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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?"

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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

Chay, Marsden, Stubbs (1993, 1995).	Standard MRP estimated at 6.5%	Data from 1931-1994.
CSFB (1990).	Tax-Adjusted MRP estimated at 8.8%	Data from 1957-1989.
PricewaterhouseCoopers (2002).	Tax-Adjusted MRP estimated at 7.5% , Standard MRP = 5.1%	Data 1925 -2001
Lally and Marsden (2004) PBFJ and ARJ	Tax-Adjusted MRP estimated at 7.2% to 7.4% (Ibbotson approach) and 5.5% to 6.2% (Siegel approach)	Data from 1931-2002

ESTIMATING THE MRP: IBBOTSON METHODOLOGY

TAMRP = average over the *Dex-Post* outcomes for each year over a long-time period.

$$R_{mt} - R_{ft} \qquad (1)$$

$$R_{mt} - R_{ft}(1 - T_{It}) \qquad (2)$$

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

$TAMRP = R_{mt} - D_{mt} T_{mt} - R_{ft} (1 - T_{It})$

Pre-imputation 1988: compute

$\Rightarrow$ compute T_I and T_m for each year $\Rightarrow$ 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:

$$R_{mt} + \frac{IC_{mt}}{S_{t-1}} - \left[D_{mt} + \frac{IC_{mt}}{S_{t-1}} \right] T_{It} - R_{ft}(1 - T_{It})$$

$\Rightarrow$ 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

Period	*Investor A*	*Investor B*
1931 - 1957	T_I = tax rate on interest (no capital gains tax)	Exempt on dividends and capital gains
1958 - 1987	T_I = tax rate on interest (no capital gains tax)	Exempt on dividends and capital gains

Tax-Adjusted Market Risk Premium

Pre-imputation: Tax assumptions for T_m

Period	*Investor A*	*Investor B*
1931 - 1957	Exempt on dividends and capital gains	Exempt on dividends and capital gains
1958 - 1987	T_m = tax rate on dividends (allowing for non-taxable dividends)	Exempt on dividends and capital gains

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.

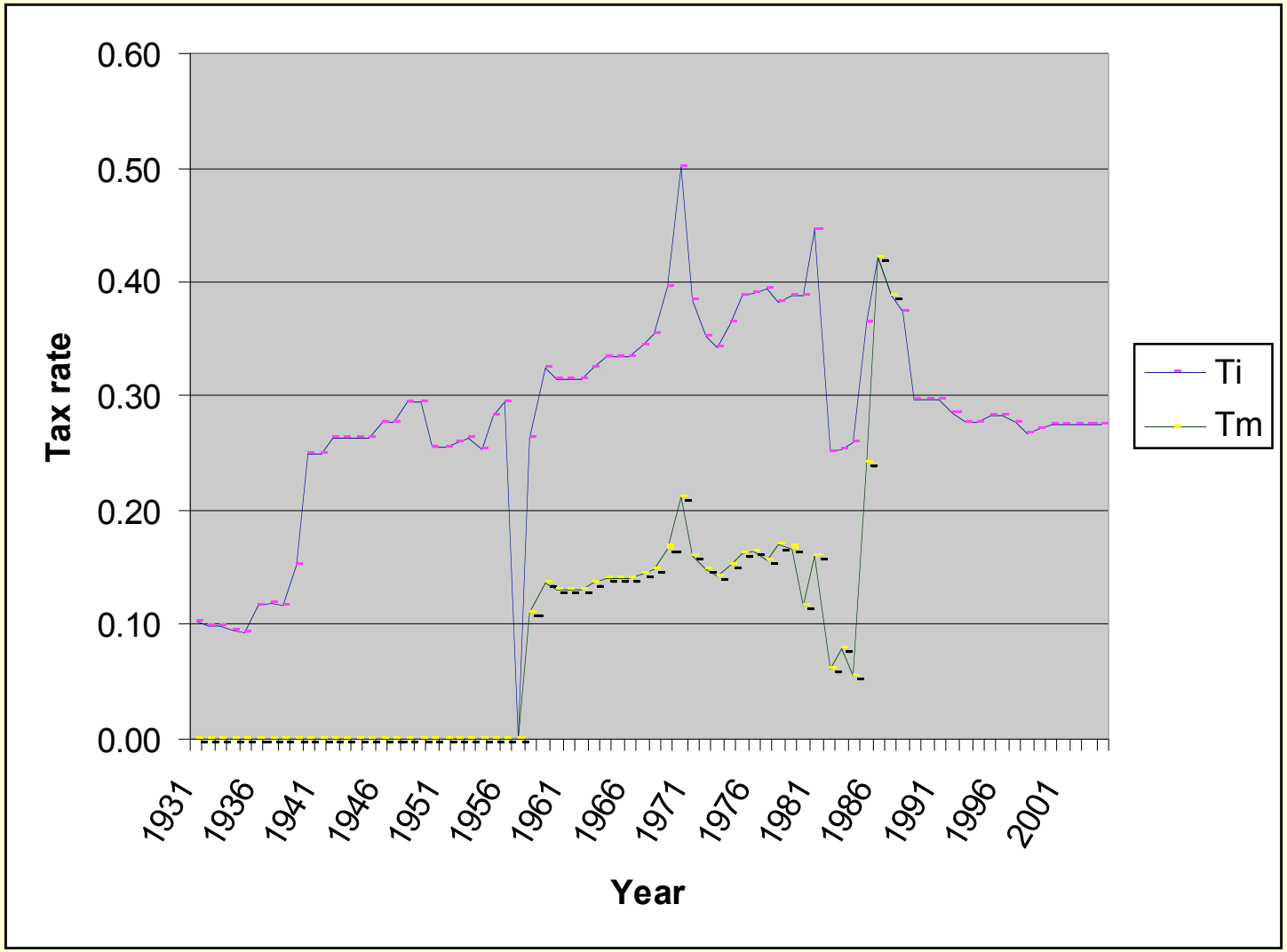
Type B investors are also taxed on interest at the marginal tax rate for individuals, and taxed on capital gains at 50% of the corporate tax rate.

