Historical Market Risk Premiums in New Zealand: 1931 – 2000

by

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HISTORICAL MARKET RISK PREMIUMS IN NEW ZEALAND: 1931- 2000

Abstract

This paper documents historical returns to equities and long-term government bonds, bond yields, and inflation rates in New Zealand over the period 1931-2000. Personal tax rates on various types of investment income are also estimated. This data is used to estimate various market risk premiums. In particular, the market risk premium in the standard CAPM is estimated using the Ibbotson (2000) methodology, yielding an estimate of .056. In addition, in respect of the tax-adjusted version of the CAPM (Cliffe and Marsden, 1992; Lally, 1992) that is now widely used in New Zealand, the market risk premium is estimated using parallel methodology, yielding an estimate of .070. Finally, both of these market risk premiums are estimated using the Siegel (1992) methodology and the results are appreciably lower, at .030-.040 and .051-.059 respectively.

Key words: *equity returns, bond returns, market risk premium, equity risk premium*

HISTORICAL MARKET RISK PREMIUMS IN NEW ZEALAND: 1931-2000

1. Introduction

The market risk premium is a parameter appearing in all versions of the CAPM, and is equal to the excess of the expected return on the market portfolio of risky assets over the return on the risk free asset (subject to tax adjustments in some versions). The parameter is of considerable practical importance to investors in their portfolio allocation decisions, and for estimation of a company's cost of equity capital under the widely used capital asset pricing model (CAPM). The latter is significant in the valuation of companies, valuation of real investment projects, and setting of fair rates of return for regulated firms.

The parameter has been estimated in a variety of ways, in a variety of markets, and for various versions of the CAPM. The seminal work is that of Ibbotson and Sinquefield (1976), who estimate it for the standard version of the CAPM (Sharpe, 1964; Lintner, 1965; Mossin, 1966) in the US. They assume that the parameter is constant over time and therefore estimate it by averaging the ex-post outcomes over a long time period, i.e., by determining the excess of the actual market return for a year over the risk free rate at the beginning of the year, and then averaging this margin over the period from 1926. The market portfolio is proxied by an index of listed equities and the return on the risk free asset by the promised yield on government stock or treasury bills. All personal taxes are ignored. Recent such estimates for the US, using data from 1926, are between .080 and .095 (Ibbotson Associates, 2000). Dimson, Marsh and Staunton (2002, Table 4) estimate the premiums for 16 developed countries over the period 1900 – 2001, yielding results from .039 (Switzerland) to.100 (Japan) with an average of .054[1]. A variant on the Ibbotson methodology is that of Siegel (1992), in which the Ibbotson estimate is adjusted to reflect the excess of the estimated long-term real bond yield over the historical average. The result for the US is an estimate of the market risk premium that is considerably lower than that from the Ibbotson methodology.

[1] The countries and historical arithmetic mean market risk premia estimates over the period 1900 – 2000 are: Australia (.079), Belgium (.047), Canada (.057), Denmark (.031), France (.067), Germany (.096), Ireland (.045), Italy (.080), Japan (.100), Netherlands (.064), South Africa (.071), Spain (.041), Sweden (.071), Switzerland (.039), United Kingdom (.055) and the United States (.067).

The objectives of this study are as follows. First, we seek to extend the prior work of Chay et al (1993, 1995) by providing an Ibbotson type estimate of the market risk premium for the standard CAPM in the New Zealand market. Second, we seek an Ibbotson type estimate of the market risk premium in the tax-adjusted version of the CAPM that is widely used in New Zealand (Cliffe and Marsden, 1992; Lally, 1992). Unlike the standard version of the CAPM this version acknowledges differential personal taxation of interest, dividends and capital gains[2]. The latter is favoured by the preferential tax treatment of dividends arising from the dividend imputation system in New Zealand, and also by the preferential tax treatment of capital gains arising from various exemptions and deferral of payment until realisation. Furthermore Lally and Van Zijl (2002) show that, in the presence of differential taxation of sources of personal income, the use of the standard version of the CAPM can significantly mis-estimate the cost of equity capital. As far as we are aware there is no published study in New Zealand that estimates the tax-adjusted market risk premium by the Ibbotson methodology[3]. Our results should therefore be of considerable interest to academics, investors, corporates and regulators. Finally, we offer estimates of these two market risk premiums in New Zealand that reflect the methodology of Siegel (1992).

The rest of this paper is structured as follows. Section 2 describes the data used to estimate long-term equity and bond returns, bond yields and inflation rates. Section 3 examines the tax-adjusted version of the market risk premium and the time-varying personal tax parameters used over the period 1931 to 2000. Section 4 presents the historical average nominal and real returns to equities and bonds, bond yields, inflation rates and estimates of the standard and tax-adjusted versions of the market risk premium. Section 5 presents estimates of the standard and tax-adjusted market risk premium based on Siegel's (1992) methodology. We conclude in section 6.

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[2] This form of the CAPM extends Brennan (1970) to allow for dividend imputation. The model is widely used by NZ companies (such as Transpower Ltd and Telecom Ltd), practitioners, The Treasury (1997), The Ministry of Economic Development and has recently been adopted by The Commerce Commission (2002).

[3] Pricewaterhouse Coopers (2001) in an unpublished study estimated the tax-adjusted market risk premium to be .08 in New Zealand over the period 1925-2000. As at June 2002, Pricewaterhouse Coopers have further reduced their tax-adjusted market risk premium estimate to .075. However they do not disclose details of their methodology, and their assumptions with respect to personal tax rates on interest, dividends and capital gains.

2. Data

2.1 Monthly Data

The data for determining returns, yields and inflation rates is primarily sourced from Chay et al (1993, 1995), but updated to the end of December 2000. A more detailed description of the data series and index construction is contained in that paper.

In respect of equity returns, the Department of Statistics Capital Index was used for the period February 1931 to December 1969. The Reserve Bank of New Zealand capital index was used for the period January 1970 to December 1978. Both the Department of Statistics and the Reserve Bank of New Zealand capital index were adjusted to construct a gross index over the period February 1931 to December 1978 using the Department of Statistics dividend yield index. The Datex gross share price index was used for the period January 1979 to December 1986 and the New Zealand Stock Exchange ("NZSE") gross share price index was used from January 1987 to December 2000. Both the Datex and NZSE gross indices assume reinvestment of dividends and are adjusted for capital changes (bonus issues, rights issues, etc.). Since April 1988 the NZSE gross index also includes the imputation credits attached to the cash dividends[4], i.e., it has not constructed a gross index that incorporates only capital gains and cash dividends. Accordingly, to facilitate estimation of the standard market risk premium, we constructed a "gross" index for the period April 1988 to December 2000 by reducing the NZSE gross index by the product of the cash dividend yield multiplied by the ratio of credits attached to dividends paid. Details of the adjustment we made to the NZSE gross index for this period are found in Appendix 2.

In respect of the risk free rate, this is proxied by the yield on long-term government bonds. For the period February 1931 to June 1985, these yields were obtained from the Official Records of the NZSE or the Reserve Bank of New Zealand. For the period July 1985 to December 2000, they were obtained exclusively from the Reserve Bank of New Zealand.

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[4] For a discussion of the dividend imputation system in New Zealand see Cliffe and Marsden (1992) and Lally (1992).

We now turn to the returns on these long-term government bonds. For the periods February 1931 to September 1936 and June 1944 to July 1946, yields on these bonds were collated from the Official Records of the NZSE. For the periods October 1936 to June 1985 (except for the period June 1944 to July 1946) yields from the Reserve Bank of New Zealand were used. These yields were used to derive the market values of the bonds at monthly frequencies. Monthly bond returns over the period February 1931 to June 1985 were then calculated as follows:

$$B_t = \frac{P_t + C_t - P_{t-1}}{P_{t-1}}$$

where B_t is the monthly holding period return for month t, P_t the price of the bond at the end of month t, and C_t is the coupon paid on the bond during month t. For the period July 1985 to December 2000, the returns on these bonds were constructed using the Credit Suisse First Boston bond price index.[5]

We turn finally to inflation. The inflation index for the period February 1931 to December 2000 was obtained from the Department of Statistics quarterly consumer price index. A monthly inflation index in each quarter was then constructed based on straight-line interpolation using the monthly food price index (see Chay, Marsden and Stubbs, 1993 for details). The realized monthly inflation rate was calculated as:

$$i_t = \frac{cpi_t - cpi_{t-1}}{cpi_{t-1}}$$

where cpi_t is the consumer price index at the end of month t.

