ESTIMATING THE MARKET RISK PREMIUM IN NEW ZEALAND THROUGH THE SIEGEL METHODOLOGY

by

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Abstract

This paper estimates the standard and tax-adjusted market risk premiums in New Zealand using historical data between 1931-2002 and a variant of the Siegel (1992) methodology. Similar to Siegel we present evidence that real bond yields in New Zealand were low over the period 1931-2002 and this may bias upwards an Ibbotson-type estimate of the market risk premium. Using an estimate for the historical average of the expected real bond yield of .03-.04, then the Siegel-type estimate for the standard market risk premium in New Zealand is .03-.04, and the Siegel-type estimate for the tax-adjusted market risk premium is .055 to .062. These figures are about .02 lower than Ibbotson type estimates, and are also lower than estimates of the forward-looking type. Our study has potential implications for the cost of equity capital and capital budgeting.

1. Introduction

The market risk premium is a parameter appearing in all versions of the capital asset pricing model (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. 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 market risk premium (MRP) 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 prevailing yield on the risk free asset at the beginning of the year, and then averaging this margin over the period from 1926. This methodology has been applied to New Zealand data by Chay et al (1993, 1995), in respect of the standard version of the CAPM. Lally and Marsden (2003) update this work to 2002, and also apply the methodology to the tax-adjusted version of the CAPM (Cliffe and Marsden, 1992; Lally, 1992).

The Ibbotson assumption that the MRP is constant over time has been challenged by a number of authors. 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 absence of any change in the true premium. One of these arguments is

that of Siegel (1992, 1999), who observes that the Ibbotson type estimate of the market risk premium in the US is unusually high in the latter part of the 20th century, and attributes this to unexpectedly high inflation in that period, i.e., real bond but not equity returns were depressed, inducing a high estimate of the market risk premium.

This paper seeks to examine the historical returns for New Zealand equities and bonds, so as to ascertain whether Siegel's observations are also valid for this market. We find that they are, and therefore seek to apply his methodology to estimation of both the market risk premium in the standard version of the CAPM and the tax-adjusted version that is widely used in New Zealand. Section 2 describes Siegel's methodology in greater detail, as applied to estimating the market risk premium in the standard CAPM. Section 3 extends this to the market risk premium in the tax-adjusted version of the CAPM that is widely used in New Zealand[1]. Section 4 describes the data employed in the analysis. Section 5 describes the results, and Section 6 concludes.

2. Siegel's Methodology

Siegel (1992, Figure 1) presents Ibbotson type estimates of the standard market risk premium for the US over the period 1802-1990, and finds considerable variation. In particular, the estimates for the sub-periods 1802-1870, 1871-1925 and 1926-1990 are .017, .039 and .070 respectively. Consequently the estimate arising from the last period (whose starting point is that of Ibbotson) is unusually high. An examination of real bond yields and real equity returns seems to provide an explanation. In particular, over the three sub-periods, the real yields on long-term government bonds were .052, .040 and .018 respectively, whilst real equity returns were .069, .079 and .086 respectively (Siegel, 1992, Tables I and II). Thus, real equity returns were stable whilst real bond yields were particularly low in the last sub-period.[2] Accordingly, the

[1]The model is widely used by NZ companies (e.g., Telecom NZ Ltd), practitioners (e.g., PriceWaterhouseCoopers) and has been adopted by The Commerce Commission (2002) in regulatory decisions.

[2] In examining returns data from 16 countries over the period 1900-2001, Dimson et al (2002, Chapter 1, Table 3) also find a low average real bond yield, of .012.

high Ibbotson-type estimate of the standard MRP in the last sub-period could be attributed primarily to unduly low real yields on bonds in that period.

Siegel (1999) goes on to argue that the very low real yields on bonds in the post 1926 period were due to pronounced unanticipated inflation in that period. Consequently the Ibbotson type estimate of the standard MRP is biased up when using data from that period. In the face of this, he suggests an alternative estimator, as follows. To a close approximation, the (nominal) MRP can be expressed as

$$MRP \ ? \ E(R_m) \ ? \ R_f \ ? \ [E(R_m^r) \ ? \ E(i)] \ ? \ [E(R_f^r) \ ? \ E(i)] \ ? \ E(R_m^r) \ ? \ E(R_f^r) \qquad (1)$$