Tax-Adjusted Market Risk Premium

Investor weights

Period	Type A investor (weight for individuals)	Type B investor (weight for super funds etc)
1931 - 1957	81%	19%
1958 - 1987	81%	19%
1988 - 2004	57% - 77%	23% - 43%

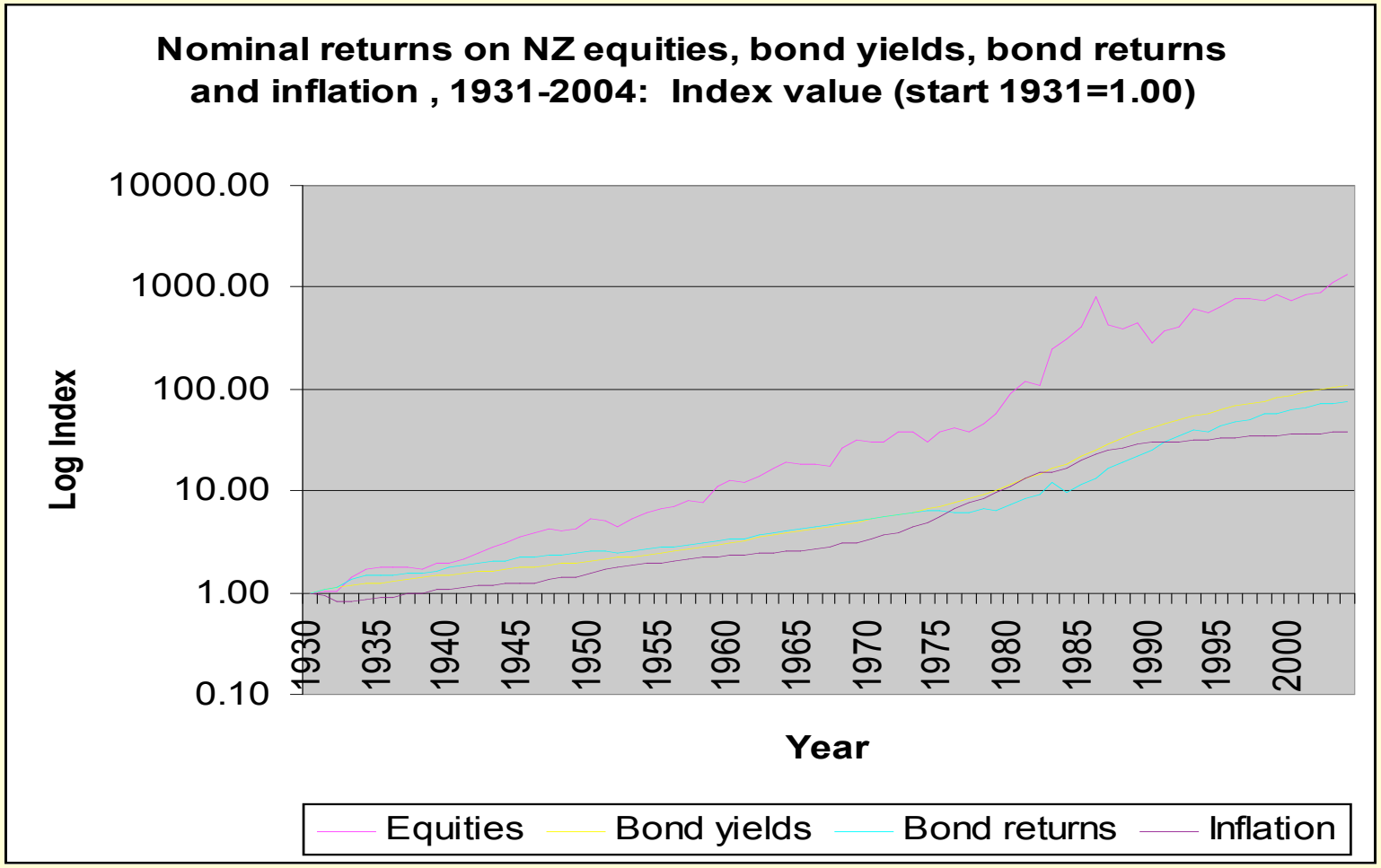
Tax rates for T_I and T_M over period 1931 - 2004



