

Estimating Equity Risk Premiums

**Sponsored by
Society of Actuaries'
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ABSTRACT

The use of historical data to forecast long term future equity returns is a common practice for retirement plans. Long term geometric historical returns of equities in the U.S. and globally are over 3% more than that of 10-year Treasury bonds¹. Historical return series have high variance and so the standard error is high, indicating a wide range of possible outcomes. To reduce the standard error, a long time period is needed, which raises the question of whether returns are stationary. If the mean is changing over time due to changes in the economy, its predictive value may be limited. The geometric mean was superior to arithmetic in predicting long term returns going back to 1962. The arithmetic mean produces forecasts much higher than actual returns over most time periods. The geometric mean is a better unbiased estimator of the true mean for long term projections. Implicit or market based forecasts are based upon current dividend yields, which may include stock buybacks, or earnings and assumptions regarding future growth. They change with the market and may be more appropriate for retirement plans where market values are used as of a valuation date. Implicit based forecasts move in the reverse direction of the stock market (*i.e.*, falling in bull markets and rising in bear markets), the opposite of the historical methods. Most of the long term forecasts since 1962 based upon implicit measures are below actual returns. Due to the last 12 years of equity underperformance, historical and implicit forecasts are now closer.

I. BACKGROUND

The Society of Actuaries' Pension Section Research Committee commissioned² this study to help actuaries develop forward thinking long-term estimates of future equity risk premiums. Equity risk premium is the amount by which the total return of a stock market index, such as the S&P 500, exceeds that of government bonds. Equity risk premiums, calculated from historical data, have been used to project long term values of equity portfolios in retirement plans. The validity of using historical data to project future equity returns will be examined along with other forward looking methods.

¹ The U.S. Treasury uses the term notes for debt issued with maturities of two to 10 years and bonds for debt issued with longer maturities. This paper will follow the practice, used by most of the references cited, of calling the 10-year rate a bond rate.

² The author gratefully acknowledges the input of the Project Oversight Group (Thomas Anichini, Gavin Benjamin, Angelita Graham, Frank Grossman, Gang Ma, Kai Petersen, and Nathan Worrell) and the help of the Society of Actuaries staff members (Andrew Peterson, Barbara Scott and Steven Siegel) in completing this study.

II. METHODOLOGY

A search of literature on the Internet was completed and key papers on equity risk premiums identified and reviewed. U.S. and global stock markets were included, because U.S. based retirement plans invest globally and global markets provide insights into equity risk premiums. Many of the studies were completed prior to the financial crisis of 2008, which significantly changed measures of equity risk premiums. Some of the data used in these studies were updated to adjust for this. A simple model was constructed to compare methods of projecting equity returns.

III. HISTORICAL EQUITY RISK PREMIUMS – UNITED STATES

The historical equity risk premium (ERP), also referred to as the realized ERP, *ex post* ERP or the excess return, can be defined as the return of a stock market index minus the risk free return calculated as an annual percent over some historical period. The term *ex ante* ERP (or just ERP) will be used for the expected future annual return of a stock market index over the yield of a risk free asset³. The historical ERP can be expressed as an arithmetic average of the annual rates or a geometric average, which is the total return over the period. In the U.S., the S&P 500 index or its predecessors are frequently used to measure stock market returns while the 6-month Treasury (T) bill or 10-year T-bond are used for the risk free rate. While these returns could be expressed in nominal or inflation adjusted terms, the ERP would be the same since the inflation adjustment would wash out in the difference.

While these are all valid ways to measure historical experience, retirement plans have a long term perspective and so the geometric mean and 10-year T-bond will be used here. The arithmetic mean approximately equals the geometric mean plus $\frac{1}{2}$ of the variance, or about 2%⁴. The T-bill yield equals T-bond yield minus the yield spread, which is usually around 2%. The total return of T-bonds compared to bills will vary significantly over time. Most private sector defined benefit plans would be better measured using the 30-year T-bond as the risk free rate while most public plans and other plans with benefits that are adjusted for inflation would be better measured using the inflation indexed 30-year T-bond, but these bonds have limited historical records and so the 10-year T-bond is used.

From the founding of the New York Stock Exchange (NYSE), which commenced trading five bank stocks and government bonds in 1792, to the present, the geometric excess return of stocks over 10-year treasury bonds is 3%. Table 1 below breaks this return down by century. The 19th and 20th centuries had similar real stock market returns, but the 19th century had higher

³ Risk Free is a term used in the literature to refer to government bonds and ignores sovereign debt risk.

⁴ Mehra [20] derived this assuming returns are log-normally distributed with a standard deviation of 20%.

bond returns. Until after the Civil War, U.S. bonds were viewed as risky. Another factor that lowered bond returns in the 20th century was the unanticipated inflation in the 1970s. The underperformance of stocks so far in the 21st century may be attributed to mean reversion after the over performance of the last decade of the 20th century (real return of 14.2% per annum)⁵.

Century	Stocks	Bonds	Difference
19	6.7%	4.4%	2.3%
20	6.9%	2.1%	4.8%
21	-1.4%	5.7%	-7.1%

The 7.1% per annum excess return of bonds over stocks in the 21st century reflects the effects of the financial crisis in 2008. Arnott [2] noted in February 2009 a 40 year period from 1969 where bonds outperformed stocks. He also noted two historical periods where bonds outperformed stocks -- a 20 year period from 1929 to 1949 and a 68 year period from 1803 to 1871. So while stocks outperformed bonds by 2.5% per annum between 1802 and 2009, there were long-term periods of underperformance. This latest period of underperformance appears to be over with 10-year T-bond yields going below 2%, according to many observers [13].

IV. HISTORICAL EQUITY RISK PREMIUMS – GLOBAL

The United States was the most successful country economically in the 20th century, resulting in the unexpectedly high historical ERP. This may not continue into the future. Even if it does, investment markets have globalized – U.S. pension funds invest globally and most large cap U.S. companies derive a significant portion of their revenues from overseas.

Dimson *et al.* [13] updated their previous paper [7] showing historical ERPs for 19 developed countries that had data for the period 1900 to 2010. The following is an excerpt using geometric returns:

	Canada	3.7%	
	U.K.	3.9%	
	U.S.	4.4%	
	World	3.8%	

Russia and China were excluded due to Communist revolutions that resulted in a long period without data during the 20th century. While both stocks and bonds returned -100%

⁵ Data in this section is taken from [23] and [12] updated to 2012 using index returns from ishares website.

making the historical ERP 0 in these two countries, a U.S. based investor would have lost 100% relative to U.S. bonds. These two countries accounted for 11% of world equity in 1900 and so including them at -100% would lower the world index by 0.1%. [13]

The world stock markets changed significantly over the 20th century⁶.

