How the Risk Premium Factor Model and Loss Aversion Solve the Equity Premium Puzzle

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Abstract

The term "equity premium puzzle" was coined in 1985 by economists Rajnish Mehra and Edward C. Prescott. The equity premium puzzle in considered one of the most significant questions in finance. A number of papers have explored the fundamental questions of why the premium exists and has not been arbitraged away over time. This paper expands upon the findings implicit in the Risk Premium Valuation Model (Hassett 2010) that the equity risk premium is a function of risk free rates. Since 1960 the equity risk premium has been 1.9 – 2.48 times the risk free rate. The long term consistency of this relationship with loss aversion coefficients associated with Prospect Theory (Kahneman and Tversky, 1979) suggest it as a solution to the equity premium puzzle and support the experimental findings of Myopic Loss Aversion (Thaler, Tverseky, Kahneman and Schwartz, 1997).

Introduction

The equity premium puzzle in considered one of the most significant questions in finance. The term "equity premium puzzle" was coined by Mehera and Prescott in their 1985 paper, "The Equity Premium, A Puzzle,"[1] referring to the inability to reconcile the observed equity risk premium with financial models.

In the analysis, they use short-term treasuries as the risk free rate to calculate the real return on equities over numerous historical periods. They conclude that on average short-term treasuries have produced a real return of about 1% over the long-term, while equities have yielded 7%, implying a premium of about 6% or seven times the risk free return. Unable to reconcile a 7 x premium with financial models, they term it a puzzle.

Since then numerous papers have also attempted to explain the difference, including Shlomo Benartzi; Richard H. Thaler, "Myopic Loss Aversion and the Equity Premium Puzzle"[2] which attempts to explain it in relation of loss aversion as first described in a paper by Daniel Kahneman and Amos Tversky in 1979.[3] They state:

> "The second behavioral concept we employ is mental accounting [Kahneman and Tversky 1984; Thaler 1985]. Mental accounting refers to the implicit methods individuals use to code and evaluate financial outcomes: transactions, investments, gambles, etc. The aspect of mental accounting that plays a particularly important role in this research is the dynamic aggregation rules people follow. Because of the presence of loss aversion, these aggregation rules are not neutral."

Our mental accounting for gains and losses determines how we perceive them.

Loss Aversion

Loss aversion refers to the fact that people are more sensitive to decreases in wealth than increases. Empirical estimates find that losses are weighted about twice as strongly as gains (e.g., Tversky and Kahneman (1992)[4]; Kahneman, Knetsch, and Thaler (1991)[5], Thaler, Tversky, Kahneman, Schwartz (1997)[6]). The pain of losing $100 is roughly twice the perceived benefit of gaining $100, so on average their subjects required equal odds of winning $200 to compensate for the potential loss of $100. In other words, the average subject required a gain of twice the potential loss to take a gamble that had equal chance of loss or gain. This was in stark contrast to the belief that people, as rational beings, evaluated the expected value and would be indifferent to a chance of gaining $100 to losing $100 if the odds were 50/50; if the gain were tilted to be slightly favorable they should take the bet. In reality, losing hurts more; people on average do not find the prospect of gaining $101 along with an equal chance of losing $99 to be an attractive wager. In their experiments, they found that subjects required about $200 to be willing to accept the 50/50 proposition of losing $100. Kahneman won the Nobel Prize in Economics in 2002 after Tversky passed away in 1996. Of course all people do not behave this way all the time, otherwise Las Vegas would not exist!

Loss Aversion and Corporate Decision Making

Incorporating loss aversion into financial thinking is in many ways a significant departure from how finance is often taught and practiced. In business school, I was taught to rely on net present value and expected value. A project with positive net present values should be pursued and that when faced with a range of outcomes, the expected value can be calculated by assigning probabilities to each outcome. The mantra: Pursue all NPV positive projects.

My experience has been that the business world rarely works this way. Due to corporate as much as individual loss aversion, decision makers are often much more risk averse, viewing the consequence of failure much greater than the rewards for success. Investments that have only slightly positive NPV or expected value are usually not pursued. Even the more risk tolerant individuals would tend to avoid risk if the organization takes a very dim view of loss.