where the superscript *r* indicates a real rate of return and *i* indicates the inflation rate. In light of the stability over time in the real return to equities, Siegel suggests estimating the expected real return on equities from the long-run historical average. In addition he suggests estimating the expected real risk free rate from the current yield on inflation-protected government bonds. Letting his value observed at time *n* for the yield on inflation-protected bonds be R_{fn}^r, his estimate at time *n* for the market risk premium (*MRP (S)*) is then

$$\hat{MRP}(S) \ ? \ AV(R_m^r) \ ? \ R_{fn}^r \qquad (2)$$

where *AV* denotes a historical average. Using an average return on equity of .07, and a then prevailing yield on inflation-protected bonds of .04, yields an estimate for the market risk premium of .03. This is markedly less than the estimate obtained from applying the Ibbotson methodology along with data since 1926[3].

Siegel's methodology in (2) involves the assumption that the expected real return on equities is constant over time. This is not only a strong assumption but is quite unrelated to the question of whether the Ibbotson estimate suffers from bias induced by unexpected inflation. The evidence that Siegel offers in support of his assumption (that the expected real returns on equities is constant) is the stability of average real

[3] Siegel (1992, Table I) gives a figure of .07 using data from 1926-1990.

returns on equities. However, even if the assumption were true, the degree of variability in annual real equity returns would imply a much greater degree of variation in the sample averages than was observed; accordingly, the observed stability would seem to be the product of chance[4]. More persuasive evidence on this question comes from the yields on the inflation-protected bonds. Siegel notes that the yield was about .04 in 1999. However, over the period since their introduction in 1997, the yield has ranged from .04 down to .01[5]. It seems unlikely that the expected real return on equities has remained constant in the face of this shift.

An alternative approach to this issue is as follows, and is entirely consistent with Siegel's belief that unexpected inflation has reduced the average real yield on bonds but not equities, thereby inducing bias in the Ibbotson estimate. Starting with the Ibbotson estimate *MRP (I)*, one simply replaces the historical average real yield on nominal bonds with a better proxy for the historical average of the market's expected real yield, i.e.,

$$M\hat{R}P(S) \ ? \ M\hat{R}P(I) \ ? \ AV(R_f^r) \ ? \ A\hat{V}[E(R_f^r)] \qquad (3)$$

If inflation-protected bonds were available across the entire period of analysis, then the average yield would be the obvious candidate for the final term in equation (3). Since they are not available for the entire period, or even a substantial fraction of it, then the best course of action would seem to be to supplement this average with the average real yield on nominal bonds over earlier periods in which inflation was stable and default unlikely. For example, in respect of the US and assuming that the historical period of examination was that from 1802, one might choose the period 1871-1925, in which inflation was stable and default unlikely. The average real yield on nominal bonds in this period was .04 (Siegel, 1992, Table II). Over the period since inflation-protected bonds were available, the average real yield on these bonds

[4] Using a standard deviation in annual real equity returns of .20 (Siegel, 1992, Table I) and a period of 70 years, the standard deviation in the mean return would be about .024. In view of this, the fact that Siegel finds the mean real returns in three non-overlapping 70 years periods to differ by a maximum of .017 is quite remarkable.

[5] Data from the Federal Reserve Bank of St Louis.

has been about .03[6]. The latter data spans a shorter period than the former, but is uncontaminated by inflation-forecasting errors. So, it might warrant a higher weight than the period length suggests.

3. The Tax-Adjusted MRP

Inter alia, the standard version of the CAPM assumes that all sources of investment income are equally taxed at the personal level. This is not a good description of the New Zealand tax regime, because both capital gains and dividends are less onerously taxed than interest[7]. Consequently it is common practice in New Zealand to invoke a CAPM that recognises the favourable tax treatment of equity returns. The tax-adjusted market risk premium (*TAMRP*) in the general form of the model is as follows (Cliffe and Marsden, 1992; Lally, 1992):

$$TAMRP = E(R_m) - D_m T_m - R_f (1 - T_I) \tag{4}$$

where

R_m	=	return on the market portfolio (cash dividends and capital gain)
D_m	=	cash dividend yield on the market portfolio *m*
R_f	=	riskfree rate of return
T_I	=	weighted average (weights x_i) over investors of $(t_i - t_{gi})/(1 - t_{gi})$
T_m	=	weighted average(weights x_i) over investors of $(t_{di} - t_{gi})/(1 - t_{gi})$
t_i	=	investor *i*'s tax rate on interest
t_{gi}	=	investor *i*'s tax rate on capital gains
t_{di}	=	investor *i*'s tax rate on cash dividends from the market portfolio
x_i	=	$\dfrac{w_i}{\lambda_i (1 - t_{gi})} \Big/ \sum \dfrac{w_i}{\lambda_i (1 - t_{gi})}$
w_i	=	market value weight of investor *i*'s equity holdings in *m*
λ_i	=	measure of the risk aversion of investor *i*

[6] Data from the Federal Reserve Bank of St Louis.

