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The Equity Premium Puzzle: A Behavioral Perspective

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Introduction

In finance we refer to the Equity Premium Puzzle meaning the empirical observation of returns in stocks markets in the last century were greater than government bonds; specifically, the average equity premium was about 6%, where the average short-term government bond's return was approximately 1%.

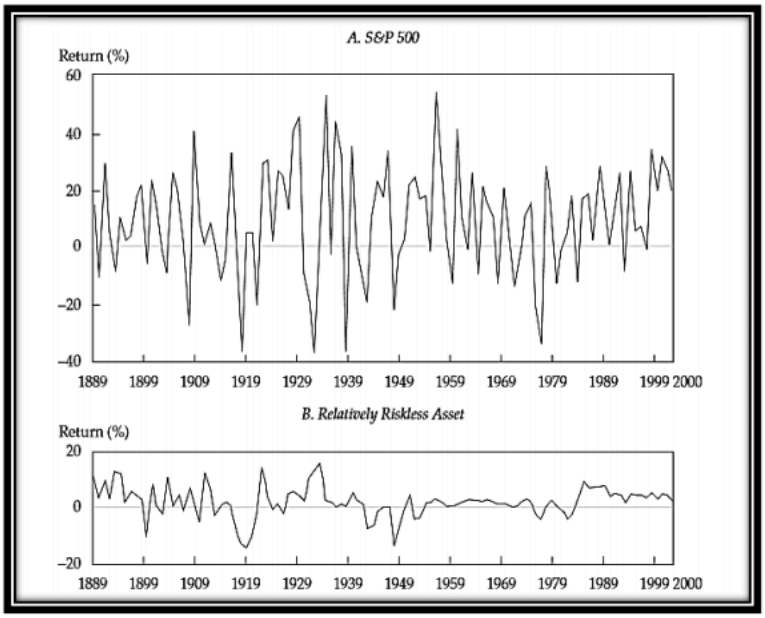


Table 0 "S&P returns and riskless activities returns"
Mehra and Prescott (1985)

This chart shows the S&P 500 Index in U.S. from 1889 to 2000 and at the same time, it also shows the trend of the riskless activities in the same time frame. For the latter ones Mehra and Prescott take in analysis the U.S. Government bonds. It is evident how the first ones have a return of approximately 6% while the other ones about 1%.

During the years, economists questioned themselves about the reason behind this wide differential and if theoretical assumptions brought to that measurements. The straightforward question is whether the traditional financial-economic models are sufficient to explain the markets observations.

If we take as example the CAPM we will see that every activity is priced according to the relative riskiness related to it, so we can say that generally speaking the riskier an activity the greater the return associated with it should be.

However, in the 80's the two American economists found out that the equity premium was to high compared to the riskiness associated with those titles.
In finance this is defined as "equity premium puzzle" and has been introduced in 1985 to highlight the fact that investors consider the investments in stocks to be too risky. The investors judgment is based on the evidence that the stocks value fluctuates much more if compared with other kind of safer investments like bonds; at the same time stocks allow to earn much more in the long run. We speak of premium associated to equity because the greater gain implied in these investments seem to be a "prize" for the investor who decided to face the high volatility and high risk of this financial activity.
The conclusion is that stocks appear to be much more profitable than any other investments but being considered riskier by investors, stocks have a minor role in investments portfolios. The economic theory suggests that investors should exploit the clear arbitrage opportunity represented by the difference between the equity premium and average return of government bonds. The investor should be attracted by the high premium risk and this would imply a higher demand of stocks. This would end in increasing the stocks titles prices, being the return a measure of the gap between the current price and the future price, an increase in current price decreases the expected return, and with that the premium risk. In an equilibrium this would reduce the gap between the premium for the risk of stocks and the return rate of riskless activities, until the point where that gap reflects the premium for risk demanded by an investor in order to invest ins stocks, given their greater riskiness.
To explain this contradiction, I went through the traditional theoretical background starting with Mehra and Prescott Empirical Analysis, presenting then the behavioral finance perspective and concluding with the Thaler's and Benartzi's work concerning the study of myopic loss aversion in order to "solve" the equity premium puzzle.

1. Problem Statement and Definition

The first definition of the Equity Premium Puzzle by Mehra and Prescott in 1985 was that of the incapacity of the traditional consumption pricing model (CAPM)[1] to produce the large equity premium found in US data from 1889 to 1978. Given that stocks imply a higher risk than bonds they should also provide a higher potential return to compensate the investors who are willing to take the risk. This is argued by Mehra and Prescott on a theoretical perspective but they fail to find the empirical results to enforce this, given that in the data examined the stocks are not enough riskier than bonds to justify the equity premium shown.

So, if on a theoretical and qualitative level the Equity Premium is intuitive and proficiently described by math formulas, on a quantitative level applied to real cases becomes a "puzzle".

I will go through the description and explanation of the theoretical background used to calculate the equity premium risk and provide the empirical results of Mehra and Prescott, after which I will present the historical attempts to explain the Equity Premium Puzzle.

1.1 Theoretical Background

This part will concern the main theoretical frameworks that were applied in the study of the Equity Risk Premium.

1.2 The Capital Asset Pricing Model

The Capital Asset Pricing Model (CAPM), developed by Sharpe and Lintner[2] (1964-65), assumes that a typical investor's consumption is perfectly correlated with the stock market return describing the relation between systematic risk and expected returns for assets, usually stocks.

[1] Based on Lucas pure exchange model

[2] See also Black (1972)

CAPM provides for each asset a beta coefficient describing the expected excess stock return and the excess return on the market portfolio, meaning that the beta of a potential investment measures how much risk the investment is adding to a portfolio equal to the market. If a stock is riskier than the market the beta will be greater than 1 while if a stock has a beta less than 1, the model is assuming it will reduce the portfolio risk.

So the formula for calculating the expected return of an asset given its risk is described here:

$$ER_i = R_f + \beta_i(ER_m - R_f)$$

Where: *ERi = expected return of investment*

Rf = risk-free rate

Bi = beta of investment

(Erm – Rf) = market risk premium

1.2.1 The Representative Agent Model – Consumption CAPM

On the contrary of the Capital Asset Pricing Model, in which we saw the assumption of the typical investor's consumption being perfectly correlated with the return of the stock market, Lucas (1978) formulated a "representative" agent model of asset returns in which the per capita consumption is now perfectly correlated with the consumption of the typical investor.

The main suggestion of this theory is the intertemporal perspective where consumption today and consumption in another future time are regarded as inherently different goods. The prices of these goods are assessed on the basis of the rate of substitution of individuals for the goods [3].

[3] And the possible capacity of business to transform the goods in each other

In the Consumption Capital Asset Pricing Model (CCAPM)[4] is used a consumption beta replacing the market beta to explain expected return premiums over the risk-free rate. This consumption beta is assessed on the basis of the volatility of a certain stock and the return premium of an asset has to be proportional to its consumption beta.

The formula for the Consumption Capital Asset Pricing Model Is:

$$R = R_f + \beta_c\,(R_m - R_f)$$

Where: R = Expected return on a security

Rf = Risk-free rate

Bc = Consumption beta

Rm = Return on the market

So While the CAPM formula relies on market portfolio return the CCAPM relies on aggregate consumption.

In the above mentioned paper of 1985, Mehra and Prescott presented a problem with the empirical observations for the representative agent model: They found that in the examined period of 1889-1978 the average annual return of stocks was approximately 7% while the average annual return of U.S. Treasury bonds [5] was approximately 1%.