This is why it is so important for organizations to employ incentive structures that reward sustainable growth in value and prudent risk taking. My own experience is that organizations without such incentives tend to be very risk averse. When decisions come down the internal calculus that investing successfully results in no reward, while failure results in unemployment or at least limited advancement, investment and growth are sure to slow. I would also argue that this also explains risk taking for traders on Wall Street where outsized rewards are given for success compared to the stigmas and punishments for failure. It's not that traders have high tolerance for risk, it's that in using OPM (Other People's Money) the penalty for failure is small.

Attempts to Solve The Equity Premium Puzzle

As discussed above, Mehra and Prescott(1985) coined the phrase "Equity Premium Puzzle" because they estimated that investors would require a very high coefficient of relative risk aversion (of the order of 40 or 50) to justify the observed equity risk premium of 7%. Mehra and Prescott revisited the topic two decades later with their 2003 paper, "The Equity Premium in Retrospect" where they continued to try and solve the puzzle by comparing real returns and ask whether the equity premium is due to a premium for bearing non-diversifiable risk. They conclude the answer is no unless you assume the individual has an extreme aversion to risk; many times higher than the 2x return seen in the lab.

They approach the problem using a general equilibrium model and compared short-term real risk free rates to observed equity premium. While I am not in a position to opine on the use of these models in evaluating equity premium, for several reasons I will discuss shortly, I believe that the use of short-term real rates is mistaken. I am not surprised they could not explain the rational for investors to such a dramatic disparity, since in my opinion they are not making the right comparison. Rather than using short-term real rates, they should be using long-term nominal rates.

What they did was a bit like measuring the speed of one moving vehicle from another moving vehicle. If Car A is moving at 60 mph and Car B is behind it at 66 mph and car C is next traveling at 61 mph, car C will see itself gaining on car A at just 1 mph. From the perspective of car C, car B is gaining on car A at a rate of 6 mph or 6 x faster than itself. This is all fine unless we care about their speed relative to a neutral observer who is not moving. Relative to the neutral observer, Car B is only going 10% faster than Car A.

Mehra and Prescott did not pick the right relative observation point. By using real returns they are measuring the difference from a moving vehicle. If we look at this from the perspective of real returns then the relative premium looks huge. But if we look at from the perspective of nominal returns, the neutral observer, then the premium it is not unreasonable. This is consistent with both the way individuals have been shown to evaluate gains and losses and with financial theory.

The mental accounting of investors focuses on the nominal returns. It's what investors track and how money managers are compensated. So it makes sense that that proper basis for evaluating the risk premium relative to the risk free rate is long-term nominal returns. For example, let's assume inflation is 2%. If an investor is considering a $1,000 investment with Treasuries at 4%, the yield is guaranteed to be $40 per year with a full return of principal. While the investor is exposed to interim fluctuations in value, the coupon and return of principal are guaranteed. Alternatively, the same investor considering an investment in the S&P 500 Index, would be evaluating the expected return relative to the nominal long-term rate rather than the real short term rate. In this case, expected equity returns of 10% would look good, yielding on average $100 per year rather than $40. If we calculate real returns by subtracting the 2% inflation, the $80 return for equities dwarfs the $20 for treasuries.

Now let's assume that expected inflation rises to 6% and the risk free rate jumps to 8%, so a new $1,000 bond would yield $80. If you applied the same 6% premium for equities, you get an expected yield of $140. Sure the real returns are the same, but doesn't the risky $140 look less attractive compared to a guaranteed $80?

Is it the right thing to track? Maybe not, but it is the reality. If investors compare their returns on equities to the nominal return of other investments, any attempt to explain the premium must compare the relative return as perceived by investors. Nominal not real returns should be used.

Long-term Treasury rates are used in determining cost of capital since they embody the market's best guess on long-term inflation. Even though this means they are not truly risk free, it is the best market estimate of expected interest rate and inflation risk; it is the right reference point. While it's true that using real equity returns accounts for the actual inflation component, it does not account for interest rate risk. In order account for expected inflation, most practitioners use long-term treasuries as the risk free rate. In doing so, they also incorporate a risk factor for interest rates.

Required return can be thought of as follows:

Nominal Equity Return = Real Equity Return + Inflation **(1)**
= Short-term Risk Free Rate + Inflation + Interest Rate Risk Premium + Equity Risk Premium **(2)**

If you subtract inflation from both sides to derive the real required return, you are still left with interest rate risk, which includes risk of unexpected inflation. So by using real equity returns and short-term risk free rate, you still have to account for the interest rate risk premium.