	Country	1900	2000	
	U.S.	22%	47%	
	U.K.	12%	8%	
	Euro-land	25%	12%	
	Japan	4%	12%	
	Canada	1%	2%	

V. THE EQUITY PREMIUM PUZZLE

In the mid-1980s, Mehra and Prescott coined the term “Equity Premium Puzzle” because the historical ERP was several times that predicted by economic models. In developing a historical ERP, they used arithmetic means and T-bills. If returns are uncorrelated, the arithmetic average should be used since the mean terminal value is obtained by compounding the mean returns⁷. T-bills are used for the risk free rate because individual behavior is being modeled and bonds carry risk of market loss if interest rates rise. They then reviewed available historical data. The data prior to 1871, constructed from published data on bank and later railroad stocks, was deemed unreliable and not used. Data between 1871 and 1926 had the total return of NYSE stocks and was viewed as reasonably good. Prior to 1920 there were no short term treasury securities and so commercial paper was used to estimate the risk free rate. After 1926 was the “golden age” of financial data – the Ibbotson data starts at that time. Mehra and Prescott came up with a historical ERP of 6.36% (1889-2005). Using Ibbotson data only (1926 to 2004) produces a historical ERP of 8.38%, while at the other extreme Siegel produced a historical ERP of 5.36% (1802-2004). [20]

In theory, the marginal utility of instruments that payoff in a bad economy is higher than those that payoff in a good economy since funds are more valuable in the bad economy to consumers who want to maintain their standard of living. Real returns on T-bills have the same payoff pattern as stocks but with lower volatility. Mehra calculated the ERP using models that

⁶ Source Investopedia <http://www.investopedia.com/articles/basics/06/alookback.asp#axzz1u6TuNBfd>

⁷ [20] Appendix A contains a proof of this.

were successful in business cycles to be around 1% compared to arithmetic ERPs in the U.S. and other countries in the 5% to 9% range. [20]

This led to an outpouring of research [*e.g.* 17, 18] to explain this discrepancy – including finding parameters to fit the data to the models and behavioral economic explanations (loss aversion, money illusion) for this anomaly. Fear of catastrophic loss was another explanation proffered. Falkenstein [8], by assuming relative levels of wealth matter and not absolute levels (*i.e.*, keeping up with the Jones), calculated an ERP of 0. Finally, Mehra in 2011 came up with an explanation for the puzzle: (1) T-bills, which are not generally purchased by individuals, are not the appropriate risk free asset – inflation adjusted T-bonds should be used; (2) there is a spread between borrowing and lending costs; and (3) there are borrowing constraints – younger individuals who would invest in stocks cannot borrow against future wage income. Mehra did conclude that with the aging of the population, demand for bonds will increase, resulting in higher ERP in the future. [13]

VI. DECONSTRUCTING THE HISTORICAL ERP

Equity returns consist of income and price appreciation. Price appreciation can be further divided into earnings per share (EPS) growth and changes in price earnings ratio (P/E). Income consists primarily of dividends with net share buybacks (share buybacks minus new share issuance) sometimes included. Dividends made up the bulk of the historical returns. Grinold *et al.* decomposed S&P500 returns for the period 1926 to 2010: [13]

Income return	4.1%	
Real EPS growth	1.9%	
Inflation	3.0%	
Changes in P/E Ratio	0.6%	
Reinvestment in year	0.3%	
Total return	9.9%	

Dimson, *et al.* [13] decomposed real geometric worldwide equity returns in U.S. dollars for 1900 to 2010 into dividend yield plus real dividend growth plus expansion of the Price to Dividend (P/D) ratio. An excerpt from this table that included 19 developed countries follows:

	Geometric	plus	plus	plus	equals
	Mean	Real	Expansion	Change in	Equity
	Dividend	Dividend	in the	Real Exchange	Returns
Country	Yield	Growth Rate	P/D Ratio	Rate	in U.S. \$
Canada	4.39%	0.84%	0.56%	0.09%	4.94%
U.K.	4.63%	0.46%	0.20%	-0.06%	4.27%
U.S.	4.24%	1.37%	0.56%	0.00%	5.26%
World US\$	4.11%	0.83%	0.48%	0.00%	4.49%

VII. ISSUES IN USING HISTORICAL DATA TO DETERMINE THE *EX ANTE* ERP

Using historical stock and bond market performance data to estimate future performance raises a number of issues beyond simply what time period and data series to use. These include the validity of using historical data to project future returns and whether arithmetic or geometric mean or some other measurement should be used.

Stationarity

A data series is stationary if the mean and standard deviation do not change over time. An earlier actuarial paper on the ERP by Derrig and Orr [6] published in 2003 contains proof that the Ibbotson data from 1926 to 2002 is stationary, despite large differences in mean and variance, assuming the annual returns are independent and identically distributed around the mean (iid). This is a result of the variance being very large. In a discussion note, Whelan comes to the opposite conclusion from this data – that you cannot say with a high degree of confidence the returns are stationary. He then looks at annual returns in the Irish stock market which has a 200 year history and other markets, such as daily exchange rates, to conclude that capital markets data series are not stationary – the mean and standard deviation will change unpredictably over time – and so you cannot extrapolate past performance into the future. He also notes that annual returns are correlated, with a fat tail distribution and volatility that spikes up and gradually fades.

Standard Error

The standard error of a sample is standard deviation divided by the square root of the number in a sample. Plus or minus two standard errors should cover 95% of the outcomes. Table 4 shows that even with 50 years of U.S. data, we cannot be confident that the equity premium is greater than 0.⁸

⁸ Data from Damodaran online www.damodaranonline.com [5]

Table 6 – Standard Error of Arithmetic Mean of ERP (T-bonds)

Period	Arithmetic	Standard	95% Confidence	
	Mean	Error	Interval	
1928-2011	5.79%	2.36%	10.51% to	1.08%
1962-2011	3.36%	2.68%	8.73% to	-2.00%
2002-2011	-1.92%	8.94%	15.96% to	-19.79%

Going back 220 years, the standard error would be about 1.3% meaning that the 95% confidence interval would be +/- 2.6% around the mean. The standard error would be larger if the returns are correlated. The U.S. went from a developing agricultural economy to an industrial economy in the mid-19th to 20th centuries to a service and technology-based economy today. The stocks comprising the market that are being measured have changed significantly. The earlier market performance may not be predictive of the future.