They display that the difference in the covariance of these returns with consumption growth would be wide enough to explain the returns difference only if investors are enormously risk averse[6]: so on a quantitative perspective the

[4] Lucas and Breeden

[5] They referred to T-Bills: short term U.S. government debt obligation

[6] Chaper 2 will go through loss aversion bias and other behavioral issues

stocks are not enough riskier than the Treasury bonds to make the spread in their returns justifiable.

1.2.2 Empirical Results of Mehra and Prescott

As presented above, in 1985 the American economists Mehra and Prescott found this anomaly concerning the stocks and bonds returns on New York Stock Exchange: in the period 1889-1978. In the examined period the average real annual return of SP's 500 Index was 7% while the average real annual of Bonds was 1%. The question they placed was : is possible to consider the difference (about 6%) as premium for the risk, hence that prize which goes to compensate the stocks investors for the higher risk taken compared to the risk taken by bonds investors? Making use of traditional finance tools the authors had achieved a risk premium of approximately 1%, so, how can we justify that 6% coming from the empirical results? That is the "puzzle". We have to notice that this anomaly of excessive returns does not concern only the American market but is visible in other markets: the annual return of stocks market in UK in the post-war period was 5.7%, providing a great 4.6% risk premium and the results are similar for other countries.

Table 2

Equity Premium in Different Countries

Country	% real return on a market index	% real return on a relatively riskless security	% equity premium
	Mean	Mean	Mean
UK (1947-1999)	5.7	1.1	4.6
Japan (1970-1999)	4.7	1.4	3.3
Germany (1978-1997)	9.8	3.2	6.6
France (1973-1998)	9.0	2.7	6.3

Source: U.K from Siegel (1998), the rest are from Campbell (2001)

Table 1.1 from Mehra and Prescott " The Equity Premium In Retrospect" 2003

This data strengthen what said above, the 4.6% of premium for UK and the other differences noticed for Japan, Germany and France and also the content of Mehra's work of 2003 "The Equity Premium: Why Is It A Puzzle?" Proving how from the post-war period until the new century, different anomalies were detected in the returns of both European and US and Japan Markets.

	% growth rate of per capita real consumption		% real return on a relatively riskless security		% risk premium		% real return on S&P 500	
Time periods	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
1889–1978	1.83 (Std error = 0.38)	3.57	0.80 (Std error = 0.60)	5.67	6.18 (Std error = 1.76)	16.67	6.98 (Std error = 1.74)	16.54
1889–1898	2.30	4.90	5.80	3.23	1.78	11.57	7.58	10.02
1899–1908	2.55	5.31	2.62	2.59	5.08	16.86	7.71	17.21
1909–1918	0.44	3.07	−1.63	9.02	1.49	9.18	−0.14	12.81
1919–1928	3.00	3.97	4.30	6.61	14.64	15.94	18.94	16.18
1929–1938	−0.25	5.28	2.39	6.50	0.18	31.63	2.56	27.90
1939–1948	2.19	2.52	−5.82	4.05	8.89	14.23	3.07	14.67
1949–1958	1.48	1.00	−0.81	1.89	18.30	13.20	17.49	13.08
1959–1968	2.37	1.00	1.07	0.64	4.50	10.17	5.58	10.59
1969–1978	2.41	1.40	−0.72	2.06	0.75	11.64	0.03	13.11

Table 1.2 Mehra and Prescott : The Equity Premium : A Puzzle, 1985

In *Table 1.2* are shown all the historical data sets used by Mehra and Prescott to detect the puzzle.

In the first column is possible to see the years we refer to, in the second column is possible to see both the mean and the standard deviation of the per capita real consumption growth rate. In the third column again the mean and the standard deviation but for the return rate on a riskless security. In the fifth column we find the difference between the riskless return means and the stocks return's means resulting in the risk premium which in this case is 6.18%. Of course the puzzle implies to research the motivation of this difference.

Many solutions were proposed during the years, it was even argued that the result could be a mere statistical illusion while other ideas argued how the preferences of investors for more or less liquid activities were to be considered as crucial.

Mehra in his 2003 "The Equity Premium: Why is it a puzzle?" argued that the equity premium puzzle was real and no solution was possible.

[…]"so obviously, stocks are considerably riskier than bills. But are they? Which of these interpretations of the equity premium is relevant for an investment advisor? Clearly, the choice depends on the planning horizon. The equity premium documented in our 1985 paper reflects very long investment horizons. It has little to do with what the premium is going to be in the next couple of years. The ex post equity premium is the realization of a stochastic process over a certain period, and it has varied considerably over time. Furthermore, the variation in the realized premium depends on the time horizon over which it is measured. Before the equity premium is dismissed, not only do researchers need to understand the observed phenomena, but they also need a plausible explanation as to why the future is likely to be any different from the past. In the absence of this explanation, and on the basis of what is currently known, I make the following claim: Over the long term, the equity premium is likely to be similar to what it has been in the past and returns to investment in equity will continue to substantially dominate returns to investment in T-bills for investors with a long planning horizon."[7]

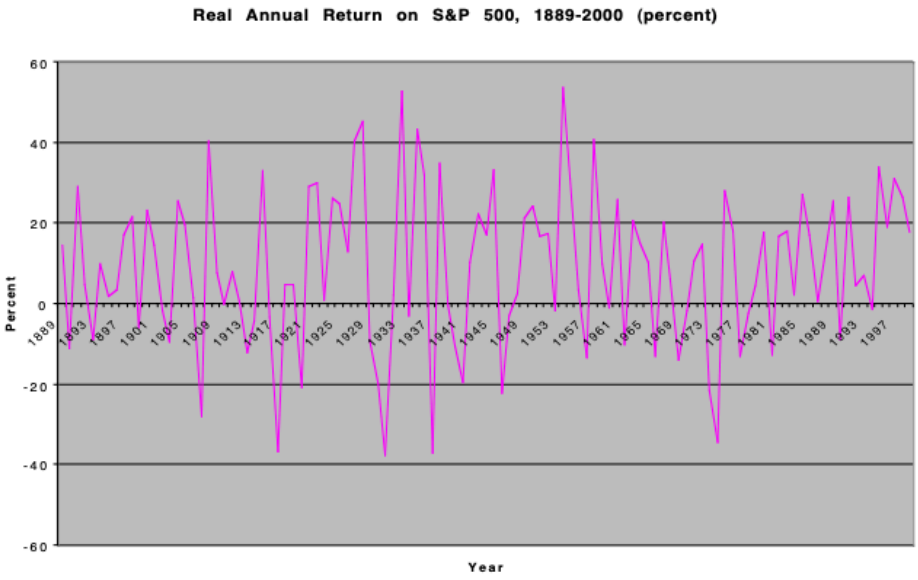
Table 1. U.S. Returns, 1802–2000

	Mean Real Return		
Period	Market Index	Relatively Riskless Security	Risk Premium
1802–1998	7.0%	2.9%	4.1 pps
1889–2000	7.9	1.0	6.9
1926–2000	8.7	0.7	8.0
1947–2000	8.4	0.6	7.8