Real Equity Return = Short-term Risk Free Rate + Interest Rate Risk Premium + Equity Risk Premium **(3)**

Essentially, what Mehra and Prescott were calling the equity risk premium, was really the equity risk premium plus the interest rate risk premium.

Some believe that interest rates do not have a material impact on equity returns since inflation will result in earnings growth and since equities are priced as a multiple of earnings, as earnings grow equity prices increase with inflation. As I will discuss later, inflation has a huge impact on equity prices.

In "Myopic Loss Aversion and The Equity Premium Puzzle," Benzarti and Thaler (1995) they posit that the high degree of loss aversion is due to "myopic loss aversion" in that investors are sensitive to interim losses as equity markets fluctuate. They suggest that investors look at nominal returns since that is what is reported, therefore that's what investors look at. They find that a loss aversion factor of 2.25 to 2.78 is consistent with observed risk premiums if investors evaluate their portfolios about once a year and overall results are very sensitive to frequency of evaluation. In "The Effect of Myopia and Loss Aversion on Risk," Thaler, Tversky, Kahneman, Schwarts (1995), looked at this question through lab experiments found that subjects were more loss averse when they evaluated their returns more frequently and that they viewed guaranteed outcomes as a reference point with an evaluation period of about one year (13 months). In other words, investors evaluate their portfolios annually and expect a premium proportionate to the nominal risk free rate. As we will see below the RPF Valuation Model provides real world support for these findings.

Determining the Equity Risk Premium

In introducing the Risk Premium Valuation Model[7] (Hassett 2010), I posited that rather than being a fixed premium, the Equity Risk Premium fluctuates with the risk free rate, maintaining a constant proportionate relationship. The Equity Risk Premium equaled the Risk Free Rate times a constant factor. That factor (Risk Premium Factor) ranged from 0.9 – 1.48 between 1960 and today. So substituting into the formula where Cost of Equity = Rf + ERP,

Cost of Equity = Risk Free Rate + Risk Free Rate x Risk Premium Factor (RPF) **(4)**

Simplifying to:

Cost of Equity = Risk Free Rate x (1 + RPF) **(5)**

The RPF does not change frequently. In fact it has shifted only twice since 1960:

Period	RPF
1960 – 1980	1.24
1981 – Q2 2002	0.90
Q3 2002 – Present	1.48

Table 1: Estimated Risk Premium Factors

A Risk Premium Factor of 0.9 – 1.48, means Cost of Equity equals the Risk Free Rate times 1.9 – 2.48, very close to the findings on loss aversion factors.

The factor was determined by applying a set of simplifying assumptions to the constant growth formula:

$$P = E / (C - G) \text{ or } P/E = 1 / (C - G) \quad (6)$$

Variables and assumptions used are as follows:

P = Price (Value of S&P 500)

E = Actual Earnings (Annualize operating earnings for the prior four quarters as reported by S&P). Earnings, while not ideal, are used as a proxy for cash flow and seem to work very well

G = Expected long term projected growth rate, which is broken down into Real Growth and Inflation, so $G = G_R + I_{LT}$

G_R = Expected long-term real growth rate. Long-term expected real growth rate (G_R) is based on long-term GDP growth expectations on the basis that real earnings for a broad index of large-cap equities will grow with GDP over the long-term. A rate of 2.6% is used with the same rate applied historically.[8]

I_{LT} = Expected long-term inflation, as determined by subtracting long-term expected real interest rates (Int_R) from the 10 Year Treasury, where Int_R is 2%; based on the average 10 Year TIPs Yields from March 2003 – present.[9]

C = Cost of Capital is derived using Capital Asset Pricing Model, where for the broad market, $C = R_f + ERP$

R_f = Risk Free Rate as measured using 10 Year Treasury yields

ERP = Risk Premium Factor (RPF) x R_f

RPF = 1.24 for 1960 – 1980; 0.90 for 1981 – 2001; and 1.48 for 2002 – present. The RPF for each period was arrived at using a linear regression to fit the assumptions above to actual PE. All data used in the analysis is available for download at: http://sites.google.com/a/hassett-mail.com/marketriskandvaluation/Home

Including all assumptions, the formula reduces to:

$$P = E / (R_f \times (1+RPF) - (R_f - Int_R) - 2.6\%) \quad (7)$$

$$\text{Or } P/E = 1/ (R_f \times (1+RPF) - (R_f - Int_R) - 2.6\%) \quad (8)$$

The model explains stock prices from 1960 - 2009 with R Squared around 90%[10] to actual index levels from 1960 – 2009 as shown in graph below.