The significant stock market changes in the 20th century bring in to question the stationarity of the return series ⁹:

Table 7 U.S. Stocks Sector Weightings

<u>Sector</u>	<u>1900</u>	<u>2000</u>
Information Tech	0.0%	23.1%
Railroads	62.8%	0.2%
Banks	6.7%	12.9%
Pharmaceuticals	0.0%	11.2%
Utilities	4.8%	3.8%
Tobacco	4.0%	0.8%

Geometric Versus Arithmetic Mean

The arithmetic mean of a sample of n entries is the sum of the entries divided by n while the geometric mean is the n^{th} root of the product of the entries. In much of the statistical work, the historical returns each year are assumed to be independent and identically distributed random variables. However, investment returns are serially negatively correlated. [3] As an extreme example, an investor with \$100 has returns of 50% and minus 50% over two years. The arithmetic mean of these two returns is 0, but the investor ends up with \$75.

⁹ Source: Investopedia, *op. cit.*

Jacquier *et al.* [15,16] developed an unbiased estimate of the mean (U) from historical data by weighing the geometric (G) and arithmetic (A) means by the ratio of number of years in the projection (P) to the number of years in the sample (S):

$$U = A*(1-P/S) + G*(P/S)$$

As the projection time gets longer, the geometric mean becomes more important. When the projection time equals the sample time the geometric mean is the unbiased estimate of the mean. Since most pension work involves long projection periods, the geometric mean is a more appropriate measure for future projections.

Effects of Parameter Uncertainty on Long-Term Projections

Historical stock market returns are negatively correlated with mean reversion, which should make longer term projections more predictable. Pastor *et al.* [21] noted that investors are uncertain whether the historical sample mean and variance are the true parameters and whether they may change over time. This uncertainty more than offsets the effect of mean reversion making long term projections less certain with predictive variances as much as twice as high as short term projections.

VIII. USING SURVEYS TO ESTIMATE ERP

Since the ERP reflects investors' requirements as to extra returns needed to assume equity risk, surveys of investors' opinions on equity returns would seem like a way to determine the ERP. The oldest continuous survey of individual investors goes back to 1987. These investors expect the highest future return at the top of bull markets and the lowest returns at the bottom of bear markets and therefore are a contrary indicator of ERP [5].

In the 1990s and 2000s several more surveys were developed including institutional investors, stock analysts, academic economists, and corporate CFOs. These groups, while better than individual investors, tend to follow the market and are poor forecasters. Institutional investors appear to have lower forecasts at market tops, while CFOs, who are answering the question of what is the minimum hurdle rate for new projects, appear to be less sensitive to market swings [11].

Table 8 – ERP Survey Results

Year	Survey Participants		
	CFOs	Finance Professors	Institutional Investors
1997		7.00%	
1998			3.00%
2000	4.65%		
2001		5.50%	
2002			3.90%
2007		5.69%	
2009	4.74%		

Surveys, which appear to be focused on short term, dependent on what questions are asked and with a high degree of variance in answers, are not very useful in determining ERP for pension plans that have very long time horizons.

IX. USING MARKET BASED FACTORS TO ESTIMATE ERP

Another method is using current market value measures to determine the ERP. The most commonly used of these implicit methods is the Dividend Discount Method. Under this method the value of equity is the present value of all future dividends. Assuming a constant growth rate in dividends (the Gordon Model):

$$\text{ERP} = \text{Dividend Yield} + (\text{Dividend Growth Rate} - \text{Risk Free Rate})$$

The unknown quantity is the dividend growth rate. Payout ratios have fallen recently as firms use stock buybacks instead of dividends, so share buybacks less new issuance could be added. Retained earnings, whether used for share buybacks or reinvested should yield higher future dividend growth. If retained earnings are reinvested at the expected equity return rate (ERP + Risk Free Rate) with a constant payout ratio, then:

$$\text{ERP} = (\text{Earnings/Price}) - \text{Risk Free Rate}$$

Here the expected return on stocks is simply the earnings yield, 1/ (Price Earnings Ratio). Since earnings are an accounting construct that can change drastically each year, Shiller [22] uses a rolling 10 year historical average. Both the Dividend growth and earnings yield models are consistent with long term historical equity returns. [3]

X. ISSUES IN USING MARKET BASED FACTORS TO DETERMINE THE ERP

In addition to determining what should be included in dividends and the growth rate for dividends, the ERP under implicit methods will be changing significantly over business cycles unlike historical ERPs, which change only gradually as new years are added to the historical data.

Dividends

Dividend yields have been declining, partially due to a decline in payout ratios. Rather than using dividends, share buybacks have become a common way to return capital to shareholders. Prior to 2001, capital gains had lower tax rates than dividends. Also, it is easier to change or stop buybacks. By increasing share prices, buybacks increase the value of stock options, which have become a major component of executive compensation. Dividends could be adjusted to add buybacks less new issuance at the firm level. Looking at the market as a whole, all share purchases for cash (buybacks, LBOs¹⁰) less share issuance (stock options, IPOs¹¹) could be added to dividends. These quantities vary significantly by year, but on average 2.2% of shares are bought back compared to 2% new issuance, leaving a net addition to dividends of .2%. Free cash flow (funds available to pay dividends) could also be used instead of dividends in these formulas. [10]

Dividend Growth Rate

One possible assumption is continuation of the 1.34% per year real long term historical growth in dividends [10]. Another is that dividends will increase with earnings (constant payout ratio), which is proportional to the increase with GDP. Since a portion of increased earnings will be captured by executives and entrepreneurs (stock options and IPOs), a lower amount such as per capita GDP could be used for existing shareholders.

Conditional versus Unconditional ERP Forecasts

Once the dates and methodology are defined (*e.g.* geometric mean, Ibbotson data, 1926 to present, 10-year T-bonds), the historical ERP remains constant, other than adding each passing year's return to the historical data. The ERP from dividend or earnings yield will change daily with the market. From the market high in October 2007 to its low in March of 2009, dividend yield based ERPs would more than double. Some authors break the ERP into a short term, or conditional part reflecting market and an unconditional, long term part based upon historical

¹⁰ LBO is an abbreviation for leveraged buyout, when the stock of a company is purchased with borrowed funds and the company is taken private.

¹¹ IPO is an abbreviation for initial public offering, when stock in a private company is sold to the public.

data. Pension plan liabilities are long term, so the breakdown between the next 10 years and beyond may be less important. When pension plan equities are valued at market, there is merit in calculating the ERP as of the same date, whether or not it is possible to determine an unconditional long term return from historical data.

XI. MODELS USING MARKET BASED FACTORS

There are a number of models that use variations of market data such as dividends, earnings or interest rates to calculate the ERP. Two examples follow:

Damodaran

Damodaran's model [5] uses cash dividends plus an estimate of share buybacks (averaging 4.7% over the past 10 years) with projected growth using consensus analysts' earnings estimates for the next 5 years and then the risk free rate thereafter to obtain the total expected return on stocks.