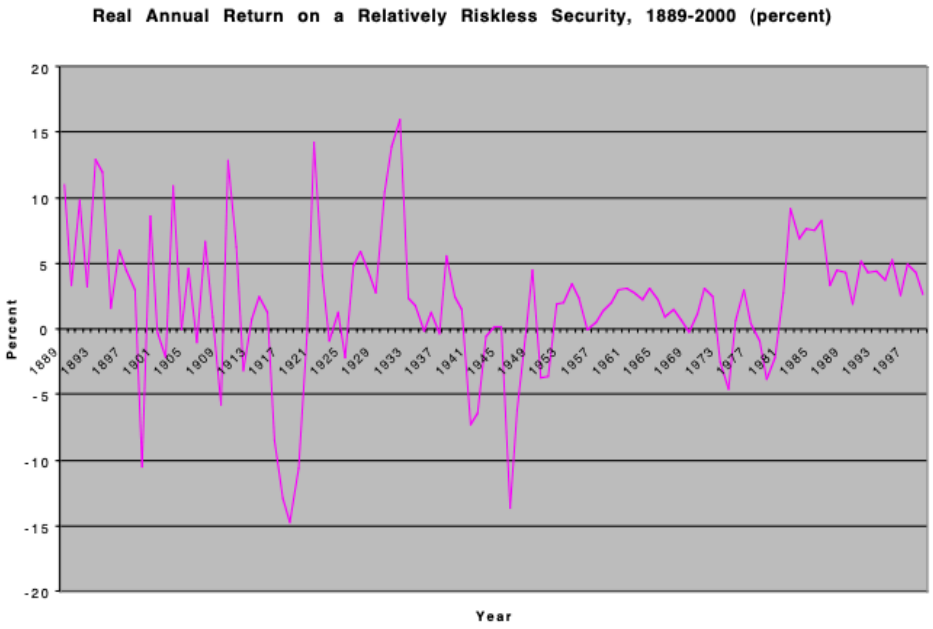
Table 1.3 S&P 500 Index returns 1802-1999 from Mehra and Prescott (1985)

[7] *Mehra (2003)*

In table 1.3 we can see the U.S. situation in 1802-1999 period. For the American market we have average returns for stocks of approximately 7% and what brings to this high difference from 1920 seems to be the incredibly low return of riskless activities. In other countries the risk premium is not that high, even if all these data coming from different markets all point to a specific anomaly. The model predicts that with so low riskless rate, consumers should have saved less and consumption should have increased as a consequence.[8]



[8] *Bailey (2005)*



Tables 1.4,1.5 from Mehra and Prescott "The Equity Premium In Retrospect" (2003)

These two tables reporting in detail the returns of the two financial activities analyzed by Mehra and Prescott can help to understand how stocks volatility was historically higher than riskless activities volatility. This has led to question whether the premium difference could be justified by the implied risk that comes with stocks investing, but if comparing the theory with empirical evidence it seems obvious that simple volatility is not enough to justify a so wide premium difference.

"Why have stocks been such an attractive investment relative to bonds? Why has the rate of return on stocks been higher than that on relatively risk-free assets? One intuitive answer is that since stocks are "riskier" than bonds, investors require a larger premium for bearing this additional risk; and indeed, the standard deviation of the returns to stocks (about 20% per annum historically) is larger than that of the returns to T-bills[9] (about 4% annum), so, obviously they are considerably more risky than bills! But are they?"[10]

[9] *U.S. Bonds*
[10] *Mehra, (2006)*

Obviously, there is something else that should be analyzed to address this puzzle and achieve a solution: human behavior and behavioral finance theories. On this subject a solution was proposed by Benartzi and Thaler in 1995. Their theory is based on behavioral finance theories, applying the prospect theory they clai that an explanation based on myopic loss aversion could clarify the puzzle. Benartzi and Thaler speculate that investors evaluate their portfolio in a myopic perspective, hence considering a really short time period and on this time period the individuals are biased by loss aversion[11]: a negative impact in utility of loss of X is greater, in absolute terms, of a positive impact on utility of a profit of X. Benartzi and Thaler justify their assumptions and proposal on the basis of experimental results achieved by Kahneman and Tversky in 1981[12].
These and other behavioral hypothesis will be discussed in the second chapter, while we will go through different proposed solutions in this first chapter.

1.3 Conclusions of Mehra and Prescott Work

The conclusions included in the prominent 1985 paper by Mehra and Prescott imply a question: not for the high stocks returns but for the very low average returns observed for the riskless assets.[13] As we said, the authors noticed how the the risk premium implies a strong risk aversion in the investors. The ,so wide, difference between the two yields seems leading to a rare behavior in the market, is not trivial to explain why financial investors, having a long-term range of investing perspective, do no take the opportunity to leverage the high stocks returns, but instead they focus on lower returns coming from riskless assets. This

[11] *See chapter 2*
[12] Kanheman,Tversky,(1981)
[13] Mehra and Prescott (1985)

could make assume that individuals have a strong perception of risk when it comes to historical performance of stocks in the market. Even the wording "risk premium" bring to the obvious understanding that the "prize" is not given to the investor choosing to invest in "safe" bonds but to the investor who chooses the "risky" stocks. The risk is rationally attributed to the fact that stocks fluctuate and will fluctuate in their future, which makes them economically riskier than other financial products. If we think at Markowitz link between risk and return[14] : its "obvious" that to a greater risk is linked a greater return, hence that perception is concrete and not only perceived.

So, the stocks have higher enough returns to make the investment look profitable but the risk perceptions linked with stocks makes the investors prefer other assets, in this case riskless assets.

Is safe to think that the equity premium risk key is the level of risk aversion of investors which seems to be extremely high. In their first paper they leave the "puzzle" unsolved[15], meaning that the financial economic models are not sufficient to explain what is happening on the financial market and this is what gave space to different proposals of solution. This is initial study of the puzzle was analyzed by many economists, who have tried to solve the premium puzzle. The result achieved by Mehra and Prescott in the first paper is based upon a general economic equilibrium model based on an agent endowed of utility function "u", so that:

$$u(C_t, t) = \delta_t \frac{C_t^{1-\gamma}}{1-\gamma}$$

[14] Markowitz Model (1952)

[15] Mehra and Prescott (1985), they define it " unsolved problem"

Where:

- **δt:** *subjective discount factor associated with the time "t"*
- **Ct:** *consumption at the time "t"*
- The γ is the relative coefficient of risk aversion present in the representative agent, providing a measure of how much in average the market operators are willing to give up consumption in the best condition (high market returns..) in order to achieve higher consumption levels in worse conditions.

As outcome of their work, the authors find a value of 10, when the theory suggests that the value should be between 0 and 1, concluding that the equity premium puzzle as a "puzzle" concerning the risk aversion as the most important determinant.

The intertemporal substitution elasticity of consumption $\frac{1}{\gamma}$ measures the willingness to give up to part of today's consumption in order to increase future consumption. Hence, the same parameter γ puts in relation two different aspects of financial operator's preferences: the propensity to transfer the consumption between different conditions, from the better ones to the worse ones, and the propensity to transfer consumption in time. Some have argued that the equity premium puzzle could arise because of the inability of a model based on a single parameter to adapt to the different preferences of financial operators, which imply the different aspect described above.

Concluding, we can argue that Mehra and Prescott in 1985 define the equity premium puzzle as a financial mistery and the the empirically observed difference is to wide to be only the result of investors risk aversion and the prize should be smaller than the one observed historically.

1.4 Historical Proposals To Solve The Equity Premium Puzzle

Over the years, we can notice many proposals and attempts to solve the puzzle, Mehra and Prescott provided a great theoretical framework to work on but according to Kocherlakota (1996) all the attempts should give up at least one of the three main assumptions on which the representative agent model (of assets returns) is based : 1) asset markets are complete 2) asset trading is costless 3) agents have preferences associated with the utility function.

In this part I will go through some explanations of the puzzle, ending with the alternative explanation on which I focus in this thesis: myopic loss aversion.

