Early research conducted by Professors Ray Ball and Philip Brown, then both at the AGSM, revealed that shares in Australian mining companies had not performed as well as shares in industrial and commercial companies, over long periods of time:

- Mining shares had earned similar average rates of return, including dividends and capital gains or losses (but not allowing for taxes), as their industrial and commercial counterparts; but
- Mining shares had generated higher levels of both diversifiable and non-diversifiable risk.

Taken together, these results implied the puzzling conclusion that there seemed to have been lesser reward for risk-bearing in mining than in industrial and commercial equities.

This earlier research covered the period from January 1958 to February 1979 inclusive, a period slightly in excess of 21 years. The decade 1964-73 received more intensive scrutiny, for reasons of data availability. (Historical data on returns to mining shareholders had to be collected manually, since researchers had not previously studied mining investments in detail).

In addition, Ball and Brown (1980a, fn11) cited data collected by Lamberton when the stock exchanges became interested in calculating share indices.† These data suggested that over the previous 21-year period, 1936-1957, there had been little difference between the average rates of return to investors in mining shares and shares in general.

There thus was evidence that the result obtained by Ball and Brown for 21 years might extend back another 21 years, to 1936.

Nevertheless, the long life of one generation of mining projects creates the residual concern that these results almost literally were a “flash in the pan” — that they were due to abnormalities of the chosen sample period. Adding to this concern is the possibility that any high returns for the 1958-79 period might already have been capitalized into December 1957 prices, thus not showing in the subsequent share market returns. While this view seems to be discredited by Lamberton’s data back to 1936, it nevertheless is useful to extend the earlier Ball-Brown period forward in time, asking whether the subsequent record has been similar.

Consequently, the research described in this report deals with the period 1974-83, the decade immediately following the 1964-73 decade studied in most detail by Ball and Brown.

1. OUTLINE OF RESEARCH DESIGN

Source of Share Data

The Centre for Research and Finance at the Australian Graduate School of Management now maintains a continuously-updated file of share price data for all companies listed on any member exchange of the Australian Associated Stock Exchanges (A.A.S.E.). The file therefore incorporates data for:

- mining companies, defined as A.A.S.E. Industries 1 (Metals) and 2 (Solid Fuels)
- industrial and commercial companies, defined as A.A.S.E. Industries 4-23.

The data are closely checked. They represent a comprehensive and accurate representation of the historical performance of Australian equity investments.

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Riskless Rate

An interpretation of each index is that it shows the rate of return of a treated taxation. Adjustments are made for terms of returns on value-weighted index of rates of return is constructed, producing the series of in

Construction of

For each area of investment studied (e.g. mining), a value-weighted index of rates of return is constructed, producing the series of monthly returns on that area in aggregate. An interpretation of each index is that it shows the rate of return of a portfolio that is continuously rebalanced so as to hold the total set of equities on the market in its area.

"Riskless Rate"

A useful benchmark for comparison is provided by the rates of return earned over the period by investments in "riskless" securities. This benchmark is measured in terms of returns on 90-day Government securities.

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### TABLE 1

<table>
<thead>
<tr>
<th>AREA OF INVESTMENT</th>
<th>AVERAGE ANNUAL RETURN</th>
<th>RELATIVE RISK LEVEL*</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Government Securities</td>
<td>10.15%</td>
<td>0.00</td>
</tr>
<tr>
<td>(2) All risky Assets</td>
<td>15.47%</td>
<td>1.00</td>
</tr>
<tr>
<td>(3) Mining</td>
<td>15.74%</td>
<td>1.34</td>
</tr>
<tr>
<td>(4) Industrial &amp; Commercial</td>
<td>15.61%</td>
<td>0.82</td>
</tr>
</tbody>
</table>

*Risk here is non-diversifiable risk, scaled so that the average share has a risk level of 1.00 and a riskless asset has a risk level of 0.00.

**Key:**

(1) 90-day Government securities.
(2) All A.A.S.E.-listed shares, including mining.
(3) A.A.S.E. Industries 1 and 2.
(4) All A.A.S.E.-listed shares, excluding Industries 1,2 and 3.

### Sample of Mining Companies

The sample includes all mining companies that were listed at any time in the 1974-83 period. It therefore includes "losers" as well as "winners".

The "D/C factors" provided by Sydney Stock Exchange Research Service are used to eliminate the "double counting" involved in inter-company shareholdings, such as CRA's equity in Hamersley.

### Calculation of Rates of Return

Rates of return are calculated on a monthly basis. Dividend entitlements and price gains or losses are treated equivalently, with no allowance for personal taxation. Adjustments are made for all changes in the basis of price quotation, such as stock splits and bonus issues.