Hassatt

Hassatt's model [14] assumes that the ERP is a multiplicative factor (referred to as RPF) instead of an add-on to the risk free rate (10-year T-bonds). The RPF can change over time but is stable for long (20 year) periods. The current RPF is 1.48, which is developed from recent data and so ERP is 1.48 times the Risk Free Rate (RF) and $Price = Earnings / (RF + ERP - G)$ where G is the expected long term GDP growth rate. The model is back tested and fits data for the last 50 years.

XII. OTHER METHODS OF CALCULATING ERP

Damodaran [5] developed a model from data going back to 1960 where the ERP = 1.96 times the 10 year Baa bond to Treasury credit spread with a standard error of 0.2. This model also produces results roughly equivalent to his cash flow model. He also noted that option volatility VIX tracks 10 year CFO survey risk premiums going back to 2000. Sovereign debt credit spreads can be used with historical developed market ERP to estimate historical ERP in emerging markets where there is limited history and high volatility.

Finally there are methods using book values [4] to estimate stock prices. Price equals the current book value of equity plus the present value of future earnings in excess of the cost of capital, where earnings are based upon analysts' estimates. This method produced ERPs in the 3 to 4% range during the 1990s.

XIII. COMPARISON OF METHODS

Fernandez [11] reviewed 150 finance textbooks published between 1979 and 2009. The five year rolling average ERP has declined from 8.4% in 1990 to 5.7% in 2009. The majority calculate the ERP from historical data with Geometric Mean – T-Bonds. Arithmetic – T-bills was the next most common method. He notes four types of ERP – historic, required, implied and expected. Most texts view the required and expected as the same.

Different authors come up with different historical ERPs using the same data, due to using different indexes. For Ibbotson data from 1926 to 2005, the historical ERP based on geometric mean minus T-bonds ranges from 4.6% (Siegel) to 5.5% (Shiller). Some texts use surveys to obtain ERPs as shown in Table 8 *supra*. [11]

Fernandez concludes that different investors have different required and expected equity premiums and implied premiums are dependent on growth assumptions while there is no generally accepted method of using historical data to obtain ERP.

XIV. MODEL OF LONG TERM FORECASTING ACCURACY

An Excel model was developed to test the forecasting accuracy of 4 different methods for 50, 40, 30, and 20 year time periods starting in January 1, 1962. The most common method is to use geometric total return of historical stock data going back to 1926 minus the total return of 10-year T-bonds during that period (HERP-G). The next most common is arithmetic mean of the same historical data minus the arithmetic return of T-bills for during that period (HERP-A). This will be close using the arithmetic mean of T-bonds for the forecast (HERP-A10), but not exactly equal due to differences in the yield curve. The forecast return is the ERP plus the risk free asset interest rate on the date of the forecast. The next two are implied methods DAMODARAN and EARNINGS (reflecting the annual earnings yield)¹². For Historical ERPs, data is used from 1927 to end of the year prior to the date of projection. For implied methods using T-bills or bonds for the risk free rate produces the same forecast.

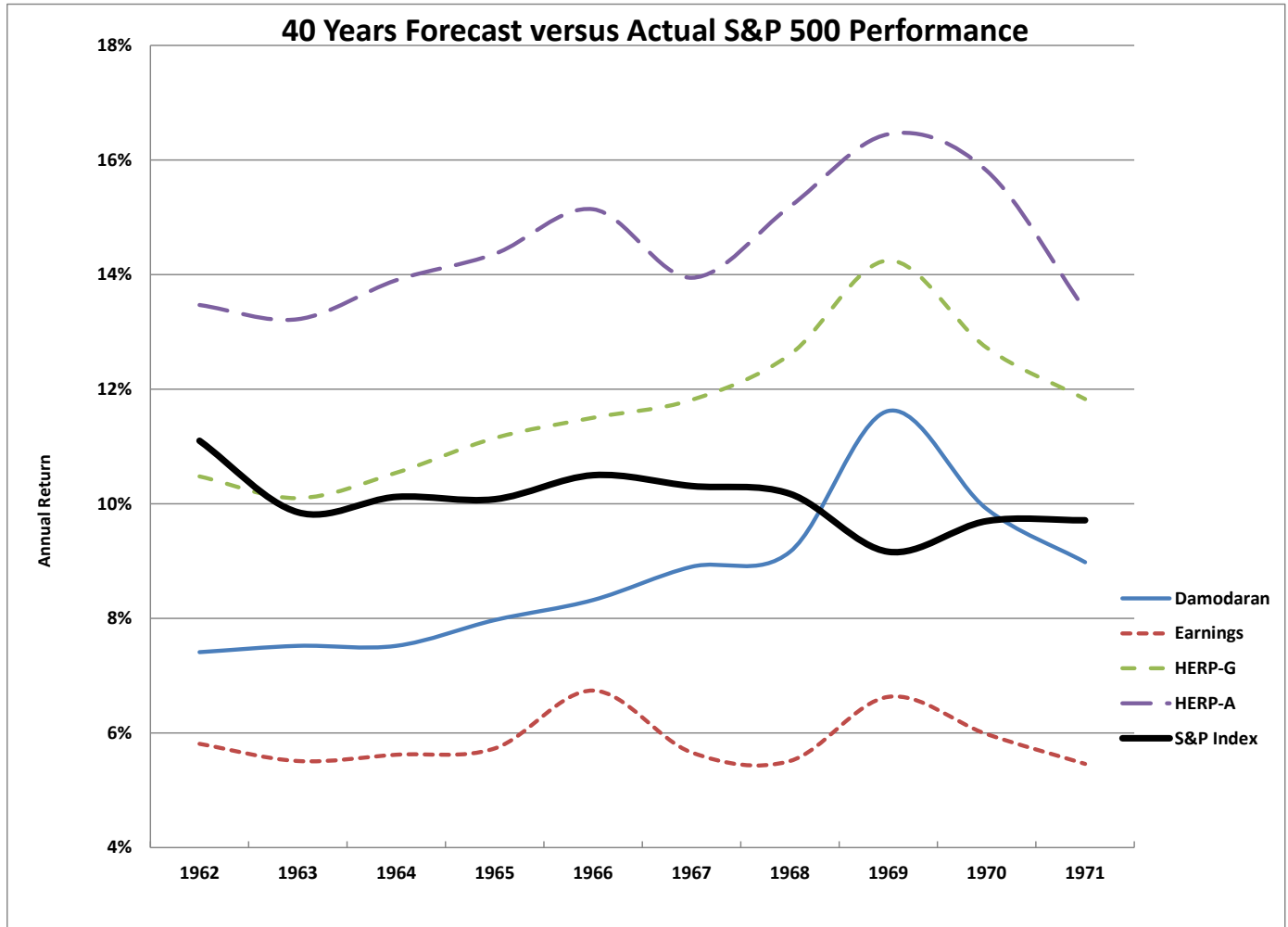
¹² Sources are Damodaran Online, Shiller Online, and author's calculation.