2.2 Transformations of Returns

The equity and bond returns described above are monthly. Following Ibbotson and Sinquefield (1976) we form annual returns, R_t, by compounding monthly returns, R_j:

[5] This index was provided courtesy of Credit Suisse First Boston (now First NZ Securities Ltd).

$$R_t = \prod_{j=Jan}^{Dec} (1 + R_j) - 1$$

The arithmetic mean return, R_a, for a holding period of T years is computed as:

$$R_a = \frac{\sum_{t=1}^{T} R_t}{T}$$

The geometric mean return, R_g, for a holding period of T years is computed as:

$$R_g = \left[\prod_{t=1}^{T} (1 + R_t) \right]^{1/T} - 1$$

The arithmetic mean is the average of single period returns measured for each year. The geometric mean measures the cumulative compound return for an investor who bought the index at the start of a period and held the index (with reinvestment of all dividends or interest) until the end of the specified period. The arithmetic mean return is always greater than the geometric mean, by an amount determined by the volatility in returns over the T year period.

The real rates of return for equities and bonds are calculated for each month between 1931 and 2000 by deflating the nominal return R_{nt} by the inflation rate i_t, i.e.,

$$R_{rt} = \frac{1 + R_{nt}}{1 + i_t} - 1$$

Real arithmetic and geometric mean returns are then computed as described above.

To estimate the standard market risk premium following the Ibbotson methodology, we first compound monthly market returns R_{mj} and monthly bond yields R_j to their annual counterparts, and then invoke arithmetic subtraction, to yield the year t estimate of the standard market risk premium, i.e.,

$$\hat{MRP}_t = \left[\prod_{j=Jan}^{Dec} (1+R_{mj}) - 1 \right] - \left[\prod_{j=Jan}^{Dec} (1+R_{fj}) - 1 \right]$$

The use of arithmetic subtraction differs from the geometric subtraction method in Ibbotson and Sinquefield (1976), but accords more closely with the definition of the standard market risk premium[6]. The annual outcomes computed in this way were then averaged over various periods, using both arithmetic and geometric averaging. Cooper (1996) shows that the arithmetic mean of historical returns is a less biased estimate than the geometric mean in the determination of the expected risk premium in the CAPM, and we concur with his analysis. Nevertheless we disclose results from both types of averaging.

Finally, the estimated standard deviation of returns over T years is calculated from annual returns R_t as follows:

$$\hat{\sigma} = \sqrt{\frac{1}{T-1} \sum_{t=1}^{T} (R_t - \overline{R})^2}$$

3. Taxes and the tax-adjusted market risk premium

3.1 Introduction

The market risk premium in the tax-adjusted version of the CAPM (Cliffe and Marsden, 1992; Lally, 1992) is as follows:

$$E(R_m) - D_m T_m - R_f (1 - T_I) \qquad (1)$$

where

R_m	=	return on the market portfolio
D_m	=	cash dividend yield on the market portfolio.
R_f	=	riskfree rate of return
T_I	=	weighted average over investors of $(t_i - t_{gi})/(1 - t_{gi})$
T_m	=	weighted average over investors of $(t_{di} - t_{gi})/(1 - t_{gi})$
t_i	=	investor i's tax rate on interest

[6] Ibbotson and Sinquefield (1976) estimate the standard market risk premium using a geometric subtraction method as follows:

$$MRP_t = \frac{1 + R_{mt}}{1 + R_{ft}} - 1$$

t_{gi}	=	investor *i*'s tax rate on capital gains
t_{di}	=	investor *i*'s tax rate on cash dividends from the market portfolio

The ex-post outcome in year *t* is:

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

In estimating this market risk premium, the concept of an "investor" is fundamental. Investors are the group who determine asset prices as a consequence of their portfolio decisions. These decisions allocate investable wealth across capital assets. For purposes of measurement, these assets are assumed to involve equities and government bonds. Bonds generate interest whilst equities generate dividends and capital gains. A complication here is that a large proportion of the owners of equities and bonds are not individuals, and include other companies, superannuation funds and unit trusts[7]. However these additional owners do not make portfolio decisions. They simply offer portfolios to individuals, who may choose to add them to their portfolios. Thus the "investors" in a CAPM world are individuals, and other owners of equities and bonds are simply conduits through which interest, dividends and capital gains flow to individuals. If these conduits do not give rise to additional (or reduced) taxes, they can be ignored. This is the case with companies, due to dividend imputation operating from 1988, to dividends and capital gains received by companies being exempt from tax prior to 1988, and to corporate holdings of government bonds being very small. However, in some cases, these conduits add or subtract from the tax layer, and such additional layers should be added or subtracted from the personal taxes ultimately faced by individuals. There are two significant instances of this. The first is that of superannuation funds prior to 1988. In general, this conduit generated a tax saving for individuals relative to direct ownership of shares or bonds. The second is that of superannuation funds and unit trusts in the period from 1988, most of which are taxed on capital gains. By contrast individuals are not taxed on capital gains when they own shares directly. Accordingly, individuals were taxed on capital gains after 1987, to the extent that they own equities via superannuation funds and unit trusts.

[7] Life insurance companies are included within the term "superannuation funds" because of the similarity in taxation treatment.

A second complication in defining investors arises from cross border ownership of assets. The CAPM of interest here assumes that capital markets are segregated. Accordingly the investor set must exclude foreigners, notwithstanding their substantial ownership of New Zealand equities and bonds.

In summary then, investors are defined to be New Zealand individuals. Ownership of equities via another company has no tax implications. Ownership of assets via superannuation funds in the pre 1988 period reduces personal taxation. Ownership of assets via superannuation funds and unit trusts in the period from 1988 adds a layer of tax (in respect of capital gains). In respect of the first conduit, it can be ignored because it has no tax implications and ownership devolves to both individuals and funds. The other two cannot be so ignored. To deal with them we decompose individual investors into two groups: those who own assets directly (type A) and those who own them via funds and unit trusts (type B).

Another significant feature of the New Zealand tax regime is the introduction of dividend imputation in 1988. This complicates the calculation of the tax parameter T_m in that knowledge of the ratio of imputation credits to cash dividends is required. However we can circumvent the need to determine this ratio by rearranging (2) above. Lally (2000a) shows that if imputation operates, and dividends are taxed identically with interest when no imputation credits are attached to the dividend, then

$$T_m = T_I - U(1 - T_I)\frac{IC_m}{DIV_m} \tag{3}$$

where U is the average utilization rate on imputation credits, IC_m are the imputation credits attached to the market dividends and DIV_m are the cash dividends on the market portfolio. Since all investors are assumed to be local, and these can fully use the credits, then the average utilization rate is 1. Substituting this into (3), and then (3) into (2), yields an ex-post value for the market risk premium in year t of

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

Recognizing that the cash dividend yield D_{mt} is the ratio of cash dividends DIV_{mt} to the value of equity at the beginning of the year (S_{t-1}), then the ex-post value for the market risk premium in year t becomes

$$R_{mt} + \frac{IC_{mt}}{S_{t-1}} - \left[D_{mt} + \frac{IC_{mt}}{S_{t-1}}\right]T_{It} - R_{ft}(1-T_{It}) \tag{4}$$

The first two terms here are the market return inclusive of the imputation credits, i.e., the "gross" return, and this is provided by the NZSE. The term [.] is the dividend yield inclusive of the imputation credits, i.e., the "gross" dividend yield and this is provided by the NZSE in that it is the difference between the return on the "gross" and capital indexes. Consequently the only tax parameter required in (4) is T_I for each year.

In summary, prior to 1988, the ex-post value for the market risk premium is calculated directly from (2), and the tax parameters required here are T_I and T_m for each year. These tax parameters are defined following equation (1) and they weight over type A and B investors. Thus, for each year prior to 1988 we ascertain tax rates on dividends, interest and capital gains and weights for each of the two-investor types. From 1988 on, the ex-post value of the market risk premium is calculated from (4), and the only tax parameter required is T_I for each year. Again, this weights over type A and B investors. Thus, for each year 1988 onwards, we ascertain tax rates on interest and capital gains, and weights for each of type A and B investors.

Appendix 1 outlines the tax characteristics of type A and B investors, estimates the market weights of the two groups, and estimates the marginal tax rates for the median investors in each group on interest, dividend and capital gain income for each year over the period 1931-2000. The estimates of tax rates, weights for type A and B investors, and tax parameters T_I and T_m are summarized in Table 1.