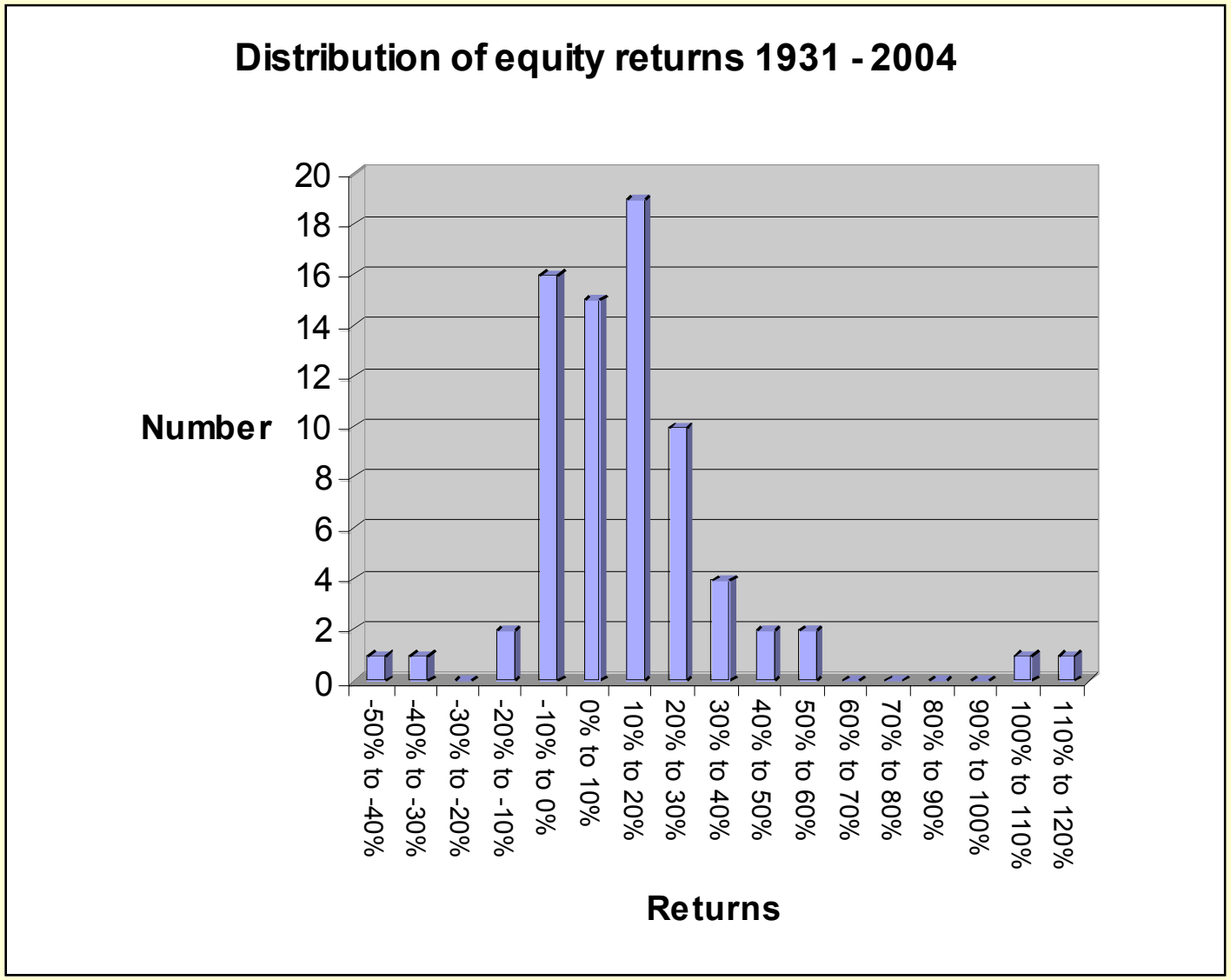
HISTORICAL HIGHLIGHTS: NZ RETURNS 1931-2004