Table 9 – 50 Year Total Return Actual versus Forecast 1/1/1962 to 1/1/2012

	Annual Return
S&P Index	9.40%
HERP-G	10.48%
HERP-A	13.47%
HERP-A10	13.22%
DAMODARAN	7.41%
EARNINGS	5.81%

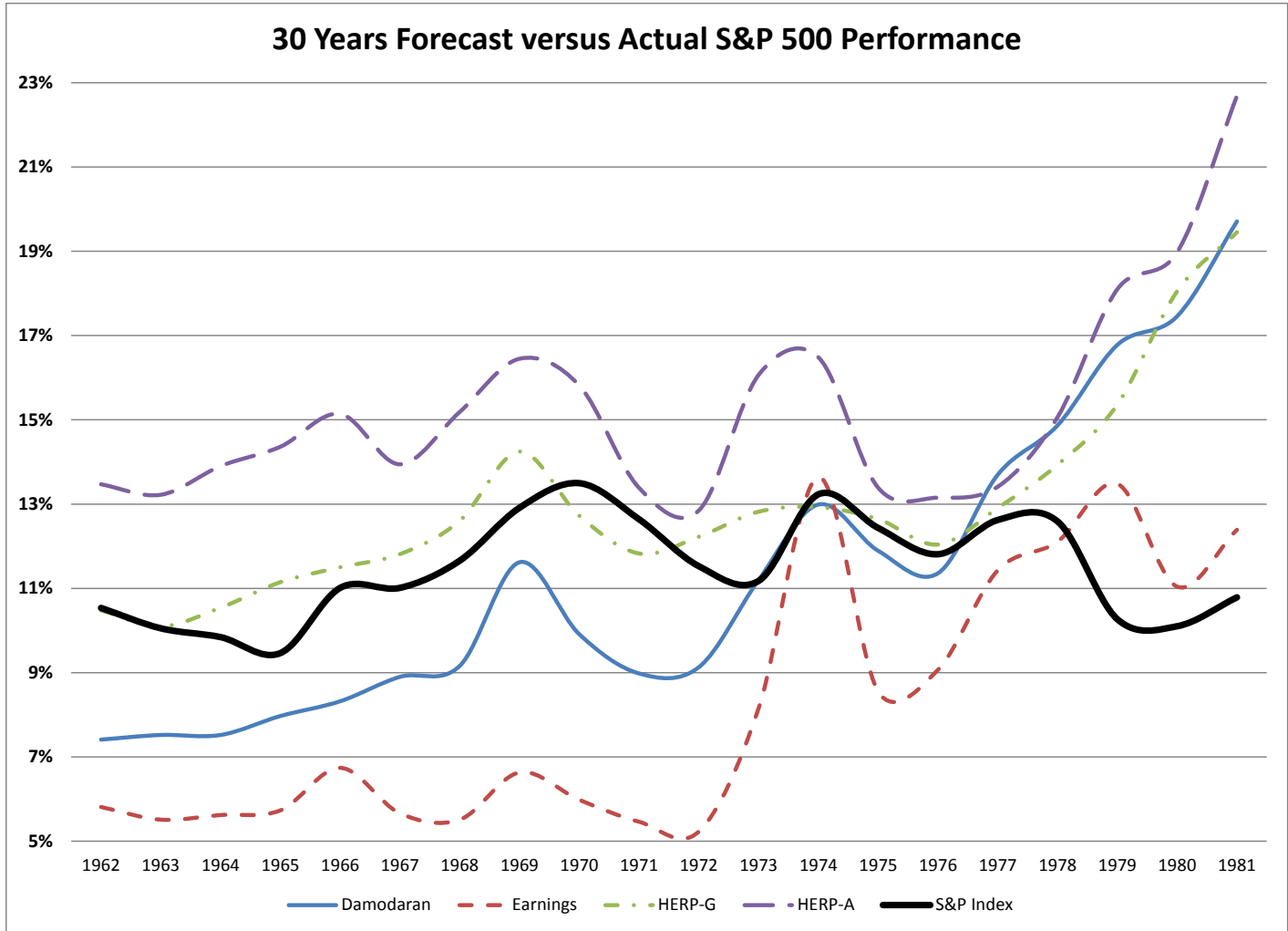
This chart shows that over the 50 year period from 1962 to 2012, the S&P 500 returned 9.4% per annum compared to forecasts using different ERP methods. The historical geometric mean calculated from data from 1927 to 1962 would have predicted a 10.48% return while the Damodaran method would have forecast a 7.41% return.

Chart 1- 40 years Total Return Compared to Forecast Starting in 1/1/1962 to 1/1/2002



