Historical and Siegel Estimates of the Market Risk Premium in New Zealand

ISCR Presentation on “The regulatory cost of capital II: What is the market risk premium?”

Alastair Marsden
The University of Auckland Business School
Market risk premium

“The single most important contemporary issue in finance is the equity risk premium”, Dimson, Marsh and Staunton, 2000, Business Strategy Review.

Why is an estimate of the ex-ante market risk premium (MRP) useful?

• Input into the cost of capital under the CAPM.

• Forecast growth in an investment portfolio over the long term in excess of the risk free rate.
Market risk premium

Standard CAPM

\[ E(R_j) = R_f + [E(R_m) - R_f] \beta_j \]

The tax-adjusted CAPM.

\[ E(R_j) = R_f (1 - T_I) + D_j T_j + [E(R_m) - D_m T_m - R_f (1 - T_I)] \beta_j \]

\( T_I = \) weighted average over investors of \((t_i - t_{gi})/(1 - t_{gi})\)

\( T_m = \) weighted average over investors of \((t_{di} - t_{gi})/(1 - t_{gi})\)

This form of the CAPM (see Lally, 1992) often used in NZ under an imputation system in preference to the Officer CAPM.
Why examine the historical MRP?

To provide an estimate of the ex-ante MRP.

- The average ex-post outcome over a long period of time is a proxy for the ex-ante MRP (following the seminal work by Ibbotson and Sinquefield (1976)).

- Provides a basis to estimate the ex-ante MRP by “reverse engineering” factors that occurred historically but are not expected to occur in the future (e.g., the Siegel approach).
## Previous Work

<table>
<thead>
<tr>
<th>Reference</th>
<th>Methodology</th>
<th>Data Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chay, Marsden, Stubbs (1993, 1995)</td>
<td>Standard MRP estimated at 6.5%</td>
<td>Data from 1931-1994</td>
</tr>
<tr>
<td>CSFB (1990)</td>
<td>Tax-Adjusted MRP estimated at 8.8%</td>
<td>Data from 1957-1989</td>
</tr>
<tr>
<td>Lally and Marsden (2004) PBFJ and ARJ</td>
<td>Tax-Adjusted MRP estimated at 7.2% to 7.4% (Ibbotson approach) and 5.5% to 6.2% (Siegel approach)</td>
<td>Data from 1931-2002</td>
</tr>
</tbody>
</table>
ESTIMATING THE MRP: IBBOTSON METHODOLOGY

\[
\text{Average over } \frac{D_{\text{ex post}} - T_{\text{fin}}}{s_{\text{fin}}} \text{ for each year over a long-time period.}
\]

(1)

(2)

Simplified \( TAMRP = \) Equation (2) but capital gains tax zero for all investors and imputation credits attached to dividends at the maximum possible rate of 0.4925
Data

Monthly returns over the period 1931 – 2004

Stock returns as a proxy for the market. This is not a true “market portfolio”.

Long term Government stock yields to proxy for the risk-free rate and as a basis to measure bond returns.

CPI indices from Department of Statistics to measure inflation.
Tax-Adjusted Market Risk Premium

1. What is an investor?
   - An individual New Zealander, consistent with a “domestic” CAPM;
   - Non-individuals are just conduits (companies, super funds, unit trusts). These can be ignored unless they add or subtract from personal taxes paid.
Tax-Adjusted Market Risk Premium continued

Asset ownership via non-individuals

Two types of “individuals”
  Type A: Own assets directly
  Type B: Own assets via super funds & unit trusts

Pre 1988: Ownership of assets via super funds reduces personal tax
Post 1988: Ownership via super funds & unit trusts adds capital gains tax
Tax-Adjusted Market Risk Premium

2. Implications of Dividend Imputation

\[ TAMRP = R_{mt} - D_{mt} T_{mt} - R_{ft} (1 - T_{lt}) \]

Pre-imputation 1988: compute

\[ \Rightarrow \text{compute } T_I \text{ and } T_m \text{ for each year } \Rightarrow \text{weight} \]

over type A and B investors
Tax-Adjusted Market Risk Premium

Post-imputation 1988: $T_m$ difficult to compute, but if value of an imputation credit to domestic investors is 100% of its face value, then:

\[
R_{mt} + \frac{IC_{mt}}{S_{t-1}} - \left[ D_{mt} + \frac{IC_{mt}}{S_{t-1}} \right] T_I - R_f (1 - T_I)
\]

⇒ compute $T_I$ for each year and weight over type A and B investors;

Note: we assumed ratio of imputation credits to cash dividends = 0.40 (max. ratio = 33/67 = 0.4925) to determine the standard MRP
## Tax-Adjusted Market Risk Premium

