INTRODUCTION TO THE EQUITY PREMIUM PUZZLE

by John Nuttall

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There can be very few investors who have not heard the story that stocks have outperformed bonds by a wide margin over the long term, for the past century at least. This is the reason why so many financial advisors recommend that a portfolio should contain a high proportion of equities. The difference in total real (after inflation) rates of return between stocks and risk-free debt has been called the equity premium. The equity premium in the US is usually taken to be about 6 - 7%/year for periods going back over 100 years from the present. In the last decade it has been more like 13%/year.

Not surprisingly, there has been a lot of effort by academics in economics and finance to explain the origin of the equity premium. As Will McClatchy wrote of a conference at UCLA

> "questions (relating to the equity premium) are of fundamental interest to any equity investor regardless of sophistication, and especially to the index investor.
>
> - Are stocks overvalued in today's high P/E ratio market, or does low inflation justify this decade's run up in stocks?
> - What kind of premium over bonds can stock investors expect in the future?"

Some other questions are

- Is the equity premium a real effect, or is it an artifact of data mining caused by survival bias?
- Is it possible that total return on stocks can compound for 100 years at a rate significantly higher than the growth rate of the general economy?
- What has been the effect on the equity premium of factors such as boomers investing for retirement, new issues and redemptions of shares, the shift to equities by pension funds and other institutions, etc.?
- What has been the effect of the widespread publication of expert opinions that the equity premium is real? A self-fulfilling prophecy? Can it go on for ever?

It seems like a worthwhile endeavor to attempt to find out what recent research has to say about the

equity premium. Whether it is discovered that there is a convincing explanation or that no plausible picture exists, the result will be useful.

Before delving into an analysis of the research on this question, readers might be interested in the following quotation from an 1997 article by Siegel and Thaler , two leading academics,

> "no economic theorist has been completely successful in resolving the [equity premium] puzzle" ... but ... "most economists we know have a very high proportion of their retirement wealth invested in equities (as we do)."

I imagine that, based on their opinion of the competence of the economics profession, readers will draw a variety of conclusions from this quotation.

My discussion will be restricted to the article by Mehra and Prescott (MP) which introduced the problem, and to recent work of Kurz and collaborators which may be regarded as an extension of MP. Some of my points undoubtedly have wider application.

1 RAW DATA

Data needed to examine the equity premium as far back as the nineteenth century have been assembled in a number of locations. One well-known source is the yearbook "Stocks, bonds, bills and inflation" from Ibbotson Associates . Another useful compilation, available for download, is to be found on the web site of Robert Shiller of Yale University. Those data were used in his recent book "Irrational Exuberance," and they also form the basis of a number of academic studies. I am indebted to Professor Shiller for permission to use his data in this report.

Shiller now has monthly data, but I will restrict my attention to yearly data which were used in the studies I shall discuss. In an Excel file and a Word file Shiller provides tables including the following information. Note that all this data relate to the US.

- S&P Composite Index 1871 - 1999. The price of a basket of stocks.
- Dividends 1871 - 1999. Dividend on the basket of stocks.
- Interest 1871 - 1997. Interest on relatively riskless short term debt.
- Consumer Price Index 1871 - 1999.
- Real per capita consumption, 1889 - 1985.

We divide by the CPI to get the real price, dividend, and interest, i.e., price, etc., after taking account of inflation. Real per capita consumption is a measure of the ability of the nation to produce real, not paper,

wealth.

2 DERIVED DATA

From the raw data it is possible to calculate some annual measures of growth and return such as

- Real percentage stock price increase
- Real dividend yield - i.e. dividend/stock price at start of year
- Real risk free interest rate
- Growth rate of real per capita consumption
- Growth rate of real dividend per share.

The real total return on the stock index is the sum of the first two quantities.

Each series of annual growth/return measures has a mean, standard deviation, etc., associated with it.

The article that introduced the term "Equity premium puzzle" was written by Mehra and Prescott in 1985. They used historical US data for the period 1889 - 1978, and quoted the following figures in percentages written as decimals.