3.2 Estimation of the Tax Parameter T_I

This section summarizes the estimation process for T_I (and the following section does likewise for T_m). Column 2 of Table 1 presents the estimated tax rate on interest for type A investors for each of the years 1931-2000. Their tax rate on capital gains is zero. In respect of type B investors, they faced no personal tax until 1988, from which time their tax rate on interest matches that of type A investors and their effective tax rate on capital gains is estimated at half of the corporate tax rate; the latter is shown in column 3 of the Table. Column 4 records the value weight on type B investors, and column 5 converts[8] this to the weight used in the computation of T_I (prior to 1988, this adjustment is not required). Column 6 then computes T_I in accordance with the definition following equation (1). To illustrate this, the calculation for 2000 is

$$(1-0.41)(.33)+.41\left[\frac{.33-.165}{1-.165}\right]=.28$$

3.3 Estimation of the Tax Parameter T_m

As noted in section 3 of the paper, direct estimation of T_m is not required after 1988, i.e., the tax-adjusted market risk premium is estimated directly from formula (4), in which the only tax parameter is T_I. Consequently Table 1 shows estimates of T_m only for the years 1931-1988. In these years the tax rate on capital gains for both type A and B investors is zero. In addition, for the years 1931-1957, dividends were not taxable. Finally, for the years 1958-1987, type B investors face no tax on dividends and even type A investors were exempt from tax on "tax-free" dividends. So, the tax parameter T_m is zero for the years 1931-1957. For the remaining years 1958-1987 it is equal to the tax rate on interest for type A investors, multiplied by their market weight and also by the proportion of dividends that were not from tax-free sources. Column 2 of Table 1 gives the marginal tax rate on interest for type A investors and column 4 gives the complement of their market value weight. Column 7 gives the proportion of dividends that were not from tax-free sources. Column 8 then gives the value for T_m.

3.4 Estimation of the tax-adjusted market risk premium

8 For details see Appendix 1.

Paralleling the approach taken to estimate the standard market risk premium, as described in section 2, the monthly market returns R_{mj} are tax-adjusted and then compounded to their annual counterparts, the monthly risk fee rates R_{fj} are subject to the same process, and arithmetic subtraction is then applied to yield the year t estimate of the tax-adjusted market risk premium. For years prior to the introduction of dividend imputation in 1988, formula (2) applies as follows:

$$TA\hat{M}RP_t = \left[\prod_{j=Jan}^{Dec}(1 + R_{mj} - D_{mj}T_{mj}) - 1\right] - \left[\prod_{j=Jan}^{Dec}(1 + R_{fj}(1 - T_{Ij})) - 1\right]$$

For the years 1988 to 2000, formula (4) applies as follows:

$$TA\hat{M}RP_t = \left[\prod_{j=Jan}^{Dec}\left\{1 + R_{mj} + \frac{IC_{mj}}{S_{j-1}} - \left[D_{mj} + \frac{IC_{mj}}{S_{j-1}}\right]T_{Ij}\right\} - 1\right] - \left[\prod_{j=Jan}^{Dec}(1 + R_{fj}(1 - T_{Ij})) - 1\right]$$

4. Historical Returns and MRP Estimates of the Ibbotson Type

Table 2 summarizes nominal and real returns to equities and bonds, bond yields, inflation rates, and Ibbotson type estimates of both the standard and tax-adjusted market risk premiums over the period between 1931 and 2000.

The arithmetic (geometric) mean annual return to equities was .123 (.099). This exceeded both the arithmetic (geometric) mean return on long-term government bonds of .064 (.061) and the arithmetic (geometric) mean yield on long-term government bonds of .067 (.066). However, the estimated standard deviation of annual equity returns (.246) was higher than those for bond returns (.072) and bond yields (.037).

The arithmetic (geometric) mean inflation rate over the 1931-2000 period was .054 (.052). This gave rise to an arithmetic (geometric) mean real return on equities of .067 (.044), with corresponding figures for bond returns of .012 (.008), and corresponding figures for bond yields of .014 (.013). As with nominal returns, the standard deviation of real equity returns (.229) exceeded that for real bond returns (.087) and real bond yields (.048).

Using nominal returns for the full 1931-2000 period, the Ibbotson type estimate of the standard market risk premium using arithmetic (geometric) averaging over years is .056 (.030)[9]. The corresponding estimate for the tax-adjusted market risk premium is .070 (.045). In using the tax-adjusted version of the CAPM, many analysts assume that capital gains tax is zero for all investors and imputation credits are attached at the maximum possible rate of .4925. If these simplifying assumptions are made, then it is necessary to invoke the same assumptions in estimating the market risk premium in this model. Doing so, we find that our estimates for the tax-adjusted market risk premium rise only slightly, to .071 using arithmetic averaging and .046 using geometric averaging[10]. If real rather than nominal returns are used, the estimates of the market risk premium using arithmetic (geometric) averaging are .053 (.030) for the standard model and .067 (.044) for the tax-adjusted model.

Table 3 provides a breakdown of nominal mean equity returns, bond returns, bond yields and inflation rates over five year periods between 1931 and 2000[11]. Nominal arithmetic mean equity returns were positive in every five-year period. Geometric mean returns were only negative for equities in the period 1986 to 1990 (coinciding with the share market crash of October 1987). The highest period for equity returns was 1981-1985 with an arithmetic (geometric) mean return of .411 (.356).

Table 4 presents a breakdown of real mean equity returns, bond returns and bond yields over five year sub-periods between 1931 and 2000. Real arithmetic mean equity returns were negative in three of the fourteen sub-periods, real bond returns were negative in seven out of the fourteen sub-periods, and real bond yields were

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[9] The arithmetic (geometric) averages for the markets examined by Dimson et al (2002) for the period 1900-2001 is .054 (.043).

[10] To estimate the tax-adjusted market risk premium for this simplified version of the CAPM we used equations (2) and (3) over the entire period 1931-2000, where D_{mt} is the cash dividend yield exclusive of imputation credits. Details of our approach to estimate D_{mt} for 1988 onwards is set out in Appendix 2, equation (A3).

[11] The results in this table differ from the results reported by Chay, Marsden and Stubbs (1995) for the period 1986 to 1990. The reason (as noted in section 2) is that we define equity returns to exclude the imputation credits attached to cash dividends.

negative in six out of the fourteen sub-periods. A similar pattern is evident for real geometric mean returns. The highest arithmetic mean real equity return was .278 for 1981-1985, and the lowest was -.053 for 1986-1990.

Table 5 details estimates of the standard and tax-adjusted market risk premiums over the five-year sub-periods between 1931 and 2000, using nominal returns. Table 6 repeats the analysis using real returns. In addition Figure 2 supplements the breakdown in Table 5 with 21-year centered moving average estimates. However, whilst interesting, such sub-periods are much too short to warrant drawing any conclusions about the true market risk premiums, which are anyway assumed to be constant over time.

We now test the sensitivity of our estimate of the tax-adjusted market risk premium to different personal tax parameter estimates. The tax rates in Table 1 may be overestimated due to tax avoidance and/or evasion[12]. For example, tax minimization schemes were prevalent in the 1970s and 1980s when personal tax rates were as high as 66%. Examples of "tax driven" schemes include special purpose partnerships in forestry investment, primary industry investment and films. Many of these special purpose partnerships were targeted at high tax rate investors and provided large up-front tax deductions and write-offs. On the other hand, the tax parameter estimates in Table 1 assume that tax rates are equal to the marginal tax rate for the median investor in each of the years 1931–2000. Accordingly they will be too low if investors in equities and government bonds are on average taxed at rates higher than that of the median investor.

Table 7 provides estimates of the tax-adjusted market risk premium under the assumption that investors' personal tax rates on interest and capital gains are either lower or higher by 10 percentage points than the rates set out in Table 1. The change in the values for these parameters is then used to recalculate the values for T_I and T_m in Table 1. These variations in tax rates are subject to the restrictions that they cannot be negative, that the tax rate on interest income cannot exceed the top marginal personal tax rate for that particular income year, and that the tax rate on dividends is

[12] In recognition of the evasion problem, resident withholding tax on dividends and interest was introduced in 1986.

zero for the period up to 1958[13]. Under the assumption that investors' tax rates (on both interest and capital gains) are at a maximum of ten percentage points lower (higher) than provided in Table 1, the arithmetic mean based estimate of the tax-adjusted market risk premium is .067 (.073) and the geometric mean based estimate is .041 (.048).

We also undertook sensitivity analysis on the weights for investor types A and B in Table 1. While the results are not reported in Table 7, under the assumption that the weights for investor B were .10 higher (lower) than our estimates in Table 1, the arithmetic mean estimate of the tax-adjusted market risk premium is .069 (.071), and the geometric mean estimate is .044 (.046).

Increasing tax rates increases the term $R_{ft}T_{It}$ in equation (2) and hence increases the estimate of the tax-adjusted market risk premium. However, this increase is partly offset by an increase in the term $D_{mt}T_{mt}$ in equation (2). Consequently the estimate of the tax-adjusted market risk premium is not particularly sensitive to variations in investors' personal tax rates or the weights as set out in Table 1.