[7] The favourable treatment of capital gains tax is due to exemption of many investors and, in respect of the rest, the opportunity for deferring payment until sale of the asset. The favourable treatment of dividends arises from dividend imputation.

As with the standard market risk premium, the problem lies with the term R_f. So, following equation (3), a Siegel-type estimate of this parameter would involve starting with an Ibbotson-type estimate, adding back the historical average real yield on nominal bonds (net of the tax effect), and then deducting a better proxy for the historical average of the market's expected real yield on bonds (net of the tax effect), i.e.,

$$\hat{TAMRP}(S) \ ? \ \hat{TAMRP}(I) \ ? \ AV[R_f^r(1 \ ? \ T_I)] \ ? \ \hat{AV}[E(R_f^r)(1 \ ? \ T_I)] \qquad (5)$$

4. Data

We start with the standard market risk premium. Following equation (3), the Siegel estimate of the standard market risk premium requires an Ibbotson-type estimate of the standard market risk premium, the historical average real yield on nominal bonds, and an improved estimate of the historical average of the market's expected real bond yield. The first two data types are drawn from the Lally and Marsden (2003) study, and a description of the data series (1931-2002) is contained in that paper. Table 1 summarises the evidence from this period on New Zealand nominal equity returns, nominal bond yields, inflation rates and the estimated Ibbotson-type market risk premiums as reported by Lally and Marsden (2003, Table 2).

As indicated in section 2, an improved estimate of the historical average of the expected real bond yield will be drawn from the historical yields on inflation-protected government bonds supplemented with the real yields on nominal bonds for some earlier periods. The latter are again drawn from Lally and Marsden, and the real yields on inflation-protected bonds are drawn from the Reserve Bank website.

In respect of the tax-adjusted market risk premium, and following equation (5), the Siegel estimate of the standard market risk premium requires an Ibbotson-type estimate of the tax-adjusted market risk premium, the historical average real bond yield, and an improved estimate of the historical average expected real bond yield. The data sources parallel those for the estimation of the standard market risk premium.

5. Results

We start by examining the history of real returns on equities and real yields on nominal bonds. Drawing from the Lally and Marsden (2003) data series, Table 2 presents the New Zealand historical arithmetic mean annual real returns for equities, real bond yields, and inflation rates over the period 1931-2002, split into five-year holding periods. Over the five-year holdings periods, mean real returns on equities averaged .067, varied between -.053 and 0.278, and were negative in three of the fifteen subperiods. Mean real bond yields averaged .015, varied between -.042 and .076, and were negative in six of the fifteen subperiods.

Figure 1 then plots the 21-year centered moving averages of the compound real rates of return on equities and real yields on nominal bonds[8]. The 21 year centered moving average real returns to equity were all positive and in the range between .007 and .125. By contrast the 21-year moving average real yields on the nominal bonds were frequently negative over the period 1940-1980. Furthermore this moving average real bond yield was greater than .02 only for the periods 1931-1938 and after 1985 (the latter period characterised by a substantial fall in New Zealand's inflation rate). By contrast, since their introduction in 1995, the annual average yields on inflation-protected bonds have ranged from .036 to .055; these figures are well in excess of the average real yield on nominal bonds. Figure 2 shows annual inflation rates in New Zealand, for the period 1931-2002. There is considerable variation in the rates, with an average of .053 and a period of fifteen years (1973-1987) in which the annual rates generally exceeded .10.

These results all point to the conclusion that unanticipated inflation generated real yields on nominal bonds that were less than those expected. This empirical evidence is reinforced by the presence of interest rate controls in the period 1972-1984, which

[8] This parallels Siegel (1992). Following Siegel (ibid, 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.

would also have had the effect of lowering the real yield on nominal bonds[9]. It follows that Ibbotson-type estimates of market risk premiums will have been biased upwards, and therefore supports recourse to the Siegel-type estimates.