1.5 No Transaction Costs Assumption

The model developed by Mehra and Prescott has the assumption of costless asset trading, so that trading financial securities implies no costs. Of course, in the real world this is not feasible, where investors will face fees and constraints. The relief of this assumption was thought to be a possible solution for the puzzle: Kocherlakota (1996) claimed that being the investors constrained on borrowing this will bring to a lower demand of loans, making the average interest rate decrease. This clearly would widen the difference average return of equities and the riskless activities returns (given the now lower interest rate and assuming no changes in the equities returns).

Heaton and Lucas (1995) on the contrary argue that constraints on the trading activity of investors do not have that impact on the equity premium, because the typical investors face constraints in the bond market and in the stock market too, and with correspondent constraints on bonds investment and stocks the expected return in both markets would decrease proportionally preserving the equity premium.

In the real world there are many levels of expenses linked with asset trading making the no trading costs assumption questionable, of course investors in the

long term have the opportunity to amortize those expenses but when investors are forced to sell investments earlier , the time frame is too short to amortize the costs. Hence, the equity premium should be higher to balance those costs.

Papers from Aiyagari and Gertler (1991) and from the above mentioned Heaton and Lucal claimed that only a very wide difference in the cost of equity trading relative to bond trading could explain the equity premium and Kocherlakota shows that this wide difference in costs is not supported by the empirical observations and hence the relief of the no transaction costs assumption cannot solve the equity premium puzzle.

1.5.1 Complete Markets Assumption

Mehra and Prescott assume that markets are complete: one of their key assumptions is that the behavior of per capita consumption growth is a proper proxy for the behavior of individual consumption growth, which is true only with complete markets. The assumption of complete markets embeds the possibility for agents to insure against eventualities which in the case of the consumption based representative agent model of Mehra and Prescott, allows the consumers against variations in their consumption flow. The assumption is crucial when using the per capita consumption as a measure of consumption for the representative agent given that agents will make us of the financial markets in order to diversify against any uncommon differences between their own consumption growth and aggregate consumption growth making the two equal.

Some argue that the relief of this assumption could solve the equity premium puzzle arguing that if markets are not complete making the investors not able to hedge the different possible fluctuations in their consumption

flow, then they would be facing a much more volatile consumption flow than what is provided by per capita consumption. Given that Mehra and Prescott showed in their model that the equity premium is equal to risk aversion multiplied by the variance of the consumption flow, the premium demanded by investors would be higher with higher consumption volatility, but Mehra and Prescott empirical

finding was that the variance of consumption was not high enough in order to explain the premium.

Weil in 1992, proposed a two-period model in which markets are not complete implying that changes in income are reflected in the consumption stream. He argues that the extra changes in individual consumption growth given by the absence of markets helps explain the puzzle.

While Kocherlakota (1996) claims that two-period models are not complete because they cannot capture the dynamic self-insurance which is a process by which individuals neutralize fluctuations in income and hence in consumption by increasing and decreasing savings so that they do not have to take the whole income risk into consumption. In this way investors can level consumption successfully if only income shocks are not too permanent. But if the income shock is permanent, dynamic self-insurance has no way to play that role and income shocks must be wholly reflected into consumption.

Heaton and D. Lucas found that income shocks are in fact not permanent given that "idiosyncratic income shocks is around 0.5"[16] meaning that income shocks decrease after some time.

Many empirical applications of dynamic incomplete markets models[17] have confirmed that individuals can approximate the allocations in the complete markets by using the dynamic self-insurance, hence, even though the complete markets assumption is unrealistic, the empirical results mentioned show that equity premium should not be affected by market incompleteness.

1.5.2 Alternative Preference Structure

We have seen how the relief of the Complete Markets Assumption and the No Transaction Costs Assumption could not solve the puzzle and could not refuse the empirical results of Mehra and Prescott.

[16] Heaton and Lucas 1995 , " autocorrelation of 1 implies a permanent income shock" the empirical analyzed was 0.5 , hence it was not permanent

[17] Kocherlakota, Telmer (1993), Lucas (1994), Heaton and Lucas (1995), Macet and Singleton (1991)

We will now go through the third assumption, concerning the preferences of the representative agent model and the consumption CAPM[18]. I will briefly explain two modifications to 1.1.4 and later add the main one of this thesis, namely: Myopic Loss Aversion.

1.5.3 Habit Formation

In 1.1.4 we assume that the level of consumption in period *t*-1 does not affect the marginal utility of consumption in period *t.* However it could be claimed that if an individual has high consumption in *t*-1, he would get used to this level of consumption making him desire the same consumption level to be achieved in period *t.* Constantinides proposed[19] a utility function implying this modification so that once an individual is used to a certain consumption level, that consumption level constitutes a "habit". Hence, more than the absolute level consumption variations, the variations from the "habit" level will matter for the individual making the utility of today's consumption a decreasing function of yesterday's consumption. The key implication of this modification is that savings demand will be higher than in Mehra and Prescott Model given that individuals for all levels of today's consumption have an increasing desire for future consumption, hence a proper level of savings is crucial for their utility. This savings demand will drive down interest rates providing a low risk-free rate, even if is still mandatory for individuals to show risk aversion towards consumption risk in order to explain the wide equity premium.

In 2003 Mehra and Prescott argued that the puzzle was still no explained claiming that even with a lower risk aversion level, Constantinides proposed a $\alpha = 2.81$, the sensitivity to consumption risk is five times α.

The explanation to this is that even if according to Constantinides the model is generating a high equity premium with a still low level of risk aversion, we have to assume that individuals (agents) will be demanding today's consumption to

[18] See 1.1.4
[19] Constantinides 1990

exceed yesterday's consumption. So even if wealth risk may be low, consumption risk aversion should be extremely (improbably) high to solve the puzzle.

1.5.4 Keeping Up With the Joneses

Before explaining Abel attempt to explain the puzzle we must mention Duesenberry who in 1949 assumed that agent's utility did not depend on their consumption like in 1.1.4 but that they depend on the aggregate level of consumption in the economy too, a preferences type called "keeping up with the Joneses".[20]

Abel in 1990 applied this preference type to explain the equity premium puzzle : in this environment an individual decision on investments will depend on one hand on the consumption risk but on the other hand on the general consumption growth in the society of that individual thus making the utility function to include individual consumption relative to per capita consumption at time *t* as well as time *t*-1.

This made possible the estimation of risk aversion linked with individuals as well as per capita consumption. The model's solution for the puzzle would be that investors, assumed a high enough sensitivity of marginal utility towards the variability in per capita consumption, do not need to have high risk aversion when it comes to individual consumption risk. Hence, investors do not find stocks not attractive because of them being risk averse to individual consumption but because their risk aversion towards per capita consumption.

Kocherlakota argues that the relief of the preference structure of Mhera and Prescott in this new modification is not bringing much of a solution given that in the original one investors were extremely risk averse , in this one they are not but at the same time they are extremely averse to all the marginal variations in the per capita consumption (which is the only way to justify the wide equity premium).