### Pre-imputation: Tax assumptions for $T_I$

<table>
<thead>
<tr>
<th>Period</th>
<th>Investor A</th>
<th>Investor B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1931 - 1957</td>
<td>$T_I = \text{tax rate on interest (no capital gains tax)}$</td>
<td>Exempt on dividends and capital gains</td>
</tr>
<tr>
<td>1958 - 1987</td>
<td>$T_I = \text{tax rate on interest (no capital gains tax)}$</td>
<td>Exempt on dividends and capital gains</td>
</tr>
</tbody>
</table>
### Tax-Adjusted Market Risk Premium

**Pre-imputation: Tax assumptions for $T_m$**

<table>
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<th>Period</th>
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<th>Investor B</th>
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<tr>
<td>1931 - 1957</td>
<td>Exempt on dividends and capital gains</td>
<td>Exempt on dividends and capital gains</td>
</tr>
<tr>
<td>1958 - 1987</td>
<td>$T_m = \text{tax rate on dividends (allowing for non-taxable dividends)}$</td>
<td>Exempt on dividends and capital gains</td>
</tr>
</tbody>
</table>
Tax-Adjusted Market Risk Premium

1988-2000: Post imputation

Values only for $T_i$ required.

Type A investors are taxed on interest at the marginal tax rate for individuals and exempt from tax on capital gains.

Type B investors are also taxed on interest at the marginal tax rate for individuals, and taxed on capital gains at 50% of the corporate tax rate.
## Tax-Adjusted Market Risk Premium

### Investor weights

<table>
<thead>
<tr>
<th>Period</th>
<th>Type A investor (weight for individuals)</th>
<th>Type B investor (weight for super funds etc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1931 - 1957</td>
<td>81%</td>
<td>19%</td>
</tr>
<tr>
<td>1958 - 1987</td>
<td>81%</td>
<td>19%</td>
</tr>
<tr>
<td>1988 - 2004</td>
<td>57% - 77%</td>
<td>23% - 43%</td>
</tr>
</tbody>
</table>
Tax rates for $T_I$ and $T_M$ over period 1931 - 2004
## HISTORICAL HIGHLIGHTS: NZ RETURNS 1931-2004

<table>
<thead>
<tr>
<th>Series</th>
<th>Mean Arithmetic Annual Return</th>
<th>Mean Geometric Return</th>
<th>Standard deviation of Annual Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity returns</td>
<td>12.5%</td>
<td>10.2%</td>
<td>24.0%</td>
</tr>
<tr>
<td>Long-term Government bond returns</td>
<td>6.3%</td>
<td>6.0%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Long-term Government bond yields</td>
<td>6.6%</td>
<td>6.6%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Inflation rate</td>
<td>5.2%</td>
<td>5.1%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Nominal market risk premium (bond returns)</td>
<td>6.3%</td>
<td>3.5%</td>
<td>23.2%</td>
</tr>
<tr>
<td>Nominal market risk premium (bond yields)</td>
<td>5.9%</td>
<td>3.3%</td>
<td>23.4%</td>
</tr>
</tbody>
</table>
HISTORICAL HIGHLIGHTS: NZ RETURNS 1931-2004

Nominal returns on NZ equities, bond yields, bond returns and inflation, 1931-2004: Index value (start 1931=1.00)
HISTORICAL HIGHLIGHTS: NZ RETURNS 1931-2004

Distribution of equity returns 1931 - 2004

Returns

Number

-50% to -40%
-40% to -30%
-30% to -20%
-20% to -10%
-10% to 0%
0% to 10%
10% to 20%
20% to 30%
30% to 40%
40% to 50%
50% to 60%
60% to 70%
70% to 80%
80% to 90%
90% to 100%
100% to 110%
110% to 120%
## HISTORICAL HIGHLIGHTS: NZ RETURNS 1931-2004

<table>
<thead>
<tr>
<th>Series</th>
<th>Mean Arithmetic Annual Return</th>
<th>Mean Geometric Return</th>
<th>Standard deviation of Annual Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal TAMRP (bond returns)</td>
<td>7.8%</td>
<td>5.3%</td>
<td>23.2%</td>
</tr>
<tr>
<td>Nominal TAMRP (bond yields)</td>
<td>7.6%</td>
<td>5.1%</td>
<td>23.6%</td>
</tr>
<tr>
<td>Simplified version of the nominal TAMRP (bond returns)</td>
<td>7.9%</td>
<td>5.4%</td>
<td>23.1%</td>
</tr>
<tr>
<td>Simplified version of the nominal TAMRP (bond yields)</td>
<td>7.7%</td>
<td>5.2%</td>
<td>23.5%</td>
</tr>
</tbody>
</table>
HISTORICAL HIGHLIGHTS: NZ RETURNS 1931-2004