5. MRP Estimates of the Siegel Type

Ibbotson type estimates of the market risk premium assume that the premium (standard or tax-adjusted) is constant over time. Numerous authors contest this presumption. For example, Merton (1980) observes that the premium is a reward for bearing risk and must therefore vary with market risk. Since market risk appears to be currently lower than its historical average, then the past average returns will tend to overestimate the current level of the premium. Other arguments of this kind involve the lower transaction costs of acquiring a well-diversified portfolio (Siegel, 1999), increased globalization of markets (Stulz, 1999), term premium effects (Booth, 1999), and time-variation in market leverage (Lally, 2002). Still other authors identify factors that might bias past returns as an estimator of the current premium even in the

[13] The tax rates we assume for interest are the marginal tax rates for investors whose income corresponds to the median income. For certain income years (1989 to 1999) the marginal rate of the median income investor also equals the top marginal personal tax rate. In the remaining years the marginal rate for the median investor is less than the top marginal personal tax rate.

absence of any change in the true premium. These include survivorship bias (Jorion and Goetzmann, 1999) and irrational exuberance (Shiller, 2000). In general these arguments favour quite different approaches to estimation of the market risk premium, most particularly forward-looking approaches such as those of Harris and Marston (1992, 2001), Cornell (1999) and Claus and Thomas (2001).

An interesting exception is that of Siegel (1992, 1999), whose estimator is derived from that of Ibbotson. Siegel analyses real bond and equity returns in the US over the sub-periods 1802-1870, 1871-1925 and 1926-1990. The real returns on long-term government bonds were .052, .040 and .018 respectively, whilst real equity returns were similar across the sub-periods (.069, .079 and .086 respectively). The result is an Ibbotson type estimate of the standard MRP that is unusually high using data from 1926-1990. Siegel argues that the very low real returns on bonds in that period were due to pronounced unanticipated inflation. Consequently the Ibbotson type estimate of standard MRP is biased up when using data from 1926-1990. Thus, if the data used is primarily from that period, then this points to estimating the standard MRP by correcting the Ibbotson type estimate through adding an estimate of the long-term real risk free rate net of the historical average. Siegel suggests a figure of .03-.04 for the long-term real risk free rate.

Similar to Siegel (1992), in Figure 1 we plot 21-year centered moving averages of the compound real rates of return on equities and bonds[14]. Apart from 1996, the 21 year centered moving average real returns to equity were all positive and in the range between .021 and .133. By contrast the 21-year moving average real bond returns were frequently negative over the period 1940-1980. Furthermore the moving average real bond returns were greater than .02 only for the periods 1931-1938 and after 1985 (the later period corresponding to the period when there was a substantial fall in New Zealand's inflation rate). These results suggest that Ibbotson type estimates based on New Zealand data since 1930 suffer from the same problem identified by Siegel. Accordingly the Siegel estimator is indicated.

[14] Following Siegel (1992, footnote 24) the averaging points were progressively shortened to 11 years at each end-point of the data series. To illustrate, for the first year of the data series, 1931, we take the average over the period 1931 - 1941. For the second year of the data series, 1932, we take the average over the period 1931 - 1942 etc until we reach the year 1941 where we take a 21-year average over the period 1931 to 1951.

Our Ibbotson type estimate of the standard market risk premium is .056 (Tables 2 and 5) and embodies an arithmetic mean real bond yield of .014 (Table 4). If we use Siegel's estimate for the long-term real bond yield of .03-.04, then the estimate of the standard market risk premium falls by .016-.026[15], i.e., to .030-.040. Turning now to the tax-adjusted market risk premium, the presence of the tax parameter T_I mitigates the correction. Using a value for T_I of .28 (for the 2000 year), the required correction to the tax-adjusted bond yield is an increase of .012-.019; the estimate for the tax-adjusted market risk premium then falls by .012-.019. Applying this to the Ibbotson type estimate of .070 (Tables 2 and 5), the result is an estimate of .051-.058[16].

In summary, the Ibbotson type estimate for the standard market risk premium is .056 and that for the tax-adjusted market risk premium is .070. The Siegel adjustment lowers the former figure to .030-.040, and the latter to .051-.059. By comparison, following the methodology of Cornell (1999), forward-looking estimates for these two parameters in New Zealand are .038-.059 for the standard market risk premium and .058-.079 for the tax-adjusted market risk premium (Lally, 2001). Thus the Ibbotson type estimates are higher than the mid-point of these forward looking estimates, and the Siegel type estimates are lower.

If one were to adopt these lower Siegel type estimates of the market risk premium, the implications for the cost of capital and capital budgeting would be significant. However, as pointed out by Dimson et al (2002), past equity returns may also have been higher if the economic and other factors that gave rise to very low real bond returns had not arisen. Thus Siegel's (1992) arguments must be treated with some caution. Lally (2001) also notes limitations in the use of forward-looking estimates of the market risk premium. In light of the current extensive debate on the market risk premium, we leave it to the readers to draw their own conclusions in this area.

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[15] We are assuming that inflation is low so that a change in the real risk free rate will lead to an approximately equal change in the nominal market risk premium.

[16] As above, we assume that a change in the real (tax-adjusted) risk free rate will lead to an approximately equal change in the nominal tax-adjusted market risk premium.

6. Conclusion

We document historical returns to equities and long-term government bonds, bond yields and inflation in New Zealand over the period 1931-2000. Over this period the returns to equities exceeded the yields on bonds, with arithmetic mean real annual outcomes of .067 and .014 respectively. However equities also had higher risk than bonds, with standard deviations for real annual returns of .229 and .048 respectively.

Our study also estimates the standard and tax-adjusted market risk premiums over the 1931-2000 period. Applying the Ibbotson methodology, the former is estimated at .056 and the latter at .07. The latter is of particular significance in view of the widespread use of the tax-adjusted version of the capital asset pricing model in New Zealand by investors, corporates and regulators. In using the latter model, many analysts assume that capital gains tax is zero for all investors and imputation credits are attached at the maximum possible rate of .4925. If these assumptions are made, then it is necessary to invoke the same assumptions in estimating the market risk premium in this model. Doing so, we find that our estimate for the tax-adjusted market risk premium rises only slightly to .071.

Such estimates of the market risk premiums may be overestimates if the estimation period was characterized by real bond yields below those expected, due to unanticipated inflation. We present evidence that points to such an occurrence, and accordingly adjust the above estimates of the market risk premium in the fashion suggested by Siegel. The result is to lower the estimate for the standard market risk premium to .030-.040, and lower that for the tax-adjusted market risk premium to .051-.059. Precise estimation of market risk premiums remains a controversial and unresolved issue, to which we hope this study contributes.

TABLE 1

INVESTOR TAX RATES

Year	Interest tax rate for Type A Investors	Capital Gains Tax Rate for Type B Investors	Market Value Weight for Type B Investors	Weights Used in T_I	T_I	Proportion of dividends not tax free	T_m
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8
1931	0.05		0.20		0.04	0.00	0.00
1932	0.05		0.20		0.04	0.00	0.00
1933	0.05		0.20		0.04	0.00	0.00
1934	0.05		0.20		0.04	0.00	0.00
1935	0.05		0.20		0.04	0.00	0.00
1936	0.12		0.20		0.10	0.00	0.00
1937	0.12		0.20		0.10	0.00	0.00
1938	0.12		0.20		0.10	0.00	0.00
1939	0.17		0.20		0.14	0.00	0.00
1940	0.23		0.20		0.18	0.00	0.00
1941	0.23		0.20		0.18	0.00	0.00
1942	0.24		0.20		0.19	0.00	0.00
1943	0.24		0.20		0.19	0.00	0.00
1944	0.24		0.20		0.19	0.00	0.00
1945	0.24		0.20		0.19	0.00	0.00
1946	0.25		0.20		0.20	0.00	0.00
1947	0.25		0.20		0.20	0.00	0.00
1948	0.25		0.20		0.20	0.00	0.00
1949	0.27		0.20		0.22	0.00	0.00
1950	0.22		0.20		0.18	0.00	0.00

TABLE 1

INVESTOR TAX RATES

Year	Interest tax rate for Type A Investors	Capital Gains Tax Rate for Type B Investors	Market Value Weight for Type B Investors	Weights Used in T_I	T_I	Proportion of dividends not tax free	T_m
Col. 1	**Col. 2**	**Col. 3**	**Col. 4**	**Col. 5**	**Col. 6**	**Col. 7**	**Col. 8**
1951	0.21		0.20		0.17	0.00	0.00
1952	0.21		0.20		0.17	0.00	0.00
1953	0.21		0.20		0.17	0.00	0.00
1954	0.21		0.20		0.17	0.00	0.00
1955	0.21		0.20		0.17	0.00	0.00
1956	0.22		0.20		0.18	0.00	0.00
1957	0.00		0.20		0.00	0.00	0.00
1958	0.24		0.20		0.19	0.42	0.08
1959	0.30		0.20		0.24	0.42	0.10
1960	0.31		0.20		0.25	0.42	0.10
1961	0.31		0.20		0.25	0.42	0.10
1962	0.31		0.20		0.25	0.42	0.10
1963	0.30		0.20		0.24	0.42	0.10
1964	0.30		0.20		0.24	0.42	0.10
1965	0.30		0.20		0.24	0.42	0.10
1966	0.30		0.20		0.24	0.42	0.10
1967	0.30		0.20		0.24	0.42	0.10
1968	0.32		0.20		0.26	0.42	0.11
1969	0.40		0.20		0.32	0.42	0.13
1970	0.41		0.20		0.33	0.42	0.14
1971	0.42		0.20		0.34	0.42	0.14