[20] *From Collins dictionary " If you say that someone is keeping up with the Joneses, you mean that they are doing something in order to show that they have as much money as other people, rather than because they really want to do it."*

1.5.5 Generalized Expected Utility

As seen in the 1.1.4 the coefficient of relative risk aversion has to be equal to the reciprocal of intertemporal substitution elasticity, so that those individuals sensible to consumption changes in different states will be averse to changes in consumption over time. Some studies have suggested that this assumption was too strict and that could be the cause of the equity premium puzzle.[21]

One of those studies came from Epstein and Zin in 1989 who proposed a concept of generalized expected utility preferences, that implied a preference structure allowing the relief of risk aversion from the intertemporal substitution elasticity. The model provided that utility of agents was linked in part to the total wealth and to the return on the agent's total assets portfolio. Even if this return is not observable in practice, Epstein and Zin use the market return as a surrogate. Assuming equilibrium the equity premium depends on the covariance of asset returns with both consumption growth and the return on total assets portfolio.

It comes crucial the fact that agents can be risk averse without demanding the consumption to be smooth over time, in 1991 Epstein and Zin argue to be able to solve the puzzle on an empirical perspective, something that was challenged by Mehra and Prescott in 2003 arguing that Epstein and Zin overstated the correlation between return on total assets and the return on market portfolio.

Kocherlakota supported this by claiming that the market portfolio underestimates the level of diversification of the total assets portfolios of agents and hence overestimates the correlation between marginal rate of substitution and stock returns and that high covariance was the reason why Esptein and Zin could explain the equity premium puzzle with moderate risk aversion.

[21] Epstein and Zin (1990), Hall (1985), Zin (1987), Attanasio and Weber (1989)

2. Behavioral Finance

2.1 What is Behavioral Finance?

Looking at stock markets it is easy to see fast moving prices and rapid changes in very short amount of time: it could take as little as few hours to gain or lose double digit percentages. If we think about market value theory, that implies at long term perspectives of companies analyzed on the basis of output, growth and fundamentals which do not change as quick as the changes we find in stock markets. Financial markets are not stable, which is usually linked with the investor's expectations about the future.

John Maynard Keynes used the term "Animal Spirits" in his masterpiece "The General Theory":

"... Most, probably, of our decisions to do something positive, the full consequences of which will be drawn out over many days to come, can only be taken as the result of animal spirits - a spontaneous urge to action rather than inaction, and not as the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities"[22]

This term was effectively used to explain the behavior of an individual beginning the undertake of a business venture having as main driving force his personal intuition and motivation to have success, without necessarily having done all the economic analysis or market research needed to take a more rational choice (which would still not grant him better chances in a unpredictable future).

This instinctive mass behavior was shown during the '29 crisis, which was preceded by market euphoria and optimism.

With classical economic theories, this kind of behaviors are not easy to rationally understand but behavioral finance provides explanations not assuming the perfect rationality of all individuals but considering the existence of irrational individuals in the financial markets and in society.

[22] Keynes 1920

Economics like the other social sciences, has the objective of helping the individual to better understand the socially constructed world, and classical economic principles were born to describe and explain economic relations. These principles usually stem from hypothesis, often not explicit and behavioral economics (or finance when talking about financial dynamics) help to fully understand them by adding more realistic and psychological basis.
So Behavioral Economics does not replace the fundamental principles of the theory but it adds more points.

Behavioral Finance and Behavioral Economics are strictly linked to each other, applying scientific research in cognitive psychology scope to the understanding of economic decisions and how this affects market prices and resources allocation. They both focus on irrationality of economic agents.
During the classical period, economics had a strong bond with psychology actually, the perfect example of this was the Adam Smith work of 1759 "The Theory of Moral Sentiments" in which the author explains the psychological principles of individual behavior. During the neo-classical period the economists began to step away from psychology when trying to consider the economic discipline as a natural science, explaining economic behavior on the basis of the nature of economic agents. Hence the focus was more on rationality of agents even if some psychological explanations were still supported by some important names of neo-classical economy like Edgeworth, Pareto, Fisher and Keynes. If in the first part of XX century psychology was rare or not even present in the economic research, in the second part different economic anomalies observed brought to challenge those rational assumptions. The psychologists in this field like Edwards and Tversky and Kahneman began comparing their cognitive models of the decisional process under risk with rational behavior economic models.
The most important work in that field was written by Kahneman and Tversky in 1979, "The Prospect Theory: Decision Making Under Risk". This work used cognitive psychology models to explain different anomalies in the rational

decision process. The prospect theory is an example of generalized expected utility theory.

Like behavioral economics, the generalized expected utility theory is motivated by doubts about the accuracy when describing human behaviors. The classical models limit the analysis about choices and individual capacities to standard hypothesis while the behavioral approach brings the individual at the core of the analysis making him the possible explanation of observed market anomalies.

The main issue with classical finance is the assumption that markets are populated by perfectly rational individuals with a clear knowledge of economic structure and principles, this rationality implies two things :

- When the individual receives an information, the agents (individuals) update in a correct manner their beliefs
- Once they have updated their beliefs is the moment to take action [23]

This diagram is very simple and would be satisfying if its forecast were confirmed by empirical data but it is now clear how in the stock market and average individual return this logic does not work.

To conclude, we can say that in the classical diagram we find rational agents hence the price perfectly reflects the fundamentals given by the sum of all possible cash flow since investors are capable of defining and update all the available information. This theory suggests us that “the prices are right”. The behavioral finance supporters do not fully agree and is undeniable that the market presents deviations from the fundamental value, and these deviations are cause by individuals who do not operate in the market in a perfectly rational manner.

2.2 The Prospect Theory

[23] Thaler (2005)

To solve the inconsistencies arised between the expected utitility model and and the empirical results, the two isreali-american psychologists created a new decisional theory putting together psychology and economics. The expected utility theory provides a theoretical model on how individuals should take optimal decisions while the prospect theory has as its objective to explain the decisional processed leading individuals to take sub-optimal decisions.

They began their work by studying the empirical violations of the expected utility theory basic axioms and they found the following:

The individuals involved in the experiments do not respect the expected utility substitution axiom according to which if B is preferred to A, any option (B) should be preferred to any option (A). And it is violated also when a win is possible but not likely and most of the individuals choose the prospect offering the biggest win and not the most likely win.[24]

Individuals think in term of loss and gains, hence in the deviation compared to a reference point but not in terms of total wealth changes (W). The utility of a decisions is given by the changes in wealth related to that reference point, called status quo, and not by a final state of wealth achieved like in the utility theory.

The reference point can be a status quo or also a level psychologically perceived as acceptable and changes in that point mean changes in the perception of the prospect , defining the prospect as the combination of alternatives among which the individuals has to take a decision.[25]

In some of the problems presented to the participants during the experiments the options were equal but with opposite sign and the preferences among the negative prospects result to be the mirror of the preferences in the positive prospects.

[24] Tversky, Kahneman,1979

[25] Levy, 1992

TABLE I

PREFERENCES BETWEEN POSITIVE AND NEGATIVE PROSPECTS

	Positive prospects			Negative prospects		
Problem 3:	(4,000, .80)	<	(3,000).	Problem 3′:	(−4,000, .80)	>	(−3,000).
$N = 95$	[20]		[80]*	$N = 95$	[92]*		[8]
Problem 4:	(4,000, .20)	>	(3,000, .25).	Problem 4′:	(−4,000, .20)	<	(−3,000, .25).
$N = 95$	[65]*		[35]	$N = 95$	[42]		[58]
Problem 7:	(3,000, .90)	>	(6,000, .45).	Problem 7′:	(−3,000, .90)	<	(−6,000, .45).
$N = 66$	[86]*		[14]	$N = 66$	[8]		[92]*
Problem 8:	(3,000, .002)	<	(6,000, .001).	Problem 8′:	(−3,000, .002)	>	(−6,000, .001).
$N = 66$	[27]		[73]*	$N = 66$	[70]*		[30]

Table 2.1 Kahneman and Tversky, 1979

Hence, reflecting the prospects based on 0 changes the order of the preferences according to the *reflection effect* (Tversky and Kahneman, 1979) . This tells us how individuals treat loss differently from gains: they tend to be seeking risk when it comes to loss and risk averse when it comes to gains. The utility function will be concave for gains and convex for the loss. The two arms have a different shape beginning from the reference point and gradually getting away from the point in both directions, there is diminishing sensibility to wealth related changes.