The equity risk premium is volatile

![Bar chart showing annualised equity risk premium from 1931 to 2001]
## Sensitivity analysis

Mean Arithmetic Annual Return 1931-2004

<table>
<thead>
<tr>
<th>Series</th>
<th>Base case</th>
<th>Tax rates on Interest and Div. ± 10%</th>
<th>B investor weight ± 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal TAMRP (bond returns)</td>
<td>7.8%</td>
<td>7.5% to 8.0%</td>
<td>7.7% to 7.9%</td>
</tr>
<tr>
<td>Nominal TAMRP (bond yields)</td>
<td>7.6%</td>
<td>7.3% to 7.9%</td>
<td>7.5% to 7.7%</td>
</tr>
</tbody>
</table>
Is the “Ibbotson” type MRP and TAMRP a good proxy for the ex-ante market risk premium?

If historical equity returns and the MRP have been higher than expected then the Ibbotson measure will over estimate the ex-ante market risk premium.
Ibbotson type estimate of the MRP

Why might the ex-ante MRP be less than the historical MRP? Reasons – may be due to unexpectedly high equity returns?

- unexpected growth due to technology changes and improved productivity;

- decreased transactions and monitoring costs (improved corporate governance);

- a decline in discount rates (risk premium) with greater scope for investor diversification;

- lower expected future market volatility.
Siegel type estimate

Siegel (1992) argues the high historical MRP was due to high unexpected inflation. Result: real bonds returns but not equity returns were depressed.

<table>
<thead>
<tr>
<th>Period</th>
<th>Real equity returns</th>
<th>Real Yields (long-term Treasury bonds)</th>
<th>MRP (US data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1802 – 1870</td>
<td>6.9%</td>
<td>5.2%</td>
<td>1.7%</td>
</tr>
<tr>
<td>1871 – 1925</td>
<td>7.9%</td>
<td>4.0%</td>
<td>3.9%</td>
</tr>
<tr>
<td>1926 – 1990</td>
<td>8.6%</td>
<td>1.8%</td>
<td>6.8%</td>
</tr>
<tr>
<td>1802 – 1990</td>
<td>7.8%</td>
<td>3.7%</td>
<td>4.1%</td>
</tr>
</tbody>
</table>
Siegel (1992, 1999) estimator

Market Risk Premium

\[ \text{MRP}(S) = \text{MRP}(I) + \text{AV}(R_f^r) - \text{AV}[E(R_f^r)] \]

How to determine

- Inflation proof bond s.

- Use average real yields on nominal bonds when inflation was stable.
Siegel: TAMRP (Tax-adjusted market risk premium) estimator

\[ \text{TAMRP} = E(R_m) - D_mT_m - R_f (1 - T_1) \]

To estimate under the Siegel methodology

\[ \text{TAMRP (S)} = \text{TAMRP (I)} + AV[R_f (1 - T_1)] \cdot AV[E(R_f) (1 - T_1)] \]
Over the period 1931-2004 were historic real yields on nominal bonds less than those expected?

Real arithmetic mean annual returns for five year holding periods

<table>
<thead>
<tr>
<th>Period</th>
<th>Real equity returns</th>
<th>Real bond yields</th>
<th>Real Bond yields × (1 - TR)</th>
<th>Inflation rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1931-1935</td>
<td>15.5%</td>
<td>7.6%</td>
<td>6.8%</td>
<td>-2.4%</td>
</tr>
<tr>
<td>1936-1940</td>
<td>-1.8%</td>
<td>-0.6%</td>
<td>-0.5%</td>
<td>4.5%</td>
</tr>
<tr>
<td>1941-1945</td>
<td>9.4%</td>
<td>0.9%</td>
<td>0.6%</td>
<td>2.3%</td>
</tr>
<tr>
<td>1946-1950</td>
<td>4.2%</td>
<td>-1.2%</td>
<td>-0.9%</td>
<td>4.5%</td>
</tr>
<tr>
<td>1951-1955</td>
<td>0.3%</td>
<td>-1.4%</td>
<td>-1.0%</td>
<td>5.4%</td>
</tr>
<tr>
<td>1956-1960</td>
<td>12.0%</td>
<td>1.7%</td>
<td>1.3%</td>
<td>3.1%</td>
</tr>
<tr>
<td>1961-1965</td>
<td>5.3%</td>
<td>2.4%</td>
<td>1.6%</td>
<td>2.7%</td>
</tr>
<tr>
<td>1966-1970</td>
<td>6.2%</td>
<td>-0.1%</td>
<td>0.0%</td>
<td>5.7%</td>
</tr>
<tr>
<td>1971-1975</td>
<td>-4.1%</td>
<td>-4.2%</td>
<td>-2.6%</td>
<td>10.6%</td>
</tr>
<tr>
<td>1976-1980</td>
<td>5.4%</td>
<td>-3.6%</td>
<td>-2.2%</td>
<td>14.7%</td>
</tr>
<tr>
<td>1981-1985</td>
<td>27.8%</td>
<td>1.7%</td>
<td>1.3%</td>
<td>11.8%</td>
</tr>
<tr>
<td>1986-1990</td>
<td>-5.3%</td>
<td>4.9%</td>
<td>3.3%</td>
<td>8.9%</td>
</tr>
<tr>
<td>1991-1995</td>
<td>17.5%</td>
<td>6.2%</td>
<td>4.4%</td>
<td>1.9%</td>
</tr>
<tr>
<td>1996-2000</td>
<td>1.6%</td>
<td>5.3%</td>
<td>3.9%</td>
<td>1.7%</td>
</tr>
<tr>
<td>2001-2004</td>
<td>14.3%</td>
<td>4.0%</td>
<td>2.9%</td>
<td>2.0%</td>
</tr>
<tr>
<td><strong>1931-2004</strong></td>
<td><strong>7.1%</strong></td>
<td><strong>1.5%</strong></td>
<td><strong>1.2%</strong></td>
<td><strong>5.2%</strong></td>
</tr>
</tbody>
</table>
Historical returns – cont.