### Construction of Indices of Rates of Return

For each area of investment studied (e.g. mining), a value-weighted index of rates of return is constructed, producing the series of monthly returns on that area in aggregate. An interpretation of each index is that it shows the rate of return of a portfolio that is continuously rebalanced so as to hold the total set of equities on the market in its area.

### 2. RESULTS

Overall, the results confirm those previously reported. Over the period 1974-83 inclusive, mining shares earned average returns that were approximately equal to the average for industrial and commercial shares, but their level of risk was substantially higher.

The principal results are reported on Table 1. Here, risk is defined in terms of the Capital Asset Pricing Model as non-diversifiable risk: i.e., risk that cannot be absorbed within a diversified share portfolio. Table 1 reveals that, over the 1974-83 period:

- The average annual rate of return on mining shares was 15.74 per cent, compared with 15.61 percent for industrial and commercial shares.
- The level of risk, relative to an average across all investments of 1.00, was 1.34 in mining and 0.82 in industrial and commercial investments.

In terms of the Capital Asset Pricing Model, mining shares earned returns less than the level that the model measures as appropriate for their level of risk, the difference being on average -1.54 per cent per year*. This relationship is graphed in Figure 1.

Table 2 provides similar data, ignoring the distinction between diversifiable and non-diversifiable risk. The risk difference between mining and industrial and commercial is slightly greater under this definition of risk.

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* Risk here is measured in a fashion that ignores the opportunity for portfolio diversification across areas of investment. It is measured as the standard deviation of the annual rate of return on each area's aggregate investments, calculated as 12 times the monthly standard deviation.

**RESULTS**

<table>
<thead>
<tr>
<th>AREA OF INVESTMENT</th>
<th>AVERAGE ANNUAL RETURN</th>
<th>ANNUAL RISK LEVEL*</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Government Securities</td>
<td>10.15%</td>
<td>2.41</td>
</tr>
<tr>
<td>(2) All risky Assets</td>
<td>15.47%</td>
<td>20.05</td>
</tr>
<tr>
<td>(3) Mining</td>
<td>15.74%</td>
<td>30.05</td>
</tr>
<tr>
<td>(4) Industrial &amp; Commercial</td>
<td>15.61%</td>
<td>16.32</td>
</tr>
</tbody>
</table>

*Risk here is measured in a fashion that ignores the opportunity for portfolio diversification across areas of investment. It is measured as the standard deviation of the annual rate of return on each area's aggregate investments, calculated as 12 times the monthly standard deviation.

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*This model is described in most finance tests. See, for example, Van Horne, Nicol and Wright, Financial Management and Policy in Australia, (Prentice Hall, 1981). Australian evidence validating the model is reported in Ball, Brown and Officer, "Asset Pricing in the Australian Industrial Equity Market", Australian Journal of Management, April 1976.

†† Calculated as 15.74 — (10.15+[15.47-10.15]1.34).
The clear conclusion is that the results documented in the earlier Ball-Brown study carry through into the 1974-83 decade.

3. INTERPRETATION

In the original Ball-Brown study, we provided four possible explanations for the apparently-low returns from investing in mining equities. Only one of those explanations, the favourable historical tax treatment of investors in mining stocks, can unequivocally be ruled out as an explanation for the continuation of the phenomenon into the subsequent decade. It is ruled out because those tax concessions did not apply over the 1974-83 period.

A second explanation that the phenomenon was a “sampling” outcome, atypical of investing in mining over prolonged periods of time, seems less likely as the apparently-low returns extend further into time. Recall that some 20 years now have been studied closely; and that there is other evidence that the phenomenon extends back as far as 1936. Consequently, it seems safe to assume that we are not observing a “chance” outcome.

The culprit could be the Capital Asset Pricing Model, as we noted in the original study. Here there are two classes of problem. First, the model does not provide for the desire by investors to reduce specific (e.g., energy, or metals-price) risks, as distinct from money-denominated risks. The desire to reduce specific risks can be due, for example, to failures in product markets (including regulation). Second, Richard Roll has observed that we implement the Capital Asset Pricing Model with error, so that it is feasible (though, I believe, a priori unlikely) that when the correct “market index” is used we will discover that Australian industrial and resource stocks have approximately the same degree of non-diversifiable risk.

It seems difficult to avoid concluding that either the Capital Asset Pricing Model fails when applied to comparing risk-adjusted returns of Australian industrial and resource stocks, or that investors in resource stocks have been short-changed for a long time. Given the length of time involved, the problem seems likely to lie in the Capital Asset Pricing Model, either because the theory is inadequate or because the data to implement the theory are inadequate. That does not mean that the model should be abandoned: one would be surprised if any model worked perfectly. It does suggest however, that asset pricing models that allow for specific risks, such as energy price uncertainty, are worth investigating more closely in the Australian setting.