Gains are treated differently compared to loss also when it comes to the slope of the curve, much steeper for the loss. Loss aversion implies that individuals prefer status quo or any other reference point than a prospect with two alternatives, one positive and one negative with 50% probability and same expected value.

The achievement of a goal or the acquisition of a good, enables the value of that good or goal according to the *endowment affect*.

This effect has relevant implications concerning the utility theory : it challenges the basic assumption according to which the preferences do not change for different representations of problems with equivalent choices, that indifference curves are reversible and not intersected and that preferences are independent from what is owned (example : the preference between A and B can depends by the fact that A is already owned by the individual).

Given that the classification in loss and gains depends on the reference point, the identification of this point is crucial. The translation towards the bottom impacts the gains because of risk aversion and the other way around for what concerns the losses.

Even though in many decisional problems the context is determined by the situation itself, in other cases the way an individual responds and codifies a decision is more subjective and related to the context. That is more likely to happen when the situation includes a series of sequential choices and where there is more ambiguity concerning the status quo.

Is important then, also how individuals get used to gains and losses. Getting used to the losses bring to risk averse behavior compared with when not used to it (losses) and the gains induce to seek risk in order to preserve that revenue. This brings to the question concerning how quick individuals change and adapt to a new status quo and under which conditions: usually the endowment effect is considered to be instant and quicker for gains than for losses.

Individuals prefer certain results than results that are only likely, according to the certainty effect. Individuals overestimate low probabilities and underestimate high and moderate probabilities. Very likely results but still uncertain are often treated like they were certain, an effect defined as *pseudocertainty*.[26]

As a consequence, changes in the probability close to 0 or 1 have a greater impact on the preferences than changes in the intermediate probabilities, leading to the principle of *subproportionality*: the impact of a positive difference between two quantities increases with their ratio.

These kind of behavior contrasts with the rules of the expected utility theory, according to which the utilities of risky events are linearly weighted by their probabilities.

There is the confirmation of the fact that to simplify choices between alternatives, the individuals often under-estimates common components to each alternative and they focus on the different components. The isolation effect can bring to different

[26] Tversky and Kahneman, "The Framing of Decisions and the Psychology of choice"

preferences depending on the decomposition method of the prospect in common and different components [27].

The expected utility theory, with the concave utility function u, implies that the probabilistic insurance[28] is greater than a normal insurance. If having a wealth W , an individual is willing to pay a prize Y to insure against a probability P of losing X, he will be willing to pay a smaller prize RY to reduce the probability of losing X from p to (1-r)p, 0<r<1. However the empirical evidence shows that a probabilistic insurance in most case is not attractive for individuals[29].

2.2.1 The Theory

The prospect theory tries to incorporate the expected utility violations experimentally observed in a theory of decision under risk. The decisional process in risky conditions can be seen as a choice among prospects. A prospect (x1,p1;…; xn, pn) is a contract producing the xi result with pi probability, where p1+p2+…+pn=1.[30]

We can divide the decisional process in two phases: editing phase and evaluation phase.

The *editing* phase includes a preliminary analysis of the problem, the identification of the available options, the possible outcomes or consequences of each one, and the values and probabilities linked to each of these outcomes. It also includes the organization and reformulation of the perceived options in order to simplify the next evaluation and choice.

In the *evaluation* phase, the edited prospects are evaluated and the preferred prospect is chosen.

The editing phase includes many operations simplifying the decisional process transforming the results and probabilities representations.

[27] Levy, 1992

[28] A protective action in which an individual pays a clear cost to reduce the probability of an event to happen without deleting it

[29] Tversky and Kahneman, 1979

[30] Tversky and Kahneman, 1979

Codification implies the identification of the reference point, usually the current wealth and the results context. These latter will be evaluated as deviations from the reference point(gains or losses), influencing the risk orientation.

The *simplification* includes the rounding of probabilities and results, including the rejection of very unlikely results, rounding them to zero, distorting the expected utility calculations.

The *detection* of dominance implies the research and the elimination of dominated alternatives. A dominant strategy is when it optimizes the results independently from the other player's decision.

There is also the *Combination* of associated probabilities to identical outcomes and the where a riskless component contained in a prospect is segregated from the risky component in the editing phase.

There is often the *cancellation* of component which are common to all the prospects or the elimination of irrelevant alternatives, which can bring to the phenomenon of preferences change.

The positioning of the simplification before or after the combination and/or segregation can make a difference in the editing of the choices and adds an other unpredictable element in the decisional process.[31]

Given that the editing operations make the decision easier, they well be used any time possible. However the application of some operations does not allow the applications of other operations, hence the final edited prospect can depend on the sequence of applied operations which can change according to the structure of the presented prospect and the way is presented.[32]

Hence Kahneman and Tversky focus on the prospects evaluation more than on the decisions editing. Once the individual edits the available options, goes to the evaluation of edited prospects selecting the one with the highest value, determined by the product of the result value and the weight of the decision. The weighted value of a prospect V is given by: V = w(pi) * v(X), where p is the perceived

[31] Levy, 1992

[32] Tversky and Kahneman, 1979

probability of the outcome x, w (p) is the weighing function of probabilities, and v(X) is the value subjectively assigned to outcome x.

2.2.2 The Value Function

The value function has three main features reflecting the behavior presented above : is defined by the deviations from a reference point rather than deviations from a net wealth position, hence if the reference point changes, the value function changes as well; generally it is concave for the gains and convex for losses reflecting the risk aversion in the gains domain and the search for risk in the losses domain; it is steeper for the losses than for the gains (with a 2:1 ratio according to experimental results). This implies that marginal utility of gains diminishes more rapidly than the disutility of the losses.[33]

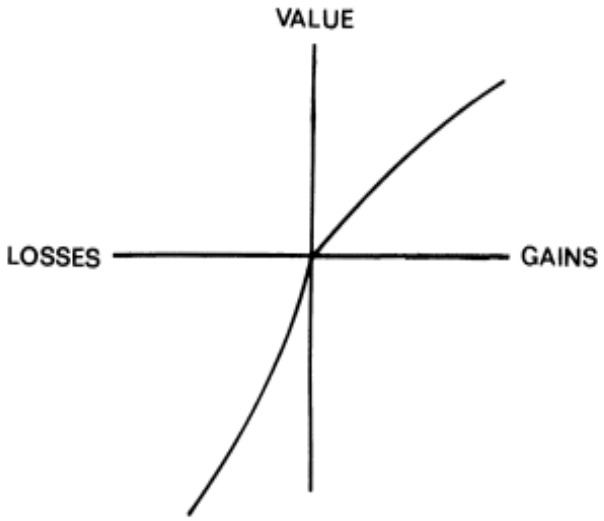


Table 2.2 Tversky and Kahneman, 1979

For what concerns the first mentioned aspect, the assumption is consistent with basic principles of perception and judgement and our perception is more incline to changes or differences evaluation than absolute magnitudes evaluation.[34]

[33] Levy, 1992
[34] Tversky and Kahneman, 1979

For what concerns the second effect, the framing effect, there are validations also in neurological experiments made with M.R.I (Magnetic Resonance Imaging). Using neuro imaging techniques was possible to find neurological mechanisms responsible of the decisional asymmetry in the positive and negative domains. Results of different experiments have confirmed that participants showed the tendency to risk for the loss frame and risk aversion for the gains. [35]

The third aspect, reflects the fact that losing an amount of money causes a greater displeasure than the pleasure of earning the same amount.