TABLE 1

INVESTOR TAX RATES

Year	Interest tax rate for Type A Investors	Capital Gains Tax Rate for Type B Investors	Market Value Weight for Type B Investors	Weights Used in T_I	T_I	Proportion of dividends not tax free	T_m
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8
1972	0.38		0.20		0.30	0.42	0.13
1973	0.39		0.20		0.31	0.42	0.13
1974	0.42		0.20		0.34	0.42	0.14
1975	0.46		0.20		0.37	0.42	0.15
1976	0.47		0.20		0.38	0.42	0.16
1977	0.48		0.20		0.38	0.40	0.15
1978	0.42		0.20		0.34	0.44	0.15
1979	0.41		0.20		0.33	0.43	0.14
1980	0.35		0.20		0.28	0.30	0.08
1981	0.48		0.20		0.38	0.36	0.14
1982	0.31		0.20		0.25	0.24	0.06
1983	0.31		0.20		0.25	0.31	0.08
1984	0.31		0.20		0.25	0.21	0.05
1985	0.31		0.20		0.25	0.66	0.16
1986	0.32		0.20		0.26	1.00	0.26
1987	0.33		0.20		0.26	1.00	0.26
1988	0.29	0.140	0.23	0.26	0.26	1.00	
1989	0.31	0.165	0.23	0.26	0.27	1.00	
1990	0.30	0.165	0.23	0.26	0.26	1.00	
1991	0.29	0.165	0.23	0.26	0.25	1.00	
1992	0.33	0.165	0.30	0.34	0.29	1.00	

TABLE 1

INVESTOR TAX RATES

Year	Interest tax rate for Type A Investors	Capital Gains Tax Rate for Type B Investors	Market Value Weight for Type B Investors	Weights Used in T_I	T_I	Proportion of dividends not tax free	T_m
Col. 1	**Col. 2**	**Col. 3**	**Col. 4**	**Col. 5**	**Col. 6**	**Col. 7**	**Col. 8**
1993	0.33	0.165	0.35	0.39	0.28	1.00	
1994	0.33	0.165	0.35	0.39	0.28	1.00	
1995	0.33	0.165	0.31	0.35	0.28	1.00	
1996	0.33	0.165	0.31	0.35	0.28	1.00	
1997	0.33	0.165	0.35	0.39	0.28	1.00	
1998	0.33	0.165	0.43	0.47	0.27	1.00	
1999	0.33	0.165	0.40	0.44	0.27	1.00	
2000	0.33	0.165	0.37	0.41	0.28	1.00	

TABLE 2

HISTORICAL HIGHLIGHTS (1931-2000) - RETURNS PRE-TAX

Series	Arithmetic Mean of Annual Returns	Annual Geometric Mean Rate of Return	Standard deviation of Annual Returns	Number of Years Returns are Positive	Number of Years Returns are Negative	Highest Annual Return	Lowest Annual Return
Equity returns	0.123	0.099	0.246	50	20	1.194	-0.486
Long-term Government bond returns	0.064	0.061	0.072	64	6	0.271	-0.192
Long-term Government bond yields	0.067	0.066	0.037	70	0	0.177	0.030
Inflation rate	0.054	0.052	0.056	68	2	0.182	-0.114
Nominal market risk premium	0.056	0.030	0.240	44	26	1.072	-0.643
Nominal tax-adjusted market risk premium	0.070	0.045	0.239	45	25	1.092	-0.604

TABLE 2

HISTORICAL HIGHLIGHTS (1931-2000) - RETURNS PRE-TAX

Series	Arithmetic Mean of Annual Returns	Annual Geometric Mean Rate of Return	Standard deviation of Annual Returns	Number of Years Returns are Positive	Number of Years Returns are Negative	Highest Annual Return	Lowest Annual Return
Simplified nominal tax-adjusted market risk premium[a]	0.071	0.046	0.239	45	25	1.092	-0.604
Real equity returns	0.067	0.044	0.229	45	25	1.119	-0.531
Real bond returns	0.012	0.008	0.087	37	33	0.227	-0.262
Real bond yields	0.014	0.013	0.048	47	23	0.194	-0.082
Real market risk premium	0.053	0.030	0.223	44	26	1.036	-0.586
Real tax-adjusted market risk premium	0.067	0.044	0.217	43	27	0.946	-0.604

[a] This assumes zero capital gains tax and the term $\frac{IC_m}{DIV_m}$ in equation (3) is the maximum allowed rate of 0.4925.

TABLE 3

NOMINAL COMPOUND ANNUAL RETURNS AND YIELDS FOR FIVE YEAR HOLDING PERIODS

	Arithmetic mean				**Geometric mean**			
Period	Equity returns	Bond returns	Bond yields	Inflation	Equity returns	Bond returns	Bond yields	Inflation
1931-1935	0.128	0.084	0.046	-0.024	0.120	0.082	0.046	-0.026
1936-1940	0.026	0.041	0.038	0.045	0.025	0.041	0.038	0.044
1941-1945	0.119	0.039	0.032	0.023	0.118	0.039	0.032	0.023
1946-1950	0.088	0.030	0.030	0.045	0.085	0.030	0.030	0.044
1951-1955	0.054	0.016	0.038	0.054	0.048	0.016	0.038	0.054
1956-1960	0.152	0.041	0.048	0.031	0.142	0.041	0.048	0.031
1961-1965	0.081	0.047	0.051	0.027	0.074	0.047	0.051	0.026
1966-1970	0.120	0.049	0.055	0.057	0.103	0.049	0.055	0.057
1971-1975	0.058	0.041	0.058	0.106	0.046	0.040	0.058	0.105
1976-1980	0.209	0.026	0.106	0.147	0.191	0.023	0.106	0.147
1981-1985	0.411	0.105	0.136	0.118	0.356	0.092	0.136	0.117
1986-1990	0.047	0.177	0.141	0.089	-0.070	0.177	0.141	0.088
1991-1995	0.196	0.113	0.082	0.019	0.181	0.110	0.082	0.019
1996-2000	0.032	0.082	0.070	0.017	0.027	0.081	0.070	0.016
1931-2000	**0.123**	**0.064**	**0.067**	**0.054**	**0.099**	**0.061**	**0.066**	**0.052**

TABLE 4

REAL COMPOUND ANNUAL RETURNS AND YIELDS FOR FIVE YEAR HOLDING PERIODS

	Arithmetic mean			**Geometric mean**		
Period	Equity returns	Bond returns	Bond yields	Equity returns	Bond returns	Bond yields
1931-1935	0.155	0.114	0.076	0.149	0.110	0.073
1936-1940	-0.018	-0.003	-0.006	-0.019	-0.003	-0.006
1941-1945	0.094	0.016	0.009	0.093	0.016	0.009
1946-1950	0.042	-0.013	-0.012	0.040	-0.014	-0.013
1951-1955	0.003	-0.035	-0.014	-0.006	-0.036	-0.015
1956-1960	0.120	0.011	0.017	0.108	0.010	0.017
1961-1965	0.053	0.020	0.024	0.047	0.020	0.024
1966-1970	0.062	-0.007	-0.001	0.044	-0.007	-0.002
1971-1975	-0.041	-0.058	-0.042	-0.054	-0.059	-0.043
1976-1980	0.054	-0.105	-0.036	0.038	-0.109	-0.036
1981-1985	0.278	-0.010	0.017	0.213	-0.023	0.017
1986-1990	-0.053	0.083	0.049	-0.145	0.082	0.049
1991-1995	0.175	0.093	0.062	0.159	0.090	0.062
1996-2000	0.016	0.064	0.053	0.010	0.063	0.053
1931-2000	**0.067**	**0.012**	**0.014**	**0.044**	**0.008**	**0.013**

TABLE 5

MARKET RISK PREMIUM CALCULATIONS USING METHOD OF ARITHMETIC SUBTRACTION

	Market Risk Premium		Tax-adjusted Market Risk Premium	
Period	**Arithmetic Average**	**Geometric Average**	**Arithmetic Average**	**Geometric Average**
1931-1935	0.082	0.073	0.084	0.075
1936-1940	-0.012	-0.013	-0.007	-0.009
1941-1945	0.087	0.086	0.093	0.092
1946-1950	0.057	0.055	0.064	0.061
1951-1955	0.016	0.009	0.022	0.016
1956-1960	0.104	0.093	0.109	0.099
1961-1965	0.030	0.023	0.038	0.031
1966-1970	0.065	0.048	0.075	0.057
1971-1975	0.000	-0.013	0.011	-0.002
1976-1980	0.103	0.086	0.127	0.110
1981-1985	0.275	0.213	0.306	0.247
1986-1990	-0.094	-0.230	-0.059	-0.188
1991-1995	0.114	0.098	0.138	0.122
1996-2000	-0.038	-0.044	-0.017	-0.023
1931-2000	**0.056**	**0.030**	**0.070**	**0.045**