We now start with the estimate of the standard market risk premium. The Ibbotson-type estimate is .055 (Table 1) and embodies an arithmetic mean real bond yield of .015 (Table 2). In respect of an improved estimate of the historical average expected real bond yield, the yields on inflation-protected bonds have averaged .048 over the eight-year period since they became available in 1995. Looking at earlier periods, in which only nominal bonds were available, there has been no long period in which inflation was stable and therefore no period in which realised real yields on these nominal bonds would be a reliable indicator of expected real yields. Some possible evidence is from the early 1960s, in which inflation was comparable to that in the preceding five years. The average real bond yield in this period (1961-65) was .024 (Table 2). Alternatively, one could exclude the entire high-inflation period from 1973-1987, in which the annual inflation rates generally exceeded .10. If this is done then the average real bond yield becomes .023. This is similar to the average real bond yield of .024 in the period 1961-65.

In conjunction with the experience with inflation-protected bonds since 1995, this evidence points to a long run expected real yield of around .03-.04. With this range, and following equation (3), the Siegel-type estimate for the standard market risk premium is then .03-.04. Interestingly this Siegel-type estimate of the standard market risk premium is similar to the Ibbotson-type estimate of .035 arising upon exclusion of the high inflation (1973-1987) from the overall period 1931-2001.

We turn now to the tax-adjusted market risk premium. The Ibbotson-type estimate is .072 (Table 1), and it embodies an average real bond yield net of the tax parameter T_I of .012 (Panel B, Table 2). Replacing this time series of real bond yields by the

[9] Direct controls on interest rates were imposed in the periods 1972-1976 and again in 1982-1984. They were supplemented with indirect controls in the sense of compelling designated financial institutions to invest in government bonds. Some controls were also introduced on dividends, but this merely transformed dividends into capital gains, and the dividend controls could be bypassed (such as by announcing a bonus or rights issue and then maintaining the dividend per share). All of these controls were lifted in 1984. Source: Reserve Bank of New Zealand Bulletins.

estimate .03-.04 as discussed above yields an average real bond yield net of the tax parameter T_I of .022 to .029[10]. Following equation (5), the Siegel-type estimate of the tax-adjusted market risk premium is then .055 to .062.

In summary, the Ibbotson-type estimate for the standard market risk premium is .055 and that for the tax-adjusted market risk premium is .072. Using an estimate for the historical average of the expected real bond yield of .03-.04, then the Siegel-type estimate for the standard market risk premium is .03-.04, and the Siegel-type estimate for the tax-adjusted market risk premium is .055 to .062. The Siegel-type estimates are .015-.02 lower than the Ibbotson-type estimates, and this consistent with Siegel's results for the US. By way of comparison, forward-looking estimates for market risk premiums also tend to produce lower estimates than those of the Ibbotson type. For example, application of Cornell's (1999) methodology to New Zealand data by Lally (2001) yields estimates of .038-.059 for the standard market risk premium and .058-.079 for the tax-adjusted market risk premium. In addition, Fama and French (2002) generate forward-looking estimates for the US standard market risk premium of .026-.043 over the period 1951-2000, and Claus and Thomas (2001) generate estimates of the same parameter for a range of countries with a maximum of .03.

Adoption of these lower Siegel-type estimates of the market risk premium would have significant implications for the cost of capital and capital budgeting. However, the Siegel methodology has its critics. For example, as pointed out by Dimson et al (2002), past equity returns may also have been different if the economic and other factors that gave rise to very low real bond returns had not arisen. In addition, the Siegel methodology inherits many of the limitations of the Ibbotson methodology, such as the exposure to wide confidence intervals on the estimates. Of course, radically different methods, such as the forward-looking approach also have their limitations. In light of all this, and the current extensive debate on the market risk premium, we leave it to readers to draw their own conclusions in this area.

[10] If the assumed real bond yield is .03, then we form the time series .03(1-T_I), with the annual T_I values over the period 1931-2002 drawn from Lally and Marsden (2003, Table 1). The average over this series is .022. Repetition with a real bond yield of .04 yields an average for .04(1-T_I) of .029.

6. Conclusion

This paper estimates the standard and tax-adjusted market risk premiums in New Zealand using a variant of the Siegel methodology, along with data since 1930. Using an estimate for the historical average of the expected real bond yield of .03-.04, the resulting Siegel-type estimate for the standard market risk premium is .03-.04, and that for the tax-adjusted market risk premium is .055 to .062. These figures are .015-.02 lower than Ibbotson-type estimates applied to New Zealand data, and are also lower than estimates of the forward-looking type applied to New Zealand data. All of these procedures have their limitations, and the best estimate should give some weight to a range of methods.