Series	Mean Arithmetic Annual Return	Mean Geometric Return	Standard deviation of Annual Returns
Equity returns	**12.5%**	**10.2%**	**24.0%**
Long-term Government bond returns	**6.3%**	**6.0%**	**7.1%**
Long-term Government bond yields	**6.6%**	**6.6%**	**3.6%**
Inflation rate	**5.2%**	**5.1%**	**5.6%**
Nominal market risk premium **(bond returns)**	**6.3%**	**3.5%**	**23.2%**
Nominal market risk premium **(bond yields)**	**5.9%**	**3.3%**	**23.4%**

HISTORICAL HIGHLIGHTS: NZ RETURNS 1931-2004



HISTORICAL HIGHLIGHTS: NZ RETURNS 1931-2004

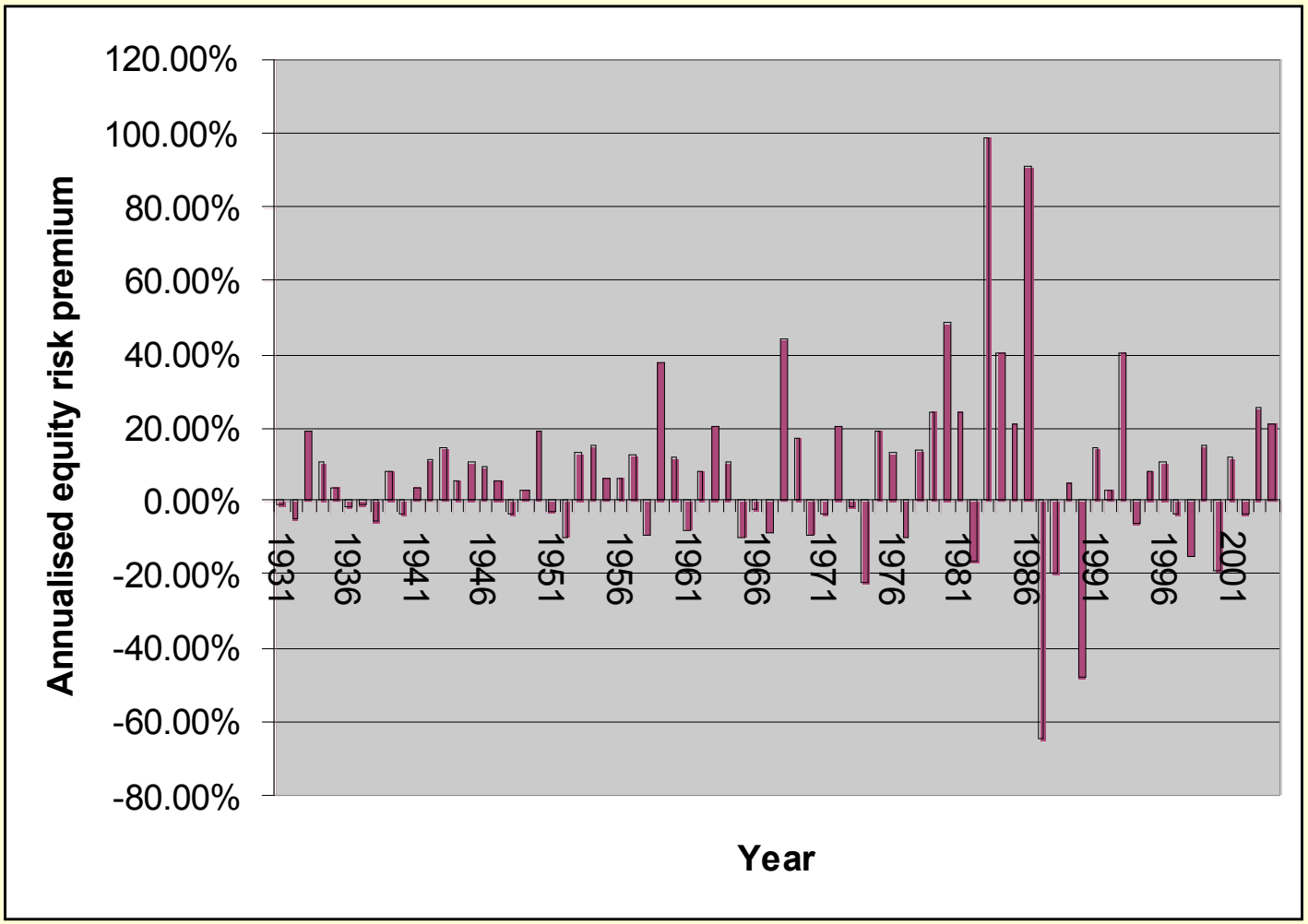


HISTORICAL HIGHLIGHTS: NZ RETURNS 1931-2004

Series	Mean Arithmetic Annual Return	Mean Geometric Return	Standard deviation of Annual Returns
Nominal TAMRP **(bond returns)**	7.8%	5.3%	23.2%
Nominal TAMRP **(bond yields)**	7.6%	5.1%	23.6%
Simplified version of the nominal TAMRP **(bond returns)**	7.9%	5.4%	23.1%
Simplified version of the nominal TAMRP **(bond yields)**	7.7%	5.2%	23.5%