TABLE 6

REAL MARKET RISK PREMIUM CALCULATIONS USING METHOD OF ARITHMETIC SUBTRACTION

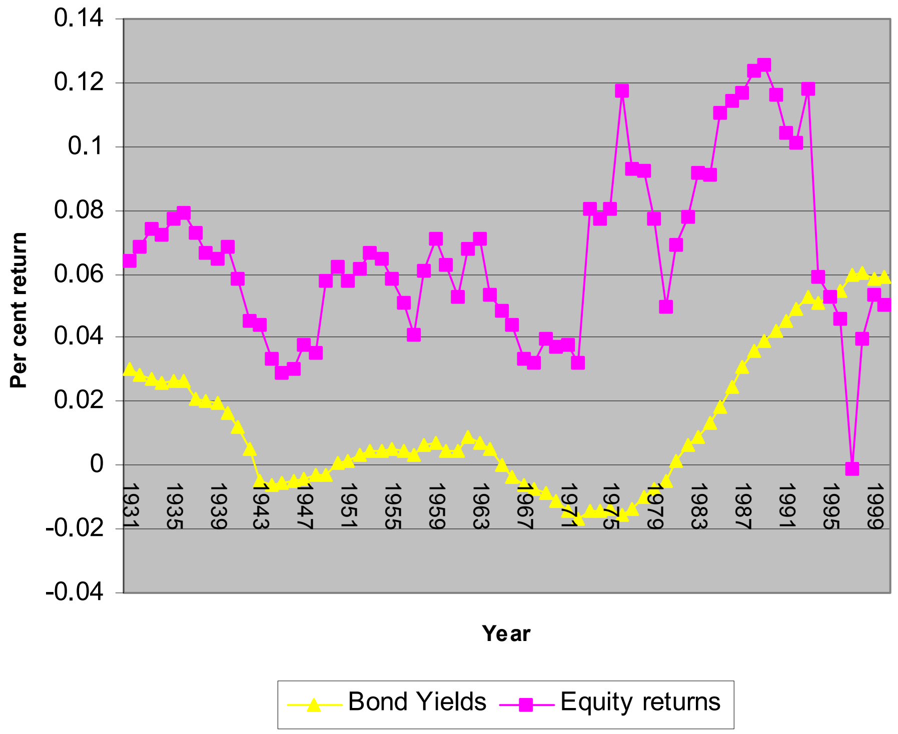
	Market Risk Premium		Tax-adjusted Market Risk Premium	
Period	**Arithmetic Average**	**Geometric Average**	**Arithmetic Average**	**Geometric Average**
1931-1935	0.079	0.070	0.045	0.041
1936-1940	-0.012	-0.014	-0.010	-0.011
1941-1945	0.085	0.085	0.086	0.085
1946-1950	0.054	0.052	0.060	0.058
1951-1955	0.016	0.011	0.040	0.036
1956-1960	0.103	0.093	0.114	0.105
1961-1965	0.029	0.022	0.040	0.034
1966-1970	0.063	0.047	0.076	0.061
1971-1975	0.001	-0.009	0.021	0.011
1976-1980	0.089	0.076	0.154	0.143
1981-1985	0.261	0.204	0.308	0.262
1986-1990	-0.103	-0.210	-0.094	-0.206
1991-1995	0.113	0.097	0.115	0.105
1996-2000	-0.037	-0.042	-0.024	-0.033
1931-2000	**0.053**	**0.030**	**0.067**	**0.044**

TABLE 7

TAX-ADJUSTED MARKET RISK PREMIUM

Tax rates compared to Table 1	**Decrease by 10 percentage points**		**Increase by 10 percentage points**	
Period	**Arithmetic Average**	**Geometric Average**	**Arithmetic Average**	**Geometric Average**
1931-1935	0.080	0.071	0.088	0.079
1936-1940	-0.010	-0.012	-0.004	-0.006
1941-1945	0.091	0.090	0.096	0.095
1946-1950	0.061	0.058	0.066	0.063
1951-1955	0.019	0.013	0.025	0.019
1956-1960	0.106	0.096	0.112	0.102
1961-1965	0.035	0.028	0.040	0.033
1966-1970	0.072	0.054	0.077	0.060
1971-1975	0.008	-0.004	0.013	0.000
1976-1980	0.122	0.105	0.133	0.116
1981-1985	0.297	0.237	0.315	0.256
1986-1990	-0.066	-0.197	-0.053	-0.181
1991-1995	0.137	0.121	0.138	0.122
1996-2000	-0.018	-0.023	-0.017	-0.023
1931-2000	**0.067**	**0.041**	**0.073**	**0.048**

Figure 1
Real Returns on Equities and Bonds (Yields), 1931- 2000:
(21-year centered moving average)



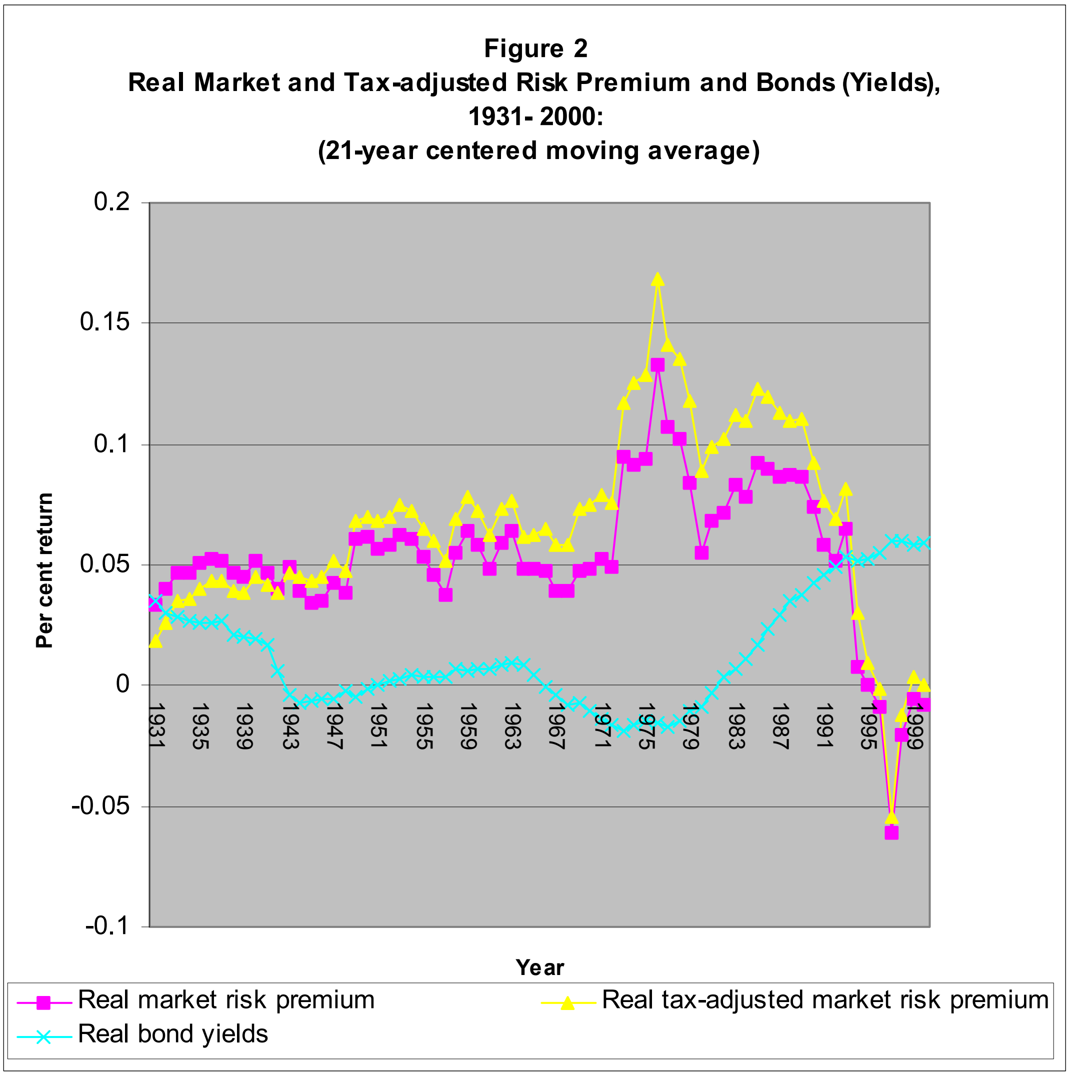


Figure 2
Real Market and Tax-adjusted Risk Premium and Bonds (Yields), 1931- 2000:
(21-year centered moving average)
Per cent return
0.2
0.15
0.1
0.05
0
-0.05
-0.1
1931
1935
1939
1943
1947
1951
1955
1959
1963
1967
1971
1975
1979
1983
1987
1991
1995
1999
Year
Real market risk premium
Real tax-adjusted market risk premium
Real bond yields

APPENDIX I

This appendix outlines the tax characteristics of type A and B investors, the determination of the market weights of these two groups, and their tax rates on interest, dividend and capital gains. This leads to estimates of the tax parameters T_I and T_m, and the results are summarized in Table 1. References to equations in this Appendix refer to the same equation in section 3 of the paper.