TABLE 1

Historical highlights: NZ returns 1931-2002[11]

Series	Mean Arithmetic Annual Return	Standard deviation of Annual Returns	Number of Years Returns are Positive	Number of Years Returns are Negative
Nominal equity returns	0.122	0.243	52	20
Long-term nominal Government bond yields	0.067	0.036	72	0
Inflation rate	0.053	0.056	70	2
Nominal market risk premium (referenced to bond yields)	0.055	0.237	45	27
Nominal tax-adjusted market risk premium (referenced to bond yields)	0.072	0.238	46	26

[11] As reported by Lally and Marsden (2003, Table 2).

TABLE 2

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	0.155	0.076	0.068	-0.024
1936-1940	-0.018	-0.006	-0.005	0.045
1941-1945	0.094	0.009	0.006	0.023
1946-1950	0.042	-0.012	-0.009	0.045
1951-1955	0.003	-0.014	-0.010	0.054
1956-1960	0.120	0.017	0.013	0.031
1961-1965	0.053	0.024	0.016	0.027
1966-1970	0.062	-0.001	0.000	0.057
1971-1975	-0.041	-0.042	-0.026	0.106
1976-1980	0.054	-0.036	-0.022	0.147
1981-1985	0.278	0.017	0.013	0.118
1986-1990	-0.053	0.049	0.033	0.089
1991-1995	0.175	0.062	0.044	0.019
1996-2000	0.016	0.053	0.039	0.017
2001-2002	0.061	0.039	0.029	0.023
1931-2002	**0.067**	**0.015**	**0.012**	**0.053**