HISTORICAL HIGHLIGHTS: NZ RETURNS 1931-2004

The equity risk premium is volatile



Sensitivity analysis

Mean Arithmetic Annual Return 1931- 2004

Series	Base case	Tax rates on Interest and Div. ± 10%	B investor weight ± 10%
Nominal TAMRP **(bond returns)**	7.8%	7.5% to 8.0%	7.7% to 7.9%
Nominal TAMRP **(bond yields)**	7.6%	7.3% to 7.9%	7.5% to 7.7%

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.

Period	Real equity returns	-	Real Yields (long-term Treasury bonds)	≈	MRP (US data)
1802 – 1870	6.9%		5.2%		1.7%
1871 – 1925	7.9%		4.0%		3.9%
1926 – 1990	8.6%		1.8%		6.8%
1802 – 1990	7.8%		3.7%		4.1%

Siegel (1992, 1999) estimator

Market Risk Premium

$$MRP(S) = MRP(I) + AV(R_f^r) - AV[E(R_f^r)]$$

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

$$TAMRP = E(R_m) - D_m T_m - R_f (1 - T_1)$$

To estimate under the Siegel methodology

$$TAMRP(S) = TAMRP(I) + AV\left[R_f^r (1 - T_1)\right] - \hat{A}V\left[E\left(R_f^r\right)(1 - T_1)\right]$$