Type A and B Investors

We start with type A investors in the period before 1988, i.e., individuals who owned assets directly. In respect of capital gains, they were exempt from taxation in this period (and also subsequently). In respect of interest, they faced taxation on this at their marginal tax rate, subject to a level based exemption. Depending upon the year this was up to $200. The effect of the exemption cannot be computed but our conjecture is that it is small. Accordingly we ignore it. Finally, in respect of dividends, they were exempt from taxation on this until 1958 (see Census and Statistics Department, 1958). Thus, this tax rate was zero for the 1931-1957 period. From 1958, dividends were taxed subject to a level based exemption (depending upon the year, up to $200 was exempt). As with interest, the effect of the first of these exemptions cannot be computed, but is judged to be small; accordingly it is ignored. In addition, up until 1985, dividends paid from "tax-free" sources were exempt from tax[17]. We accommodate this by estimating the proportion of dividends paid from tax-free sources for each of the years 1958-1985, and reduce the effective tax rate on dividends accordingly.

We now turn to type B investors in the period before 1988, i.e., investors who received asset returns via superannuation funds rather than directly. The result is lower effective tax rates on these returns due to the aggregate effect of two principal incentives. The first is a tax deduction on the contributions made up to some level. The second is, in respect of some funds, the deferral of tax on the returns until the

[17] The opportunity to pay dividends from tax-free sources was terminated in August 1985 (Minister of Finance, 1985).

investor's retirement (Minister of Finance, 1988, Ch 4)[18]. Both features reduce the effective tax rate quite significantly. In respect of deferral, to illustrate this, suppose that deferral operated on average for 10 years; the effective tax rate would then be reduced by the present value of the tax obligation for 10 years at the risk free rate. If the latter were .06, then the reduction in the effective tax rate would be from the statutory rate *T* to

$$\frac{T}{(1.06)^{10}} = .56T$$

i.e., a reduction of almost 50%.

In respect of the tax saving on the amount invested, suppose each dollar invested generated an immediate tax saving at the investor's marginal rate *T*. Also, let the expected pre-tax return per \$1 invested be denoted *k* and this is taxed at rate *T* at that time. The expected rate of return after personal tax is then

$$\frac{k(1-T)}{\$1-\$1T} = k$$

Thus the effect of the immediate tax saving is to reduce the effective tax rate to zero. To this can be added the benefit of deferring tax until retirement, which is equivalent to a further reduction in the effective tax rate. This suggests that the effective tax rate was negative.

However there are some countervailing factors. First, there were limits on the tax deductibility of the premiums paid. Second, some superannuation schemes paid tax immediately on their investment income (rather than the tax being deferred until the retirement of the beneficiary, at which point the latter paid it on the pension payments from the fund). We judge it impossible to properly allow for all of these factors. Instead we assume that returns (interest, dividends and capital gains) received via superannuation funds in the period prior to 1988 incurred an effective tax rate of zero.

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[18] These favourable features of the tax regime were progressively eroded over the period from 1982 to 1988. In the interests of simplicity we act as if the regime shift took place solely in 1988 (Minister of Finance, 1988, Ch. 4).

We now turn to type A investors in the period from 1988, for which tax rates on only interest and capital gains need to be considered. The situation is identical to that prevailing before 1988, i.e., capital gains were exempt from tax and interest was taxed at the investor's marginal tax rate.

Finally, we consider type B investors in the period from 1988. In respect of taxation of dividends, receipt of them via funds and unit trusts in this period is essentially identical to that of receiving them directly, and therefore equation (4) is still valid in the presence of type B investors. The explanation for the largely identical tax treatment is as follows. First, in respect of unit trusts, they are taxed on dividends at the corporate tax rate but can fully utilize the associated imputation credits to reduce the tax payable, and any additional tax paid gives rise to imputation credits, which can be passed on to the individual claimants. The end result (in after-personal tax terms) for a New Zealand individual is identical to receipt of the dividend directly from the company. Secondly, in respect of superannuation funds, they are taxed like unit trusts except that imputation credits cannot be passed on and the beneficiaries face no tax on payouts upon retirement. For beneficiaries with a marginal tax rate below the company tax rate faced by the fund, this is disadvantageous relative to direct ownership of shares; for those with a higher tax rate, it is advantageous. We judge any net effect to be small, and therefore disregard it. In addition some funds faced a lower tax rate than the corporate rate for a transitional period; again the effect is considered small and therefore disregarded.

Since equation (4) is still valid from 1988 even in the presence of type B investors, only their tax rates on interest and capital gains are required. In respect of interest, for the reasons just given in respect of dividends, taxation is essentially identical to that when the interest is received directly rather than via a fund or unit trust. In respect of capital gains, and unlike that of direct receipt, taxation is incurred by the fund or unit trust. The taxation rate is the corporate tax rate, but taxation only occurs upon realization of the capital gain by the intermediary. Protopapadakis (1983) estimates that this opportunity to defer payment of the tax until realization of the asset reduces the effective tax rate by 50%, and we invoke this figure. Thus the effective tax rate faced by type B investors on capital gains in the period from 1988 is 50% of the corporate tax rate.

In summary then, we can decompose the estimation process for the tax parameters in equations (2) and (4) into three subperiods.

(a) 1931-1957: Equation (2) is employed, and this requires values for the tax parameters T_m and T_I. Neither type A nor type B investors are taxed on dividends or capital gains, and therefore T_m is zero. In addition, in the absence of capital gains tax for either investor class, T_I is simply the effective tax rate on interest. In turn, since type B investors are exempt, this tax rate is the marginal tax rate for individuals multiplied by the market value weight of type A investors.

(b) 1958-1987: Equation (2) is employed, and this requires values for the tax parameters T_m and T_I. Both type A and type B investors are free of tax on capital gains. Thus the parameter T_m equals the effective tax rate on dividends and parameter T_I equals the effective tax rate on interest. Type B investors are exempt from tax on both dividends and interest. Consequently T_m is the marginal tax rate for individuals multiplied by the market value weight of type A investors, and also by the proportion of dividends that were not from tax-free sources. In addition, T_I is the marginal tax rate for individuals multiplied by the market value weight of type A investors.

(c) 1988-2000: Equation (4) rather than (2) is used, requiring values for only the tax parameter T_I. 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.

This marginal tax rate for individuals clearly varies over years, and we recognize this. It also varies over individual investors, even those of type A. In the interests of computational simplicity we elect not to model this, and treat type A individuals as a homogeneous group, with a marginal tax rate equal to that of the individual whose income corresponds to the median income. Thus, if the median income in year t is \$12,000, and the marginal tax rate at that level is .30, then we act as if all type A individuals experience a marginal tax rate of .30.

Weights on Type A and B Investors

We start by considering the period from 1988. Following the definition of T_I in equation (1), the weight for investor i is

$$x_i = \frac{w_i}{\theta_i(1-t_{gi})} \div \sum \frac{w_i}{\theta_i(1-t_{gi})}$$

where w_i is the value weight of investor i and θ_i is a measure of the risk aversion of the investor (see Lally, 1992). In light of the absence of any information about variation in risk aversion across the two classes of investors considered here (types A and B), we assume that they are equal. Accordingly the weight for investor i becomes

$$x_i = \frac{w_i}{(1-t_{gi})} \div \sum \frac{w_i}{(1-t_{gi})} \qquad (5)$$

In respect of the value weights w_i, the value weight on type B investors in year t is simply the ratio of the market value of shares held by New Zealand funds and unit trusts to the sum of the market value of shares held by New Zealand individuals, funds and unit trusts. Deutsche Bank (2000) provides an ownership analysis for the New Zealand sharemarket for 1991-2000, from which the value weight on type B investors can be computed. For example, for 2000, the proportion of New Zealand shares held by New Zealand individuals was 24% and that of New Zealand funds and unit trusts was 14%[19]. Accordingly the year 2000 value weight on type B investors is

$$\frac{.14}{.24+.14} = .37$$

These value weights are shown in column 4 of Table 1, for the years 1991-2000. In respect of the earlier years 1988-1990, we simply invoke the 1991 figure (of .23).

[19] The figure for individuals includes that for ESOPs, because their beneficiaries are solely individuals and this conduit has no personal tax implications.