Focusing on the reference point, it should be found in current wealth for what concerns the most of the cases. In other situations it can be identified with an expected level or with a level the individual aspires to, different from the status quo.

A discrepancy between the reference point and the current wealth can be due to recent changes in the economic situation of the individual, to which the individuals did not get used yet. Not adapting to recent losses can also explain the behavior of seeking risk in cxaertain situations. Another case where there is a change in the reference point is when a person formulates his own decisional problem in final wealth terms , like in the expected utility theory, rather than in losses or gains terms. In this case the reference point is zero on the wealth scale and the value function is probably concave. In line with the prospect theory, this formulation deletes the risk seeking, with the exception of bet sin low probability situations.[36]

In uncertainty conditions an individual can be subject to status quo bias: the person chooses not to take a decision and stay in the status quo. The reasons can be inaction and procrastination, uncertainty in the modification of the current status.[37]

Due to this effect, small variations from the status quo are preferred than great changes. Also, there are other factors like thinking cost, transaction costs,

[36] Tversky and Kahneman, 1979
[37] Bowles, no date

psychological effort in previous decisions that can induce this effect also with absence of loss aversion.[38]

The probabilities weighting function measure the impact of the probability of an event on the desirability of a prospect. It is not a probability linear function and the decision weights are not probabilities. Technically, the decisional weights can be influenced by other external (from probability) factors, like ambiguity or uncertainty on the risk level.

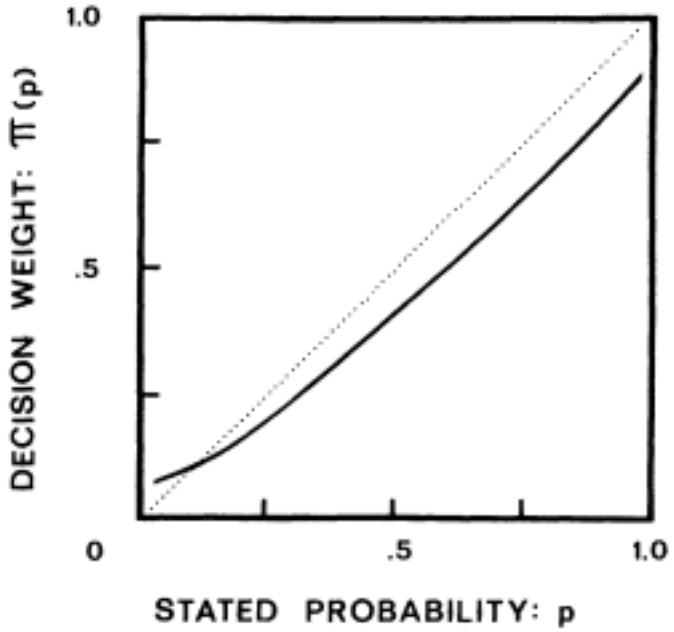


Table 2.3 Tversky and Kahneman, 1979

W is an increasing function in p, with w(0)=0 and w(1)=1. First, the weighting function is not well specified near the final points. This reflects the unpredictability of behavior in extreme smallness or greatness of probabilities. Kahneman and Tversky, conscious of this unpredictability, argue that highly improbable events can be both ignored and overestimated and the difference between highly probable events and certainty can be ignored or exaggerated due

[38] Tversky and Kahneman, 1991

to the limited ability of individuals to understand and evaluate extreme probabilities.

That brings to a second important characteristic: there is a clear increase in the weighting function near to undetermined regions. Changes in the probabilities near 0 and 1 have disproportionally great effect on prospect evaluation.

A third characteristic of the weighting function is that the slope is less than 1 on the whole range with exception of the regions close to the limits. Given that the slope is a measure of the weighting sensibility of decisions (hence of preferences) to probability changes, this means that the preferences are generally less sensible to probability variations than the principle of expectations would claim (with the exceptions of regions close to 0 and 1). One implication is that the amount of the decision's weights associated to complementary events is generally less than the weight given to a certain event, which reflects the certainty effect described above.

Fourth characteristic, the low probabilities are overestimated while the high probabilities are underestimated. Even though there are no proofs on the specific point in which the overestimation changes to underestimation, or if this point changes significantly among individuals or context, it seems from experiments to be falling in the 0.10 - 0.15 rang. This implies that the probabilities are underestimated for the most part of the range and this brings to the fifth characteristic of the function: for each $0<p<1$, $w(o) + w(p-1) < 1$, principle called of sub-certainty. The sum of the weights associated to complementary events is closer to the unit when the probabilities are low than when the probabilities are high.

Hence, in the weighting function, in the gains domains where the perceived probabilities are above the transition point from the overestimation to underestimation, the devaluation of probabilities together with the concavity of the value function leads to evaluate less a bet than a certain result, boosting the risk aversion.

In the losses' domain, the underestimation of probabilities (above the transition point) reduces the weights given to risky negative prospects, it makes them less risky and hence encourages the risk seeking. In this probabilities range, the value function effect and the weighting function do reinforce each other.

Given the weighting function shape and the transition point, this means that for what concerns the Prospect Theory, the inversion of risk propensity can happen only in the low probabilities range. If it happens depends on the relative shape of the value and weighting functions. This determination about the orientation to risk is limited to the extremely low probabilities range, where the value function is concave for the gains and convex for the losses but the weighting function is undetermined. [39]

[39] Levy, 1992

How Can Behavioral Finance Solve The Equity Premium Puzzle?

Benartzi and Thaler propose two different approaches, for the first one they envisage a model in which the investor has to allocate wealth among stocks and bonds, in which is assumed that gains and losses correspond to positive and negative variations of personal wealth. The Myopic Loss Aversion is the result of the combination of the psychological aspects typical of investors' behavior:

- *Loss Aversion*, the tendency of individuals to be more sensible to losses than to gains
- *Mental Accounting*, the tendency of individuals to decodify the information according to various mechanisms among which the temporal frequency of information reception. An investor who frequently evaluates his portfolio puts more emphasis on the losses, compared to an investor rarely evaluating his portfolio, hence is likely that he finds risky activities like the stocks to be little attractive.

The combination of loss aversion and frequent portfolio evaluation is called myopic loss aversion. Through a simulation, Benartzi and Thaler have determined that an average investor checks his portfolio performance at least once every 13 months, hence approximately once a year. However in a single year time frame it often happens that the stocks have a worse performance than bonds, even if when they increase their value they are capable of recovering from the loss and exceed the return assured by the bonds. But if investors evaluate the return of their investments every year and if they are risk averse, then it is understandable that they want a very high premium to face the risk of finding out their investment to be losing. Those who check their investments every year, change their reference

point yearly which prevents them to evaluate their investments with a long-term global perspective. In fact the authors show that when the evaluation time frame increases the risk premium decreases. Putting t=20 they have achieved a risk premium value of 1.4, significantly less than 6.5 (the one achieved by Mehra and Prescott) achieved with t=1. The difference of 5.1 according to Benartzi and Thaler can be considered as the "price for excessive vigilance", meaning the tendency of investors to frequently check their stock investments.