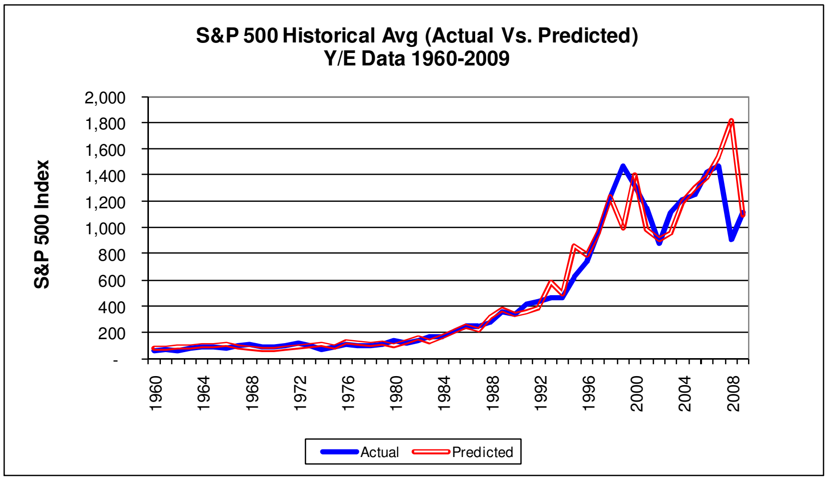

Figure 1: S&P 500 Actual vs. Predicted - 1960- 2009

The model only works if we assume that the Equity Risk Premium is conditioned on the Risk Free Rate, meaning that it gets bigger when the Treasury yields increase and smaller when they shrink. In fact one reason that I suspect many studies compared real returns, rather than nominal returns, may be the belief that inflation does not impact valuation. One common belief is that since profits will grow with inflation, inflation does not matter when discounted back. Another look at the constant growth equation can help understand this thinking:

$$P / E = 1 / (C - G), \text{ where} \quad (9)$$

$$C = Rf + ERP \quad (10)$$

$$G = \text{Real Growth} + \text{Expected Inflation} \quad (11)$$

$$Rf = \text{Real Interest Rate} + \text{Expect Inflation} \quad (12)$$

We can restate the equation for P/E as:

$$P/E = 1/ ((\text{Real Interest Rate} + \text{Expect Inflation}) - (\text{Real Growth} + \text{Expected Inflation}), \quad (13)$$

Expected Inflation is canceled out and:

$$P/E = 1/ (\text{Real Interest Rate} + \text{Real Growth}) \quad (14)$$

Since we assume the Real Interest Rate and Real Growth are a constant over the long term, P/E is also a constant. And, this would be true if the Equity Risk Premium were a constant. But if we assume that the Equity Risk Premium moves with the Risk Free Rate, then we get the relationship charted above, which is a very good fit with historical data.

Impact of Inflation on Value

Some argue that inflation should not have an impact on equity values, since higher costs can be passed on in the form of higher prices, so on average, earnings growth should keep up with inflation. If you assume P/E ratios should be a constant, say, 19 then with earnings of $2.00 share a company would trade at $38.00. With 5% inflation, earnings would grow to $2.10 and the share price to $39.90 – a gain of 5% which just matches inflation.

We get the same result using a constant growth model and a fixed Equity Risk Premium. Let's assume the Equity Risk Premium is 6%, the Risk Free Rate is 7%, which embodies 5% inflation, and real long term growth rate of 2.6%. Using the formula P/E = 1 / (C-G) we get, P/E = 1 / ((7%+6%) – (5%+2.6%) for a P/E of 18.5. If we lower the inflation rate to 2% the risk free rate drops to 4% and we calculate P/E = ((4%+6%)-(2%+2.6%) = 18.5. As shown earlier, any change inflation cancels itself out.

However, if we derive the Equity Risk Premium using the RFP Model, then the Equity Risk Premium varies with inflation. More inflation results in a higher risk premium. Using a 2% real interest rate, Table 2 below demonstrates the impact of inflation on P/E:

Inflation	R_f	ERP	Cost of Equity	G	Predicted P/E
2.0%	4.0%	5.9%	9.9%	4.6%	18.8
3.0%	5.0%	7.4%	12.4%	5.6%	14.7
4.0%	6.0%	8.9%	14.9%	6.6%	12.1
5.0%	7.0%	10.4%	17.4%	7.6%	10.2
6.0%	8.0%	11.8%	19.8%	8.6%	8.9

Table 2: Inflation Drives Valuation

Since investors expect a proportionately higher return over risk free, as inflation rises they apply a greater discount to future earnings, resulting in a lower present value, resulting in a lower multiple.