Turning now to the period before 1988, Young (1987) provides an analysis of New Zealand's equity market ownership in 1987. Local superannuation funds (which includes life insurance companies) held 10% of the market and local individuals 43%, with the remainder being largely New Zealand companies and foreigners[20]. This implies a value weight on type B investors of 19%. Courtis (1975) provides an analysis for 1975, at which point local individuals owned 62%, and companies and institutions owned the remaining 36%. However Courtis does not separately identify local superannuation funds. Nevertheless, part of the 36% will be foreigners, which we exclude, and part will be local companies, which we also exclude. Neither of the groups excluded would have been trivial at this time (1975). This points to a similar value weight on superannuation funds in 1975 to that prevailing in 1987. In the absence of further data on this subject, we assign a value weight for superannuation funds of 20% for the entire period 1931-1987 (being the figure of 19%, rounded to avoid suggesting more precision than is warranted). This is similar to the figure of 23% for the 1991 year that was derived from the Deutsche Bank (2000) data. Thus the removal in 1988 of the tax advantages from investing via superanuation funds does not appear to have reduced the desire for such investment mediums. This may seem paradoxical; however, there is likely to have been an adverse effect masked by a long-term trend away from individual holdings in favour of institutional ownership (this trend is apparent in the figures after 1990 in Table 1, and parallels such trends in other Anglo-Saxon markets).

Estimation of the Tax Parameter T_I

We can now proceed to the estimation of the tax parameter T_I. We start by estimating the marginal tax rate of the median investor, for each of the years 1931-2000.

The Census and Statistics Department (1931-1984) provides a classification of the aggregate income of individuals into income brackets, along with the investment income component, and applicable marginal tax rates. This permits calculation of the marginal tax rate for the median recipient of investment income (comprising interest and, after 1957, dividend income) for each of these years. To illustrate this, suppose

[20] The figure for individuals includes that of nominee companies, because their owners are largely individuals (rather than individuals and funds), and this conduit has no personal tax implications.

that the first \$20,000 of taxable income (*Y*) is taxed at 20%, the next \$20,000 at 40%, and higher levels are taxed at 60%. In addition the aggregate taxable incomes earned by individuals whose taxable income lay in these three brackets, along with the investment income component, are as follows:

Y	Tax Rate	Total *Y*	Total Invt Income
0-\$20,000	.20	\$20m	\$1m
\$20,000-\$40,000	.40	\$10m	\$4m
> \$40,000	.60	\$4m	\$2m

In this scenario, \$1m of investment income will be taxed at 20%, \$4m at 40% and \$2m at 60%. The median tax rate on them is then 40%.

There are some complications in applying this methodology, as follows. First, in some of these years, interest and dividends are not explicitly detailed; proxies are then used, such as "Unearned income" for the years 1931-58. Second, in ten of these years (1932, 1933, 1942, 1943, 1944, 1945, 1961, 1965, 1974 and 1976), these tables do not seem to have been produced; accordingly the marginal tax rates employed were an average of the adjoining years. Third, from 1931-1946, and from 1958-1984, "Taxable Income" is replaced in the tables by "Assessable Income", which differs by the extent of exemptions. These exemptions were substantial up until 1974, and therefore warrant some allowance in this period[21]. To make such an allowance it is assumed that all taxpayers enjoy the personal exemption and one half of the sum of

(a) the exemption allowed for two dependent children
(b) the maximum exemption for a dependent wife

To illustrate the application of these exemptions, if these exemptions totaled \$2000, then the tax brackets recorded in the first column of the illustrative table above would each be increased by \$2000.

After 1984, this information was no longer produced by the Census and Statistics Department. However, Inland Revenue has recently complied information relating to the first three columns of the illustrative table above, for the years 1984-1998, and we

[21] Exemptions contingent upon investing in superannuation funds are not considered here; they have been recognized earlier in estimating the effective tax rate on such investments.

calculate the median tax rate from such[22]. Implicitly we are assuming that the result from doing so (i.e., using columns 2 and 3 from the above illustrative table) will not materially differ from that of using columns 2 and 4; examination of the results from both approaches applied to the tax years 1984 and 1983 supports this assumption. In respect of the final years 1999 and 2000, in which the information has not been compiled, the marginal tax rate of the median investor is assumed to match the figure for 1998 (of 33%).

Column 2 of Table 1 presents the marginal tax rates for the years 1931-2000 calculated in this fashion, and these represent the tax rates on interest for type A investors. Their tax rate on capital gains was zero. In respect of type B investors, they faced no personal tax until 1988; from that time their tax rate on interest matches that of type A investors, and their effective tax rate on capital gains is estimated at half of the corporate tax rate for that year; the latter is shown in column 3 of the Table. Column 4 records the value weight on type B investors, and column 5 uses equation (5) to convert this to the weight used in the computation of T_I (prior to 1988, this adjustment is not required). Column 6 then computes T_I in accordance with the definition following equation (1). To illustrate this, the calculation for 2000 is

$$(1-0.41)(.33)+.41\left[\frac{.33-.165}{1-.165}\right]=.28$$

Estimation of the Tax Parameter T_m

As noted in section 3 of the paper, direct estimation of T_m is not required after 1988, i.e., the tax-adjusted market risk premium is estimated directly from formula (4), in which the only tax parameter is T_I. Consequently Table 1 shows estimates of T_m only for the years 1931-1988. In these years the tax rate on capital gains for both type A and B investors is zero. In addition, for the years 1931-1957, dividends were not taxable. Finally, for the years 1958-1987, type B investors face no tax on dividends and even type A investors were exempt from tax on "tax-free" dividends. So, the tax

[22] The Income Distribution information appears in Inland Revenue Department (1999) and the information on tax rates was kindly supplied by Sandra Smith (Forecasting and Analysis Unit, Inland Revenue Department).

parameter T_m is zero for the years 1931-1957. For the remaining years 1958-1987 it is equal to the tax rate on interest for type A investors, multiplied by their market weight and also by the proportion of dividends that were not from tax-free sources. Column 2 of Table 1 gives the marginal tax rate on interest for type A investors and column 4 gives the complement of their market value weight. Column 7 gives the proportion of dividends that were not from tax-free sources[23]. Column 8 then gives the value for T_m. In respect of extrapolating the 1976 figure for the proportion of dividends that were tax free back to 1958, Prebble (1986, pp. 6-7) notes that the opportunities for creating tax-free dividends increased as one moves back through time; however, the awareness of the opportunities is likely to have been less in earlier times, and we assume these two effects offset[24].

[23] This was based on examination of the top 20 companies for each of the years 1976-1985, and extrapolation of the 1976 figure back to 1958. The extrapolation was prompted by difficulties in obtaining data prior to 1976. In respect of the ten years examined, the data was obtained from the Annual Reports of the New Zealand Stock Exchange.

[24] To illustrate the point concerning opportunities, Prebble (ibid) notes that up until 1965 merely revaluing assets could create tax-free dividends, and until 1982 the same opportunity could be generated by the sale of company assets to a subsidiary at a "profit".

APPENDIX 2

This appendix explains the calculation of the market returns R_{mt} exclusive of imputation credits for the period since 1988. Over this time span the NZSE gross index provides a market return GR_{mt} inclusive of imputation credits as follows:

$$GR_{mt} = R_{mt} + \frac{IC_{mt}}{S_{t-1}} \tag{A1}$$

where IC_{mt} is the imputation credits attached to the cash dividend, and S_{t-1} is the value of the index at the beginning of period t.

The last term in equation (A1) is

$$\frac{IC_{mt}}{S_{t-1}} = \frac{DIV_{mt}}{S_{t-1}} . \frac{IC_{mt}}{DIV_{mt}} \tag{A2}$$

where DIV_{mt} is the cash dividend paid on the market portfolio in period t. Under dividend imputation, the gross dividend yield GDY_{mt} comprises cash dividends and imputation credits:

$$GDY_{mt} = \frac{DIV_{mt}}{S_{t-1}} + \frac{IC_{mt}}{S_{t-1}} = \frac{DIV_{mt}}{S_{t-1}} \left[1 + \frac{IC_{mt}}{DIV_{mt}} \right]$$

The cash dividend yield is then

$$\frac{DIV_{mt}}{S_{t-1}} = \frac{GDY_{mt}}{\left(1 + \dfrac{IC_{mt}}{DIV_{mt}} \right)} \tag{A3}$$

The monthly gross dividend yield for 1988 onwards was calculated as the difference in returns between the NZSE Gross capital index (which includes capital gains, cash dividends and the attached imputation credits) and the NZSE Capital index (which comprises only capital gains). Over the period 1988-2000 the imputation credit ratio IC_{mt}/DIV_{mt} was assumed to be 0.4 (Lally, 2000b, p 6 gives this figure for 1999). Substitution of these results into equation (A3) yields the cash dividend yield for each month. Substitution of this, along with the imputation credit ratio of .40, into equation (A2) then yields the imputation credit ratio IC_{mt}/S_{t-1}. Substitution of this, along with the gross returns GR_{mt}, into equation (A1) then yields the returns R_{mt}.

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