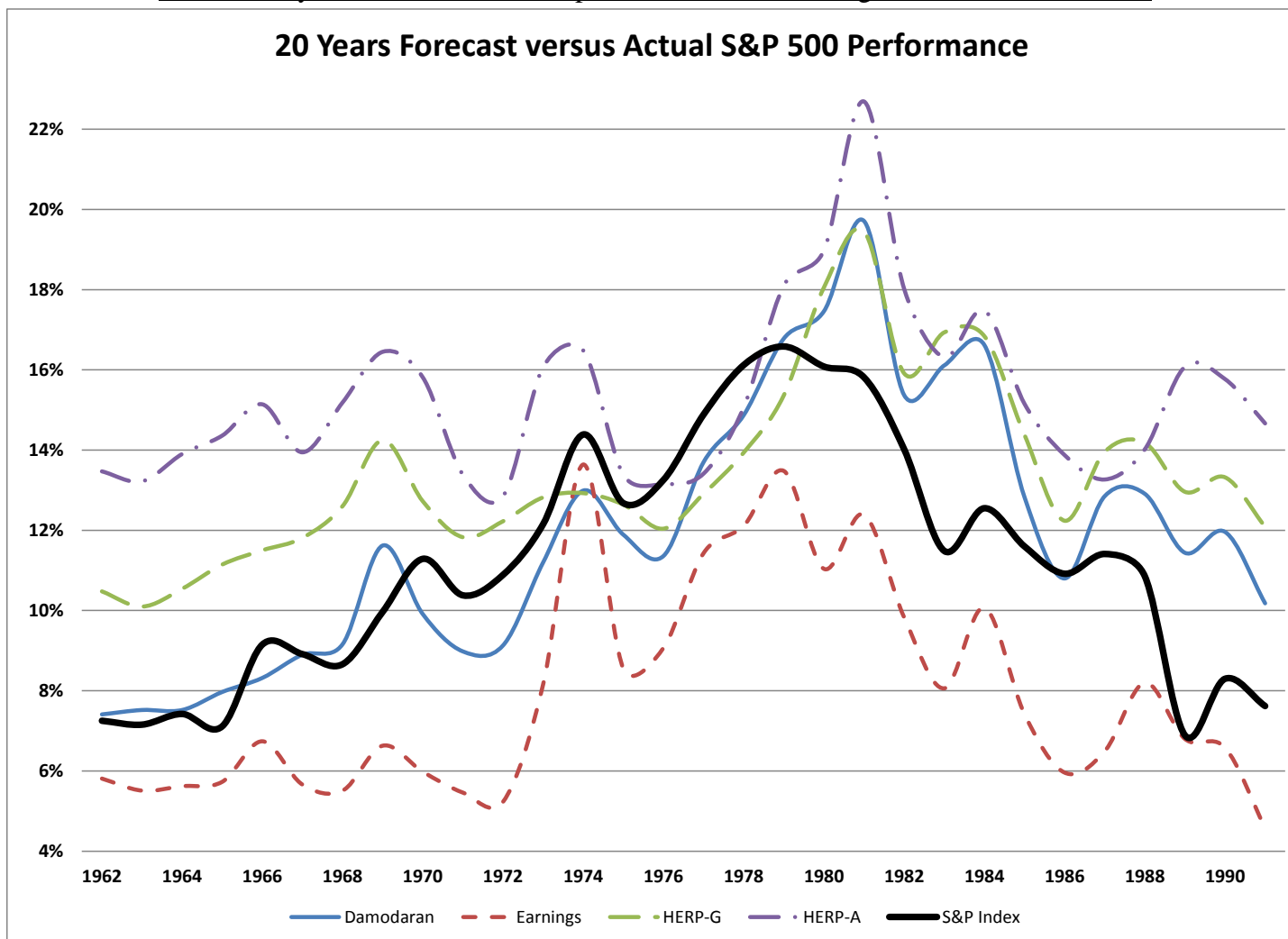
This chart compares actual returns of the S&P 500 (thick black line) to forecasts using historical and implied methods. The first entry is the 40 year period from 1962 to 2002; the next is 1963 to 2003, while the last is 1972 to 2012.

Chart 2- 30 years Total Return Compared to Forecast Starting in 1/1/1962 to 1/1/1992



In the same manner as Chart 1, this chart compares actual versus forecast returns for 30 year periods starting with the period 1962 to 1992 and ending with 1982 to 2012. The next chart shows 20 year periods starting with the period 1962 to 1982 and ending with 1992 to 2012.

Chart 3- 20 years Total Return Compared to Forecast Starting in 1/1/1962 to 1/1/1992



These Charts show that long-term forecasts based upon the historical ERP using the arithmetic mean are far too high, with a few exceptions. The geometric mean is the better historical ERP forecast. Prior to 1986, Damodaran ERP equals the dividend yield and the forecast is simply the dividend yield plus the 10-year T-bond yield. This is the Gordon model where dividend growth rate equals the 10-year T-bond yield. The earnings yield forecasts are usually below the actual returns but tend to follow them.

XV. ERP AND LONG TERM STOCK MARKET FORECAST 2012

As of 12/30/2011, the 6-month T-bill yielded .06%, while the 10-year bond was at 1.94%. The 10 year inflation adjusted yield was -.11%. The 30 year rates were 2.98% nominal and .78% for inflation indexed. The ERP and stock market return forecast using the methods in the last section and a few other ones are shown below. The ERP is based upon the 10-year T-bond except for the historical ERP based upon arithmetic mean, which uses T-bills. The dividend yield on the S&P 500 was 2.06%.

<u>Basis for Estimate</u>	<u>ERP</u>	<u>Stock Market Forecast</u>
Earnings Yield	5.78%	7.72%
Shiller 10 Year Earnings Yield	2.67%	4.61%
Damodaran	6.04%	7.98%
Historical Geometric from 1927	4.10%	6.04%
Historical Arithmetic from 1927 ¹³	7.62%	7.68%
Historical Geometric from 1792	3.00%	4.94%
Hassatt	2.87%	4.81%
Fernandez	4.00%	5.94%
1.96 x Baa Credit Spread	5.64%	7.58%
Gordon DDM ¹⁴	3.60%	5.54%

Calculating the future value of funds using these stock market forecasts would be the same for all these methods: $FV = PV \cdot (1 + FR)^N$, where FV=Future Value, PV = Present Value, FR=Forecast Rate and N is the number of years in the forecast. Some of the implicit methods in 2012 are producing higher ERPs than historical methods contrary to the period 1962 to 1992 studied in the last section. After a period of poor stock market performance, implicit methods tend to produce higher ERPs than historical methods, while the opposite is true after periods of strong performance. The average of these forecasts is 6.28% which is 4.34% higher than the 10 year T-bond.

XVI. OTHER ASSET CLASSES

Most other asset classes would use implicit or market based measures to project future returns. For treasuries, the yield is the expected return and historical performance should not be used. The 30 year nominal return on a 30-year zero-coupon T-bond can be predicted precisely. For corporate bonds, yields may be reduced for defaults (based upon ratings) and, if applicable,

¹³ The Arithmetic Mean uses T-bills as the risk free rate, while all others use 10-year T-bonds.

¹⁴ Dividend Discount Model using 2.06% dividend yield plus .2% net buybacks and real growth based upon 50 year historic average of 1.34%.

call risk in forecasting total return. Since pension liabilities are long term, short term price performance is likely not an issue, although reinvestment may be. Damodaran developed a method to use corporate credit spreads to estimate ERP. Real estate capitalization ratio, the price of a building divided into the income can be compared to 10 year treasury rates to compute a risk premium. While in the early 1980s, real estate capitalization ratios were below treasury yields, possibly due to tax advantages, more recently they have tracked credit spreads and could be used to forecast ERP. [4]

It is also possible to break equities into classes. There are foreign markets (developed and emerging). The U.S. market can be broken down into small, mid and large cap. Other than developed stock markets, these asset classes have limited history and high volatility. The standard error would be high and so historical ERP methods may not be appropriate. Global developed market historical ERPs, which are 0.6% below U.S. in 1900 - 2010, could be used. Globalization should, in theory, result in a convergence in ERPs. Implicit methods may not be exactly comparable – dividend yields are higher in Europe, but growth is lower and earnings based on different accounting. In the U.S. market, French & Fama [9] developed a model dependent on capitalization and book to equity ratio to replace CAPM. The higher performance of small cap stocks may be explainable by liquidity (bid-ask spread) and survivorship bias (become large cap or fail). [8] Thus even if the historical data is predictive of the future, the market returns may not be achievable in practice¹⁵. So it may be better to use one equity premium for the entire market.

