0.0805	0.0041
19970310	-12	0.0024	-0.0047	0.0857	0.0053
19970311	-11	0.0043	0.0019	0.0845	-0.0013
19970312	-10	0.0032	-0.0011	0.0864	0.0020
19970313	-9	0.0022	-0.0009	0.0787	-0.0077
19970314	-8	-0.0048	-0.0071	0.0863	0.0076
19970317	-7	0.0023	0.0071	0.0822	-0.0042
19970318	-6	0.0069	0.0046	0.0822	0.0000
19970319	-5	-0.0073	-0.0142	0.0756	-0.0066
19970320	-4	-0.0235	-0.0162	0.0667	-0.0088
19970321	-3	-0.0249	-0.0014	0.0508	-0.0159
19970324	-2	-0.0390	-0.0141	0.0382	-0.0126
19970325	-1	-0.0243	0.0147	0.0447	0.0065
19970326	0	-0.0321	-0.0077	-0.0153	-0.0600
19970327	1	-0.0734	-0.0413	-0.0587	-0.0433
19970331	2	-0.0836	-0.0102	-0.0729	-0.0142
19970401	3	-0.0901	-0.0065	-0.0479	0.0249
19970402	4	-0.0743	0.0157	-0.0364	0.0115
19970403	5	-0.0836	-0.0093	-0.0398	-0.0034
19970404	6	-0.0770	0.0066	-0.0388	0.0010
19970407	7	-0.0868	-0.0098	-0.0597	-0.0209
19970408	8	-0.0925	-0.0057	-0.0790	-0.0192
19970409	9	-0.0939	-0.0014	-0.1025	-0.0236
19970410	10	-0.0978	-0.0040	-0.0893	0.0133
19970411	11	-0.1118	-0.0139	-0.0964	-0.0071
19970414	12	-0.1104	0.0014	-0.1183	-0.0219
19970415	13	-0.1145	-0.0041	-0.1114	0.0069
19970416	14	-0.1209	-0.0064	-0.1182	-0.0068
19970417	15	-0.1300	-0.0091	-0.1023	0.0159
19970418	16	-0.1248	0.0052	-0.0919	0.0104
19970421	17	-0.1351	-0.0103	-0.1000	-0.0081
19970422	18	-0.1509	-0.0158	-0.1140	-0.0141
19970423	19	-0.1589	-0.0080	-0.1141	-0.0001
19970424	20	-0.1870	-0.0281	-0.1156	-0.0015

Notes: AR_t is the abnormal return on day t from the estimation of the multifactor market model. This represents the abnormal change on a given day. CAR_t is the cumulative abnormal return up to day t. This represents the sum of all the individual daily abnormal returns up to and including a given day.

Table 3

Event Dummies for Various Bre-X Event Windows

Event Window	Dummy Coefficients 59 Firm Portfolio	Dummy Coefficients Vancouver Index
(-10,10)	-0.005492 (-1.780)*	-0.009709 (-4.339)***
(-5,5)	-0.008828 (-2.148)**	-0.012157 (-4.051)***
(3,-3)	-0.010022 (-1.963)**	-0.017589 (-4.778)***
(-1,1)	-0.011948 (-1.537)	-0.034253 (-6.301)***
(0,1)	-0.026098 (-2.753)***	-0.055437 (-8.767)***

Notes: The dummy coefficient represents the average daily abnormal returns. To calculate the cumulative abnormal return over the entire period, one needs to multiply the coefficient estimate by the number of days in the event window.

t-statistics are in parentheses.

* denotes significance at the 10% level.

** denotes significance at the 5% level.

*** denotes significance at the 1% level.

Table 4

Event Dummies for Size and Geographic Portfolios

Sample	N	Event Window			
		(0,1)	(-1,1)	(-3,3)	(-5,5)
Firms without proven reserves	18	-0.0437 (2.09)** (0.99)	-0.0169 (1.37)	-0.0153 (0.94)	-0.0085
Firms with proven reserves	41	-0.0190 (1.96)** (1.30)	-0.0103 (1.54)	-0.0080 (2.21)**	-0.0092
F-statistic		(3.66)** (1.18)	(1.89)	(2.66)*	
Firms without 1996 production	21	-0.0389 (2.00)** (1.06)	-0.0168 (1.42)	-0.0148 (0.86)	-0.0072
Firms with 1996 production	38	-0.0198 (2.09)** (1.28)	-0.0099 (1.49)	-0.0076 (2.44)	-0.0099
F-statistic		(3.73)** (1.22)	(1.87)	(3.10)**	
Firms with 1996 reserves < 5,000,000 oz	46	-0.0286 (2.56)***	-0.0129 (1.49)	-0.0112 (1.86)*	-0.0097 (2.00)**
Firms with 1996 reserves > 5,000,000 oz	13	-0.0184 (1.88)*	-0.0096 (1.21)	-0.0067 (1.29)	-0.0067 (1.58)
F-statistic		(3.79)** (1.27)	(1.94)	(2.41)*	
Firms with 1996 production < 100,000 oz	35	-0.0314 (2.27)** (1.19)	-0.0134 (1.78)*	-0.0130 (1.69)*	-0.0101
Firms with 1996 production > 100,000 oz	24	-0.0192 (2.13)** (1.41)	-0.0103 (1.30)	-0.0063 (1.93)*	-0.0075
F-statistic		(3.90)** (1.36)	(1.93)	(2.64)*	

Table 4 (contd.)

Firms with assets in LDCs	18	-0.0290 (1.56)	-0.093 (0.62)	-0.0081 (0.82)	-0.0068 (0.85)
Firms with no assets in LDCs	41	-0.0254 (2.58)** (1.64)*	-0.0132 (2.08)** (2.30)**	-0.0110 (2.08)** (2.30)**	-0.0098 (2.08)** (2.30)**
F-statistic		(3.80)** (1.36)	(2.20)	(2.70)*	
Firms with 1996 reserves < 5,000,000 oz and LDCs	12	-0.0372 (1.27)	-0.0105 (0.44)	-0.0089 (0.57)	-0.0071 (0.56)
Firms with 1996 reserves < 5,000,000 oz and no LDCs	34	-0.0266 (2.47)*	-0.0136 (1.55)	-0.0118 (2.04)	-0.0103 (2.22)
F-statistic		(3.49)** (1.22)	(2.11)	(2.49)*	
Firms with 1996 production < 100,000 oz and LDCs	10	-0.0391 (1.04)	-0.0098 (0.32)	-0.0121 (0.60)	-0.0076 (0.47)
Firms with 1996 production < 100,000 oz and no LDCs	25	-0.0296 (2.24)** (1.35)	-0.0145 (1.88)*	-0.0133 (1.88)*	-0.0107 (1.88)*
F-statistic		(2.83)*	(0.93)	(1.84)	(1.80)

Notes: t-statistics are in parentheses. The F-statistic is for the cross equation restriction that the dummy coefficients are equal for the two groups.

* denotes significance at the 10% level.

** denotes significance at the 5% level.

*** denotes significance at the 1% level.