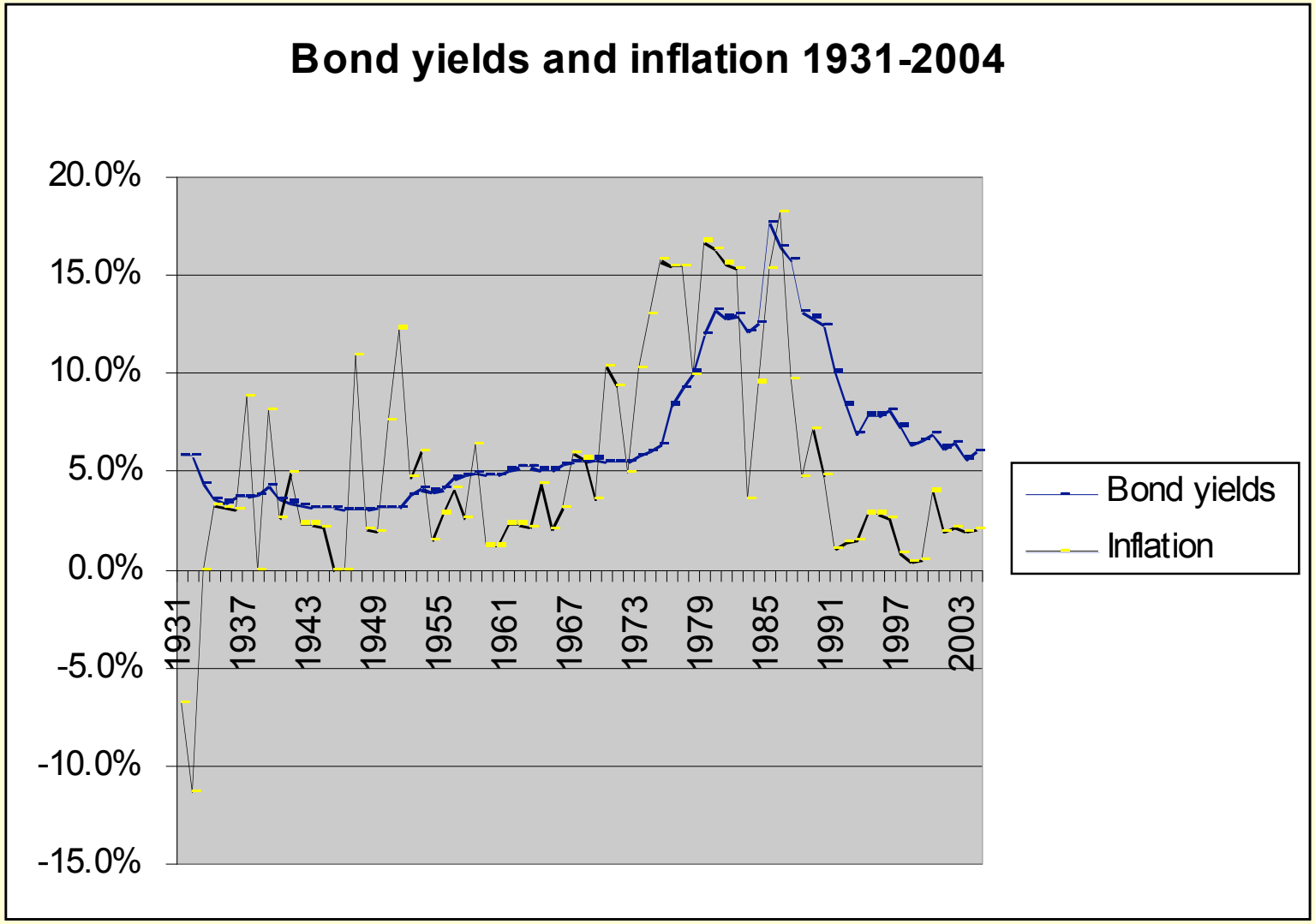
Data

Over the period 1931- 2004 were historic real yields on nominal bonds less than those expected?