Then there is a class referred to as alternative assets, which have been increasing recently. This includes private equity, hedge funds, commodities, collectables, timber, limited partnerships and other vehicles that may have equity like characteristics. These tend to be volatile and have short histories so past performance may not be indicative of future returns. Indeed if investment demand were to increase asset prices, future returns would be reduced, other things being equal.

XVII. VOLATILITY, ERP AND HIGH FREQUENCY TRADING

An interesting question is whether higher stock market volatility would increase the ERP in the future. High frequency trading (also called program trading or robot-trading), where computers using algorithms trade directly on exchanges, has more than doubled since 2006 to over 60% of daily trading. The increased daily volatility and the flash crash of 2010 have been blamed on these traders. It has been argued that individual investors have been abandoning the stock market, as evidenced by outflows from equity mutual funds, due to this volatility. A more likely explanation is that the financial crisis has reminded these investors of the possibility of

¹⁵ Falkenstein [8] describes the effect of liquidity (bid-ask spreads) and why junk bond ETFs significantly underperform their indexes on p. 116 and survivorship bias on small cap fund performance on p. 56.

catastrophic losses in equities and that diversification is no panacea for risk. Another factor is the aging population, as older workers with shorter time frames and less labor income prefer bonds. With more uncertainty in the labor markets, younger workers may have increased preference for safe investments. Whatever the merits of high frequency trading, the short term volatility is likely to be noise to long term investors such as pension plans.

CONCLUSIONS

Most of the papers published on ERP focus on individual investors. Their objective is to preserve consumption over the short and long term. Pension plans focus on the long term and in many cases on fixed dollar benefits. Taking into account these differences, on both theoretical and empirical grounds, the geometric mean is preferred to the arithmetic mean for pension plans. Using the arithmetic mean would have led to forecast returns substantially higher than those actually realized. Stationarity and standard error would indicate that there is significant uncertainty in using any historical ERP estimate to forecast returns and so it might be preferable to quote a range of possible outcomes instead of a single point estimate. Future standards might someday provide for a range of forecasts.

Implicit or market based ERP methods have the advantage of reflecting current market conditions. When pension plan stocks are valued at market as of the date of valuation, it would be consistent to have an ERP calculated as of the same day. Implied ERPs fall in bull markets and rise in bear markets, while historical ERPs do the opposite. If the market suddenly fell by half and nothing else changed, the forecast return based on implied methods would double, but the forecast from historical methods would be unchanged, until the end of the year when the performance would be incorporated into the ERP, lowering the forecast returns. Implicit methods are based upon dividend or earnings growth assumptions and forecasts based on them also have significant uncertainty. Prior to 2000, the historical ERPs produced higher forecasts than implicit methods, but after 12 years of poor performance, the historical and implied ERPs are much closer.

While this paper discusses estimating ERP, the risk free rate for a pension liability is the rate at which expected payments are matched to cash flows from T-bonds. Investing in stocks and lowering reserves based upon an ERP is equivalent to saying that there is a 50% chance the funds will be adequate to pay benefits. So unless there is a financially secure counterparty that is guaranteeing continuing funding, the benefits are at risk. Indeed, it could be argued that deviation from a matched bond strategy should require more collateral to secure benefits, not less.

BIBLIOGRAPHY AND SUMMARIES

(Note: URL's listed below are as of 6/15/12)

1. Arnott, Robert and Ryan, Ronald, "The Death of the Risk Premium: Consequences of the 1990's", The Journal of Portfolio Management Spring 2001, Vol. 27, No. 3: pp. 61-74
http://www.ryanalm.com/portals/5/research/30020102_@Death_of_the_Equity_Risk_Premium_-_Arnott_Ryan.pdf
This article makes the case in 2001 that bonds are likely to outperform stocks for extended periods of time by looking at metrics such as dividends, earnings and bond yields.
2. Arnott, Robert, "Bonds: Why Bother?" Journal of Indexes May/June 2009
http://www.ltadvisors.net/Info/research/2009_149.pdf
This article notes that bonds outperformed stocks for extended periods of time – the 40 year period from 1969 to 2009, 1929 to 1949, and 1803 to 1871.
3. Campbell, John Y., Diamond, Peter A., and Shoven, John B. "Estimating the Real Rate of Return on Stocks Over the Long Term," Social Security Advisory Board (August 2001)
<http://www.ssab.gov/publications/financing/estimated%20rate%20of%20return.pdf>
This consists of three papers, one from each of the authors. The first discusses limitations of historical methods and the superiority of geometric mean when returns are correlated. The second uses the dividend discount model and other measures to show that continuation of a 7% real return for stocks is implausible and the implications of a lower return over the next 10 years (from 2001) before resuming the 7% long term return. The third paper also argues that stocks are overvalued and a period of underperformance is likely before the 7% long term return will resume.
4. Claus, J. and Thomas, J. "Equity Premia as Low as Three Percent? Evidence from Analysts' Earnings Forecasts for Domestic and International Stock Markets", The Journal of Finance, 56: 1629–1666. (2001)
<http://onlinelibrary.wiley.com/doi/10.1111/0022-1082.00384/abstract>
This paper calculated the equity premium to be 3% by determining the discount rate that equates the value of the stock market with forecasts of future cash flows and subtracting that from the risk free rate.

5. Damodaran, Aswath, "Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2012 Edition" (March 2012).
<http://people.stern.nyu.edu/adamodar/pdfiles/papers/ERP2012.pdf>
www.damodaran.com
 This paper is one of the most important references, along with 6, 11, and 13. It discusses economic theories behind the ERP and examines various methods and their limitations, historical and implied, used to determine ERP.

6. Derrig, Richard A. and Orr, Elisa D., "Equity Risk Premium: Expectations Great and Small," *Casualty Actuarial Society Forum*, Casualty Actuarial Society Winter 2004 pp. 1-44 <http://www.casact.org/pubs/forum/04wforum/04wf001.pdf> and Discussion in the NAAJ by Shane Whelan http://www.soa.org/library/pdfest/journals/north-american-actuarial-journal/2005/january/new_naaj0501-8.pdf
 This paper and discussion form the actuarial view of ERP. The various historical methods are discussed including choice of arithmetic, geometric mean and risk free rate.

7. Dimson, Elroy, Marsh, Paul and Staunton, Mike, "Global Evidence on the Equity Risk Premium", *Journal of Applied Corporate Finance*, 2002
<http://faculty.london.edu/edimson/assets/documents/Jacf1.pdf>
 This paper computes the historical ERP for 16 developed countries for the period 1900-2001.

8. Falkenstein, Eric G., "Risk and Return in General: Theory and Evidence," SSRN (June 15, 2009) <http://ssrn.com/abstract=1420356> or <http://dx.doi.org/10.2139/ssrn.1420356>
 This paper presents the view that higher risk does not produce higher returns. Individuals are concerned about relative wealth, risk taking is then deviating from the consensus portfolio, and thus the ERP is 0.