MP 1889 - 1978	Mean	Variance
Stock index total return	0.0698	0.0274
Real interest rate	0.0080	0.0031
Growth rate of consumption	0.0183	0.0012

Table 1.1 Economic data from Mehra and Prescott

Using the data from the Excel file of Shiller for all quantities except per capita real consumption and the risk free interest rate, for which I used the Shiller Word file, I find the following results.

1889 - 1958	Mean	Compound annual	Variance
Dividend/Price	0.0524	0.0523	0.0001
Stock index annual price gain	0.0348	0.0156	0.0388
Stock index total return	0.0872	0.0685	0.0394
Real interest rate	0.0142	0.0116	0.0054
Growth rate of real dividends	0.0220	0.0119	0.0199
Growth rate of consumption	0.0166	0.0116	0.0016

Table 1.2 Economic data for 1889 - 1958 calculated from Shiller files.

1889 - 1978	Mean	Compound annual	Variance
Dividend/Price	0.0487	0.0486	0.0001
Stock index annual price gain	0.0265	0.0089	0.0349
Stock index total return	0.0753	0.0581	0.0358
Real interest rate	0.0141	0.012	0.0042
Growth rate of real dividends	0.0204	0.0123	0.0162
Growth rate of consumption	0.0181	0.0175	0.0013

Table 1.3 Economic data for 1889 - 1978 calculated from Shiller files.

1889 - 1998	Mean	Compound annual	Variance
Dividend/Price	0.0468	0.0467	0.0002
Stock index annual price gain	0.0389	0.0225	0.0330
Stock index total return	0.0857	0.0700	0.0334
Real interest rate 1889 - 1997	0.0181	0.0162	0.0037
Growth rate of real dividends	0.0187	0.0119	0.0133
Growth rate of consumption	N/A		

Table 1.4 Economic data for 1889 - 1998 calculated from Shiller files.

1959 - 1998	Mean	Compound annual	Variance
Dividend/Price	0.0370	0.0369	0.0001
Stock index annual price gain	0.0461	0.0350	0.0217
Stock index total return	0.0831	0.0724	0.0216
Real interest rate 1959 - 1997	0.0250	0.0246	0.0008
Growth rate of real dividends	0.0129	0.0120	0.0018
Growth rate of consumption	N/A		

Table 1.5 Economic data for 1959 - 1998 calculated from Shiller files.

1979 - 1998	Mean	Compound annual	Variance
Dividend/Price	0.0381	0.0380	0.0001

Stock index annual price gain	0.0947	0.0860	0.0183
Stock index total return	0.1328	0.1248	0.0174
Real interest rate 1979 - 1997	0.0367	0.0362	0.0010
Growth rate of real dividends	0.0110	0.0103	0.0013
Growth rate of consumption	N/A		

Table 1.6 Economic data for 1979 - 1998 calculated from Shiller files.

1989 - 1998	Mean	Compound annual	Variance
Dividend/Price	0.0289	0.0289	0.00004
Stock index annual price gain	0.1323	0.1242	0.0175
Stock index total return	0.1612	0.1536	0.0169
Real interest rate 1989 - 1997	0.0276	0.0275	0.0002
Growth rate of real dividends	0.0112	0.0108	0.0007
Growth rate of consumption	N/A		

Table 1.7 Economic data for 1989 - 1998 calculated from Shiller files.

Period	Mean equity premium %	Compound annual equity premium %
1889 - 1958	7.30	5.69
1889 - 1978	6.12	4.61
1889 - 1998	6.76	5.38

1959 - 1998	5.81	4.78
1979 - 1998	9.61	8.86
1989 - 1998	13.36	12.61

Table 1.8 Values of the mean and compound annual equity premiums for various periods.

There is an unexplained difference between the MP values listed in Table 1.1 and the corresponding results from my calculations in Table 1.3, but the general trends are similar. For the period 1889 - 1978 MP obtain a mean equity premium of 6.18%, whereas I find 6.12%, certainly an insignificant difference, but it should be noted that the mean total returns differ by 0.55%.