Bond yields and inflation 1931-2004

-15.0%
-10.0%
-5.0%
0.0%
5.0%
10.0%
15.0%
20.0%


Bond yields
Inflation
Historical returns – cont.

Real returns on NZ equities, bond yields, bond returns, 1931-2004: Index value (start 1931=1.00)
### Real returns in NZ 1931 – 2004

Real arithmetic mean annual returns excluding years 1973 -1987

<table>
<thead>
<tr>
<th>Period</th>
<th>Real equity returns</th>
<th>Real bond yields</th>
<th>Real Bond yields $\times (1 - T_d)$</th>
<th>Inflation rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1931 -2004</td>
<td>7.1%</td>
<td>1.5%</td>
<td>1.2%</td>
<td>5.2%</td>
</tr>
<tr>
<td>All periods except 1973 - 1987</td>
<td>5.6%</td>
<td>2.2%</td>
<td>1.8%</td>
<td>3.1%</td>
</tr>
</tbody>
</table>
Historical bond returns – continued

In New Zealand there were also price and interest rate controls between 1972 and 1984.

Since 1995: annual average yields on New Zealand inflation protected bonds have ranged between 3.6% - 5.5%.
Conclusion

The evidence is consistent with historic real yields on nominal bonds being less than expected due to price control and high unanticipated inflation?

Possible explanation?

Estimate of Siegel MRP

\[ \text{MRP (S)} = \text{MRP (I)} + \text{AV (R}_f^r\text{)} - \text{AV [E (R}_f^r\text{)]} \]
Estimate of Siegel TAMRP

\[
\text{TAMRP}(S) = \text{TAMRP}(I) + \text{AV}\left[\mathbb{R}_f^i (1 - T_1)\right] \hat{\text{AV}}\left[\mathbb{E}(\mathbb{R}_f^i) (1 - T_1)\right]
\]

\[
= 7.6\% + 1.2\% - [2.1\% to 2.9\%]
\]

\[
= 5.9\% - 6.7\%
\]
Conclusion on Siegel’s estimates

Siegel type estimates of the MRP and the TAMRP are lower than historical estimates.

Arguments that ex-ante MRP is lower than the simple historical average market risk premium is consistent with a number of authors e.g. Stulz (1999), Fama and French (2002), Dimson et al (2003, 2005).
Siegels’s estimates continued.

But the Siegel methodology has its critics. For example:


- Dimson et al (2002) – historical equity returns may be different if factors leading to low real bond returns had not arisen.
Some issues with the use of historic data to estimate the MRP and TAMRP

- Data reliability in early periods?
- Changes in equity market “characteristics” over time, for example:
  - Offshore investor participation;
  - Change in the composition of the index;
  - Changes in “market leverage” over time;
  - Time varying volatility.
Conclusion

Historical estimates in the NZ market over 1931-2004 are:

<table>
<thead>
<tr>
<th>Equity risk premium relative to bond yields.</th>
<th>Ibbotson type estimate (i.e. historical average).</th>
<th>Siegel type estimate (i.e. reverse engineer low historic returns on bonds).</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRP</td>
<td>5.9%</td>
<td>3.4% to 4.4%</td>
</tr>
<tr>
<td>TAMRP</td>
<td>7.6%</td>
<td>5.9% to 6.7%</td>
</tr>
<tr>
<td>Simplified TAMRP</td>
<td>7.7%</td>
<td>6.0% to 6.8%</td>
</tr>
</tbody>
</table>

Are these good estimates of the ex-ante MRP and TAMRP in NZ?