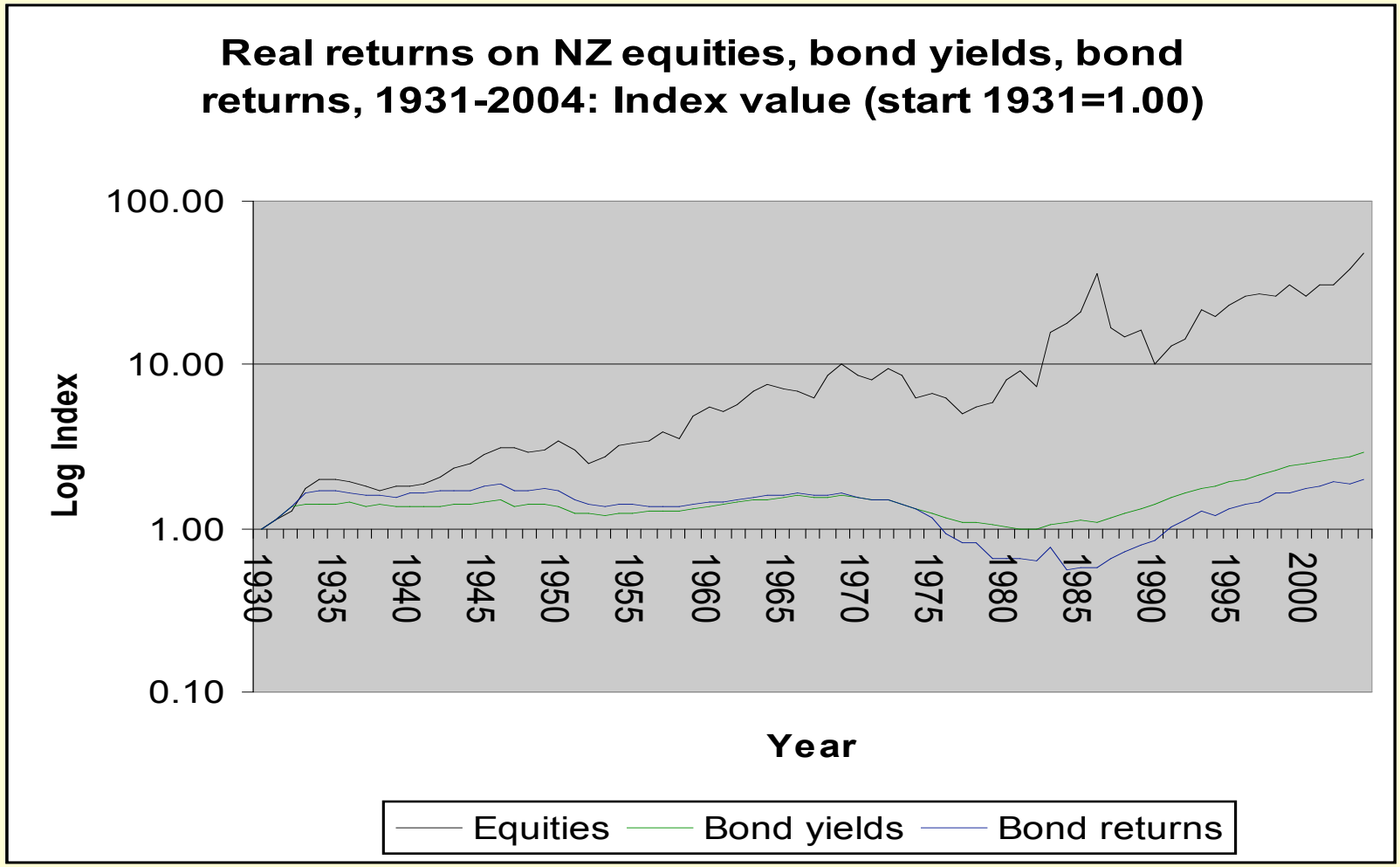
Real arithmetic mean annual returns for five year holding periods

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

Historical returns – cont.



Historical returns – cont.



Real returns in NZ 1931 – 2004

Real arithmetic mean annual returns excluding years 1973 -1987

Period	Real equity returns	Real bond yields	Real Bond yields × (1- T_I)	Inflation rate
1931 -2004	7.1%	1.5%	1.2%	5.2%
All periods except 1973 - 1987	5.6%	2.2%	1.8%	3.1%

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?

Shafir et al (1997) in Quarterly Journal of Economics: Investors suffer “Money Illusion” in the presence of high inflation.

Estimate of Siegel MRP

$$MRP\ (S) = MRP\ (I) + AV\left(R_f^r\right) - AV\left[E\left(R_f^r\right)\right]$$

Estimate of Siegel TAMRP

$$TAMRP(S) = TAMRP(I) + AV\left[R_f^r(1 - T_1)\right] - \hat{A}V\left[E\left(R_f^r\right)(1 - T_1)\right]$$

$$= 7.6\% + 1.2\% - [2.1\% \text{ to } 2.9\%]$$

$$= 5.9\% - 6.7\%$$

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).

Siegel's estimates continued.

But the Siegel methodology has its critics. For example:

- Levy, Levy and Edry (2003) in Fin. Analyst Jnl. argue negative after-tax real interest rate may hold in equilibrium if inflation high.

- 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:

Equity risk premium relative to bond yields.	**Ibbotson type estimate (i.e. historical average).**	**Siegel type estimate (i.e. reverse engineer low historic returns on bonds).**
MRP	5.9%	3.4% to 4.4%
TAMRP	7.6%	5.9% to 6.7%
Simplified TAMRP	7.7%	6.0% to 6.8%

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