If we assume that the mean interest rate for 1889 - 1997 is unchanged by the addition of another year, I find that the mean equity premium for 1889 - 1998 is 6.76%. Kurz and Beltratti (KB) propose a slightly different value for the mean total return for this period of 8.34% compared with my 8.57%. The estimates of KB for the variance of the total return for both periods are close to mine, and are somewhat larger than that of MP for the first period.

3 REMARKS ON THE DATA

3.1 Arithmetic Mean

Since regulators usually insist that fund performance data be presented in terms of compound annual returns, it may come as a surprise to many investors that the equity premium is stated in terms of an arithmetic mean, that is the sum of the annual returns divided by the number of years. A standard mathematical inequality states that the mean annual return will always be greater than the compound annual return. In the cases above, the tables show that there is a difference of about 1.5%/year between the arithmetic and compound returns for the longer periods.

It is of interest to mention that there is an approximate formula which relates the difference between the compound and arithmetic returns to the variance of the series of returns in question. The formula, which becomes more accurate as the fluctuations from the mean become smaller, says

> Volatility increases mean return over compound return by about half the variance.

For example, consider the stock index annual price gain in Table 1.3 for the period 1889 - 1978. The two sides of the formula in per cent are

Compound return + half the variance = 0.89 + 0.5 x 3.49 =2.635; Mean return = 2.65

Compound return + half the variance = 5.81 + 0.5 x 3.58 = 7.60; Mean return = 7.53

The approximate formula works quite well for all the cases in the above tables. It seems that, given the compound return, an good estimate for the mean return will be obtained using the formula if the variance is known. This point is useful for our subsequent analysis.

3.2 Rates of growth of share price, etc.

The models of MP , Kurz , and some other authors assume that consumption, dividends, and share price all fluctuate about a trend of steady growth which MP chose to have a mean of 1.8%/year. While for shorter periods there have been significant departures from this trend for share price, the long term numbers do seem to be consistent with the assumption. However, see Sec. 1.3.3 on dividends.

It would be of interest to determine whether the number of shares per capita has remained constant, as would be consistent with the trend of growth in the economy. A clear finding to the contrary would cast doubt on the validity of the MP and Kurz models which assume a constant number of shares.

Readers might wish to meditate on an important point concerning total return from shares. If the number of shares outstanding does not change, it is impossible for investors on average to reinvest their dividends and so take advantage of the compound total return. One investor can buy new shares with the dividend only if another one sells some shares.

3.3 Contribution of dividend to total return

Another thing that many investors probably do not realize is that dividends, not share price increases, have contributed the bulk of the compound total return over the hundred or so years under consideration. For the period 1889 - 1978 the total compound return of 5.8% consisted of
4.9% in dividends and 0.9% in stock price increases.

As Kurz and others have pointed out, the past century has seen a number of episodes of rapid growth in real stock prices followed by several years when real stock prices declined. It happens that 1978 falls near the end of one of the periods of decline. We see a different picture when we look at 1889 - 1998, which ends with 16 years of high growth in stock prices. This growth was sufficient to increase the 110 year compound return due to real stock prices to 2.3% from 0.9% for the period ending 20 years earlier. In spite of this, dividends at 4.7% still formed the bulk of the total compound return of 7%.

For the last 40 years of the second period it appears that the contribution of dividends to total return has been diminishing. For 1889 - 1958 the mean dividend yield was 5.2%. During that time, D/P never fell

below 3.9%, and reached as high as 8.7% in 1950. For 1959 - 1998 the mean dividend yield was 3.7%, with a high of 5.8% in 1982. In the nineties D/P has fallen dramatically to little more than 1%.

Many years ago it used to be thought that, except in periods of excessive speculation, investors required that the dividend yield be higher than the bond yield to compensate for the perceived greater risk in stocks. A strong argument can be made that investors have now ceased to pay much attention to dividends and expect their return to be largely due to stock price increases.

3.4 Other markets

Jorion and Goeztmann have argued that the equity premium in many other stock markets has been considerably less than that in the US.

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CONTACT INFORMATION

E-mail jnuttall@uwo.ca