9. Fama, Eugene F. and French, Kenneth, "The Cross-Section of Expected Stock Returns," *The Journal of Finance* Vol. XLVII No.2 June 1992
http://www.bengrahaminvesting.ca/Research/Papers/French/The_Cross-Section_of_Expected_Stock_Returns.pdf
 Size and book to market equity explain differences in return better than Beta.

10. Fama, Eugene F. and French, Kenneth, "The Equity Premium," (April 2001). EFMA 2001 Lugano Meetings; CRSP Working Paper No. 522.
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=236590

Dividend and earnings growth rates for the period 1951 to 2000 was much lower than the returns experienced by the stock market indicating returns were unexpected and driven by declines in the discount rate.

11. Fernandez, Pablo, “The Magnitude and Concept of the Equity Premium in 150 Textbooks,” (July 16, 2011). <http://dx.doi.org/10.2139/ssrn.1898167>
This is a summary of 150 textbooks on ERP published between 1979 and 2009.
12. Goetzmann, William N. and Ibbotson, Roger G. “History and the Equity Risk Premium,” (April 6, 2005). Yale ICF Working Paper No. 05-04.
<http://ssrn.com/abstract=702341>
This paper contains U.S. stock and bond market data going back to 1792.
13. Hammond, P. Brett, Leibowitz, Martin L. and Siegel, Laurence B., “Rethinking the Equity Risk Premium,” The Research Foundation of CFA Institute (2011)
<http://www.cfapubs.org/doi/pdf/10.2469/rf.v2011.n4.full>
This is a collection of 11 papers on ERP published after the financial crisis of 2008 and is the most significant up to date source on ERP. It contains a summary of ERPs from 20 different sources and discusses different methodologies and meanings. Ibbotson discusses historical data and the building blocks of expected returns. Dimson *et al.* brought up to 2010 worldwide ERP data for developed countries. Grinold decomposed S&P 500 returns and discussed implied methods such as earnings yield and dividend discount model. Arnott discusses myths of ERP such as buybacks replacing dividends. Ilmanen notes that ERP can vary over time. Chen predicts that going forward, stocks will outperform bonds. Siegel also makes the case for stock over performance.
14. Hassett, Stephen D., “Risk Premium Factor Valuation Model for Calculating the Equity Market Risk Premium and Estimating S&P 500 Market Values,” (February 16, 2010). Journal of Applied Corporate Finance <http://ssrn.com/abstract=1445445>
This paper has the Hassett model for calculating ERP using an empirically developed multiplicative factor.
15. Jacquier, Eric, Kane, Alex and Marcus, Alan J., “Geometric or Arithmetic Mean: A Reconsideration,” Financial Analysts Journal, Vol. 59, No. 6, pp. 46-53, November/December 2003.
<http://web.mit.edu/~jacquier/www/papers/geom.faj0312.pdf>
This paper develops a model for an unbiased estimator of the true mean of historical returns by weighing arithmetic and geometric means.

16. Jacquier, Eric, Kane, Alex and Marcus, Alan J., “Optimal Estimation of the Risk Premium for the Long Run and Asset Allocation: A Case of Compounded Estimation Risk,” *Journal of Financial Econometrics*, 2005, Vol. 3, No. 1, 37–55
https://www2.bc.edu/alan-marcus/papers/JFEC_2005.pdf
Geometric mean is a superior estimator of mean when sample period and projection periods are long. Asset allocation for retirement plans would be higher for risk free assets when parameter uncertainty is factored in due to estimation risk which increases with the projection period
17. Kan, Raymond and Zhou, Guofu, “What Likely Range of My Wealth Will Be?” February, 2009
http://www.rotman.utoronto.ca/~kan/papers/KZ_Wealth_04.pdf
This paper develops a model for unbiased estimates of range of values of returns where the true mean and standard deviation is unknown.
18. Kocherlakota, Narayana R., “The Equity Premium: It’s Still a Puzzle,” *Journal of Economic Literature*, Vol. XXXIV (March 1996), pp. 42–71
<http://www.econ.ucdavis.edu/faculty/kdsalyer/LECTURES/Ecn200e/Kocherla.pdf>
This is one of the many papers on the ERP puzzle that contains a literature review of various theories to explain the puzzle.
19. Mehra, Rajnish, “The Equity Premium Puzzle: A Review,” *Foundations and Trends in Finance* Vol. 2, No. 1 (2006) 1–81
<http://www.academicwebpages.com/preview/mehra/pdf/FIN%200201.pdf>
Mehra takes a retrospective look at the original paper on the ERP puzzle and explains the conclusion that the equity premium is not a premium for bearing non-diversifiable risk.
20. Mehra, Rajnish and Prescott, Edward C., “The Equity Premium: ABCs,” *Handbook of the Equity Risk Premium*, Elsevier, Amsterdam, 2008.
<http://www.academicwebpages.com/preview/mehra/pdf/Ch01-N50899.pdf>
This is a handbook that goes through a complete explanation of the ERP.
21. Pastor, Lubos and Stambaugh, Robert F., “Are Stocks Really Less Volatile in the Long Run?” (March 22, 2011). AFA 2010 Atlanta Meetings Paper
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1136847
This paper concludes that while mean reversion contributes strongly to reducing long-horizon variance, it is more than offset by uncertainties faced by the investor, especially

uncertainty about the expected return, which will reduce the stock allocations of long-horizon investors in target-date funds.

22. Shiller, Robert, “Online Data,” <http://www.econ.yale.edu/~shiller/data.htm>

This is a source of data including the Shiller earnings yield, a 10 year moving average of earnings yield.

23. Siegel, Jeremy J., “Historical Results I” Equity Risk Premium Forum, November 8, 2001

<http://www.jeremysiegel.com/index.cfm/fuseaction/Resources.ViewResource/type/article/resourceID/6239.cfm>

This is a source of data for historical ERPs.

24. van Bellegem, Sebastien, “Locally Stationary Volatility Modelling,” August 2011

<http://www.vanbellegem.org/research/pub/2011VB.pdf>

This contains a discussion of stationarity of stock market return data over time.

25. Wendt, Richard Q., “Understanding Equity Risk Premium,” Risks and Rewards, No. 38, February 2002, Special Insert <http://publications.milliman.com/publications/life-published/archive/pdfs/Risk-And-Rewards-GARP-PA09-01-02.pdf>

Another actuarial article on ERP – long-run equity returns and ERP are closely tied to long T-Bond yields. A simple linear regression model is a more effective predictor of 15-year equity returns than assuming a constant ERP.