Figure 1

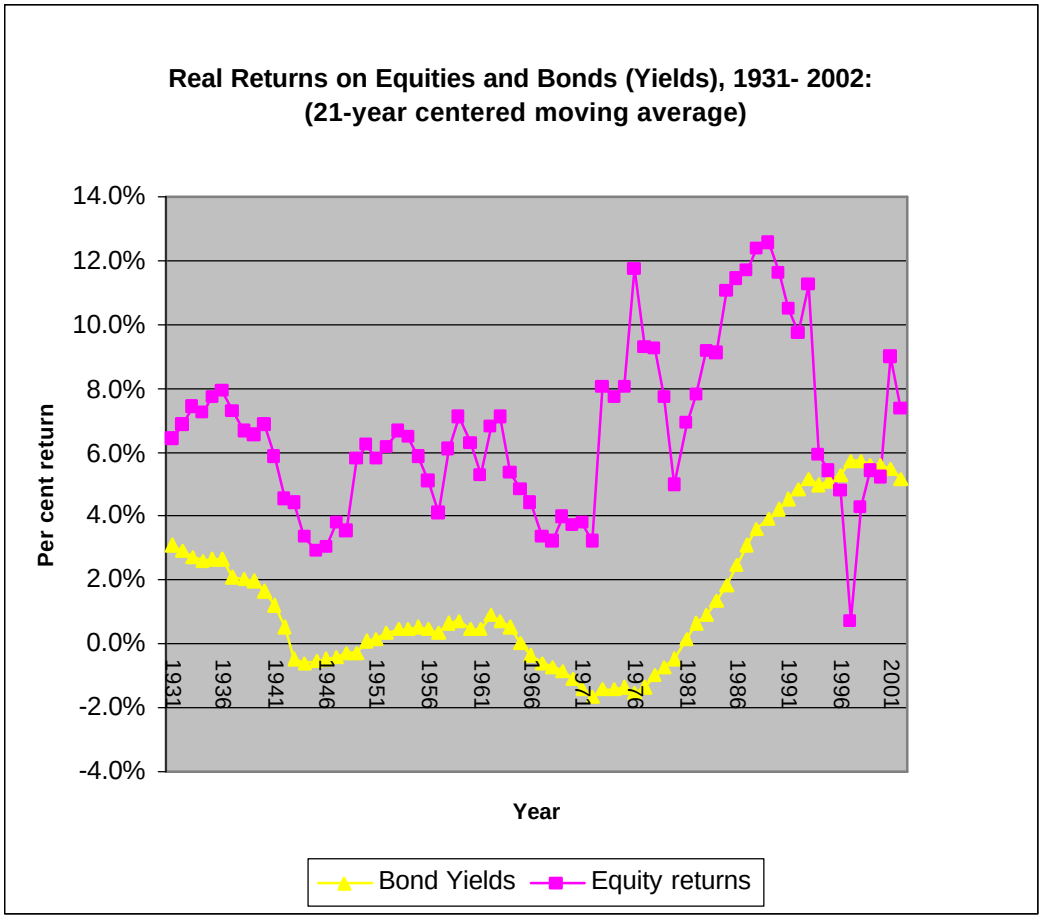
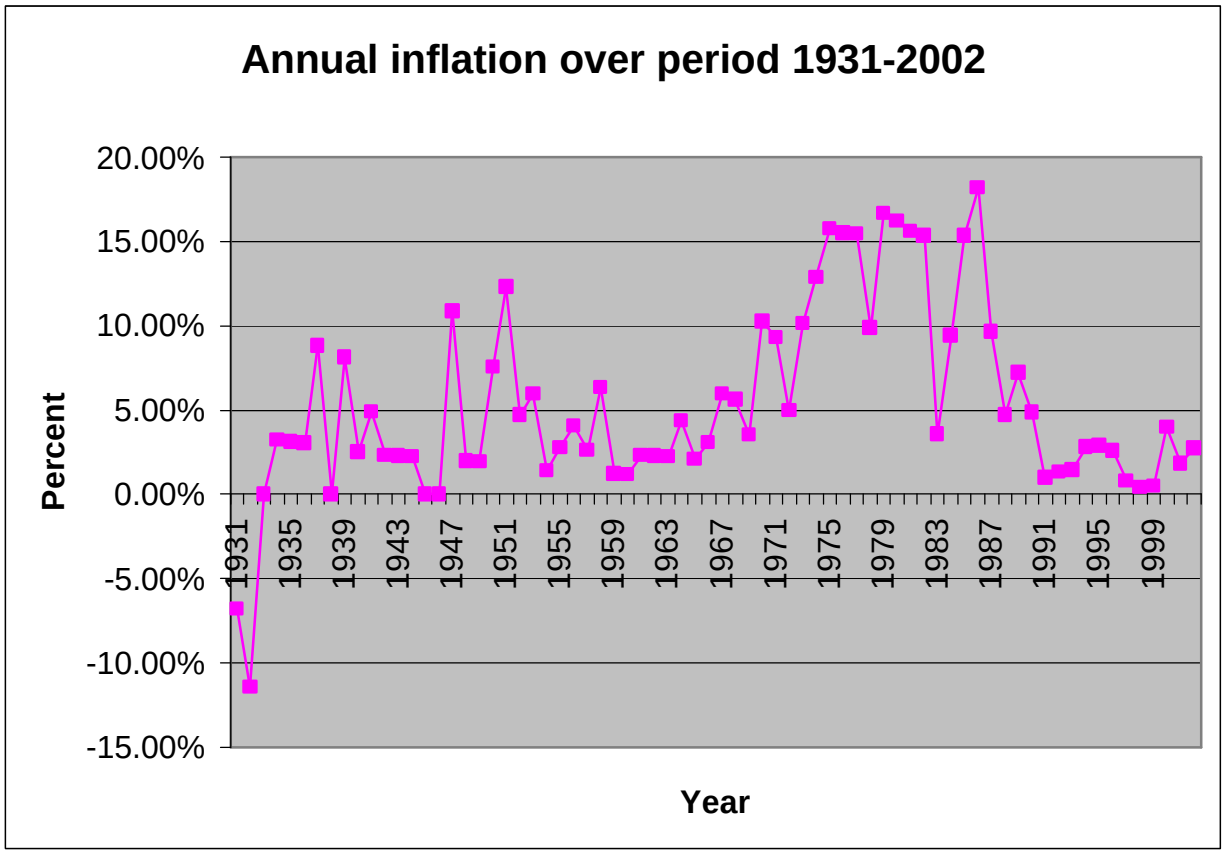

Real Returns on Equities and Bonds (Yields), 1931- 2002:
(21-year centered moving average)
14.0%
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
-2.0%
-4.0%
Per cent return
1931
1936
1941
1946
1951
1956
1961
1966
1971
1976
1981
1986
1991
1996
2001
Year
Bond Yields
Equity returns

Figure 2


Annual inflation over period 1931-2002
20.00%
15.00%
10.00%
5.00%
0.00%
-5.00%
-10.00%
-15.00%
Percent
1931
1935
1939
1943
1947
1951
1955
1959
1963
1967
1971
1975
1979
1983
1987
1991
1995
1999
Year

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