Back to Loss Aversion

We know that individuals have different tolerances for risk. If the RPF is 1.48, that implies the market as a whole has a loss aversion coefficient of 2.48. That is the average of all investors, not every individual. We would expect some to have lower coefficients and others higher. Gambling addicts destroy their own lives, knowing the odds are not better than even, implying a loss aversion coefficient of less than 1.0**.** Likewise, some people are more risk averse than average. This is one of the factors that act to set price.

The prices for individual stocks are set at the margin. For example, Google closed today at $476 and traded about 2.5 million shares. But with 320 million shares outstanding, that is less than 1%. The price is set by the investors trading that 1%. The implication is that the owners of the remaining 99% think Google is worth more than the current $476 and some number of investors would be will to buy Google at a lower price. Mechanically the way this works is that sellers offer to sell a number of shares at a certain price, called the Ask, and potential buyers offer to buy at a specified price, called the Bid. The Bid for Google might be 200 shares at $476.07 and the Ask 700 shares at $476.18. The difference, $0.11 in this case, is called the Bid-Ask spread. These are the current best offers to buy and sell. For high volume stocks like Google, the Bid-Ask spread is small, just 0.02% in this case. For lower volume equities the spread will generally be higher.

If an investor places a marker order to, say, buy 500 shares, the first 200 shares will be filled at the current Bid price for 200 shares at $476.17. The remaining 300 shares will be filled by the next best ask price, which will be $476.17 or higher. It is not the consensus or average estimate of value that determines the price, but the price at which investors at the margin are willing to buy or sell at any moment. So if I don't own shares of Google and I think it's worth just $400 or even $100, I am not a factor in setting the price. But if in the moment described above, I enter a bid for 200 shares at $476.18, the order is immediately filled and, for that moment, I am the price setter.

Similarly, investors with loss-aversion coefficients at the extremes should not be expected to have much market impact. An investor with a loss aversion coefficient well above 2.5 will be risk averse and have portfolio skewed towards government bonds, while and investor with a loss aversion coefficient near 1.0 will always have a portfolio that is mostly equities. Therefore neither will have much impact on price setting. On the other hand, investors with loss aversion coefficients around 2.5 will be more likely to be shifting their portfolios between bonds and equities and have a larger impact on pricing.

Conclusion

Loss aversion is hard wired into us and drives a number of decision processes that seems to include how investors set prices in the stock market. Thaler, Tversky, Kahneman, Schwarts (1995) found evidence of what they called Myopic Loss Aversion and demonstrated the expectations of risk premiums were consistent experimental findings for loss aversion if portfolios were evaluated annually. The Risk Premium Factor Valuation Model (Hassett 2010) provides real world evidence that the market actually behaves this way. Combing evidence that the risk premium varied with the risk free rate in a proportion consistent the findings in behavioral studies, suggests that Loss Aversion is the answer to the equity premium puzzle.

Endnotes

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[4] Kahneman, D., A. Tversky. 1992. Advances in Prospect Theory: Cumulative Representation of Uncertainty. *Journal of Risk and Uncertainty*, 5:297-323.

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[6] Thaler, R., A. Tversky, D. Kahneman, and A. Schwartz. 1997. "The Effect of Myopia and Loss Aversion on Risk Taking: An Experimental Test." *Quarterly Journal of Economics*, vol. 112, no. 2

[7] Hassett, S. D. (2010), The RPF Model for Calculating the Equity Market Risk Premium and Explaining the Value of the S&P with Two Variables. *Journal of Applied Corporate Finance*, 22: 118–130. http://bit.ly/d6b1Py

[8] "Economic Projections and The Budget Outlook." Whitehouse.gov, Access Date March 15, 2009, http://www.whitehouse.gov/administration/eop/cea/Economic-Projections-and-the-Budge-Outlook/

[9] "H.15 Selected Interest Rates", The Federal Reserve Website, Accessed March-July 2009, http://www.federalreserve.gov/datadownload/Choose.aspx?rel=H.15

[10] See Hassett (2010)