The second approach, with the goal of giving an explanation to the equity premium puzzle, is based on the principle of Ambiguity Aversion, hence the tendency of individuals to refuse bets in which they do not know the probabilities distribution. This situation is quite usual in the financial reality, due to the fact that investors are often uncertain about the return distribution of a stock . When the investor is worried by the uncertainty of his asset return calculation model, he requires a greater equity premium as compensation for the ambiguity of the probability's distribution. However, as justification of a high equity premium like the real one, a very remarkable degree of concern is required. Hence, the ambiguity aversion can be considered only a partial solution for the puzzle.
Concluding, to later go through a deeper understanding of the theory, we should report that in the recent years a strong reduction of the risk premium occurred. One of the possible explanations has been the substantial presence of institutional investors and mutual funds in the markets. Framing the phenomenon in the Benartzi and Thaler perspective, we could say that the equity premium is decreased because the economic agents are now characterized by a lower risk aversion and also because their time frame is longer, hence there is greater trust in the stocks investments.

Behavioral Finance helps to understand many of the anomalies, observed in the individual investment decision making. The low participance in the stock market is analyzed by Benartzi and Thaler (1995), in the debate on the equity premium puzzle : Applying *The Prospect Theory,* the authors claim that investors evaluate

the stock investment framing it in a too short time-frame (myopia), anticipating potential losses, to which they are adverse, deterring from buying stocks, losses that do not occur in the long-term. Myopic loss aversion would be then at the root of the puzzle. Investors would not be averse to high variability of the stock title's returns but they would be averse to the possibility of registering a loss in the moment in which they decided to verify their investments performance. Benartzi and Thaler's results were applied to a multi-period model by Barberis and Huang (2001), who, besides speculating that the representative investor is characterized by loss aversion, introduce in the analysis a type of *mental accounting* according to which the negative impact of a loss on the utility function is greater if the loss is preceded by negative returns on the initial investment.
Considering that dynamic aspect of the risky investment decisions evaluation allows to replicate the high return excess of stock titles. Benartzi and Thaler (2001) show that the investors change their attitude of holding few stocks if they receive performance information referred to the long-term instead of the short term. Participants of a U.S. corporate pension plan who where showed a comparative chart of a stocks funds returns and a bond fund's returns relative to a thirty years period, they chose to invest in the stocks fund a share of approximately 80%, the double of the previous share which they had chosen after seeing an annual based chart.

Not all of individuals follow the utility maximization models and CAPM models, but on the market we can find different individuals with different goals, a theory implying a revolution of the classical paradigm but which seems more "human" based. It is then necessary to highlight how the classical theory presents some conceptual gaps which the empirical evidence keeps showing, creating real puzzles. As reported in this worl, sometimes canonical concepts are not enough to explain the complexity of human behavior and this bring to the statement of economics not being an exact science. Behavioral finance helps to overcome those gaps which classical theory cannot explain (unless with very restrictive assumptions and hypothesis).

3.1 Myopic Loss Aversion And Equity Premium Puzzle

As showed by Mehra and Prescott it is difficult to explain the equity premium puzzle in the usual economic paradigm because the necessary risk aversion level to justify a so high premium would be too great. Investors should have relative risk aversion coefficients greater than 30 to explain the historical equity premium puzzle, while the previous estimates and the theoretical topics suggest that the current figure is close to 1.0. There are two questions to be made: why the premium is so high? And why is someone willing to buy and hold bonds?

Benartzi and Thaler propose a new explanation based on Kahneman and Tversky's theories. The explanation has two components: first, the investors are assumed to be risk averse meaning that they are much more sensible to losses than to gains. Second, the investors are assumed to evaluate their portfolios very often, even if they have long-term investing objectives as retiring saving plan. The second point, as showed above concerns the mental accounting aspect which has a crucial role in this work and it is composed by the aggregation rules that people tend to follow. These norms are applied along two dimensions : transversely and intertemporally. For instance, an investor owning stocks of different companies could evaluate his stocks portfolio as stock or aggregate, and he could to this once a month, year or every ten years. Because of the presence of risk aversion, these aggregation rules are not neutral. This point can be better explained with an example: let's consider the problem of Paul Samuelson (1963)[40].

Samuelson asked to a colleague whether he was willing to accept the following bet:

- 50% chance of winning $200
- 50% chance of losing $100

[40] Benartzi and Thaler,1995

His colleague refuses the bet adding that he would have been much happier to accept sure 100$. Samuelson thought that his colleague's behavior was absolutely irrational, and Benartzi and Thaler underline this behavior as risk aversion. A simple utility function capturing this notion is the following:

$U(x)=x$ if $x > 0$
$2.5x$ if $x < 0$

If Samuelson's colleague had this utility function, he would refuse a bet but he would accept a two or three sequence as long as he did not have to watch while it unfolded. The results' distributions realized by a two bets portfolio:

(400$,0.25; 100$,0.50; -200$,0.25)[41]
This has positive expected utility with the previous utility function, even if simple repetitions of the single bet are clearly less attractive if evaluated one at a time.
Like this example shows, when the decision makers are risk averse, they will be more willing to run risks if they rarely evaluate their performance. The relevance of this topic for the equity premium puzzle can be seen considering the problem of an investor having the utility function defined above. Let's suppose that the individual has to choose between a risky activity paying 8% a year, with a standard deviation of more than 20% (like stocks) and a safe one paying 1% for sure. With the same logic applied to Samuelson's colleague, the attractiveness of the risky good depends on the time frame of the investors. The longer the investor is willing to own the good, the more attractive the risky activity appear, as long that the investment performance is not checked too often. In other words, if an investor is not willing to bear with the risks linked to an activity, this is due to two elements: risk aversion and short time frame evaluation. We refer to this combination as myopic loss aversion.

[41] U = [400 * 0.25 + 100 * 0.50 – 2.5*200 * 0.25] = 25

Can this solve the equity premium puzzle? Which risk aversion combination and period evaluation would be necessary to explain the historical model of returns? How many times an investor having this set of preferences has to evaluate his portfolio in a way to make him unconcerned about historical distribution of returns for stocks and bonds? The authors have tested and have done experiments with both the returns, real and nominal and they did a comparison between stocks and bonds and they have always achieved results between 9 and 13 months.

The two authors do not only do tests, but they question whether the equity premium puzzle is real or not. They questioned if the 1926 year studied by Mehra and Prescott was somehow "special". The strength of the equity premium was proved by Jeremy Siegel (1991,1992) examining the returns from 1802. He finds that the equity returns were considerably stable. For instance the real stocks return between 1802-1870, 1871-1925, 1926-1990 were respectively 5.7%, 6.6% and 6.4%. However the short term government bonds had for those same periods plummeting returns: 5.1%, 3.1%, 0.5%. Hence, there was no equity premium in the first two thirds of 19th century (because of high bonds returns) but if we examine the last 120 years, the stocks had a significant advantage.

The equity premium does not seem to be a recent phenomenon. Could the equity premium be coherent with the rational model of expected utility and maximization of economic behavior?

Mehra and Prescott's contribution was that of showing how risk aversion alone is unlikely to produce a satisfying solution. They have found out, as said above, that people should have a relative aversion coefficient of over 30 to explain the historical model of returns. The equity premium is produced by a risk aversion combination and frequent evaluations. The first interprets the risk aversion role in standard models, and can be considered a preference's matter. On the contrary, the frequency of evaluations is a strategic choice that could be changed, at least in principle. Also, actions become more attractive with the increase of the evaluation period. This observation brings to the question, how much should fall the equity premium puzzle if the evaluation time frame increases?

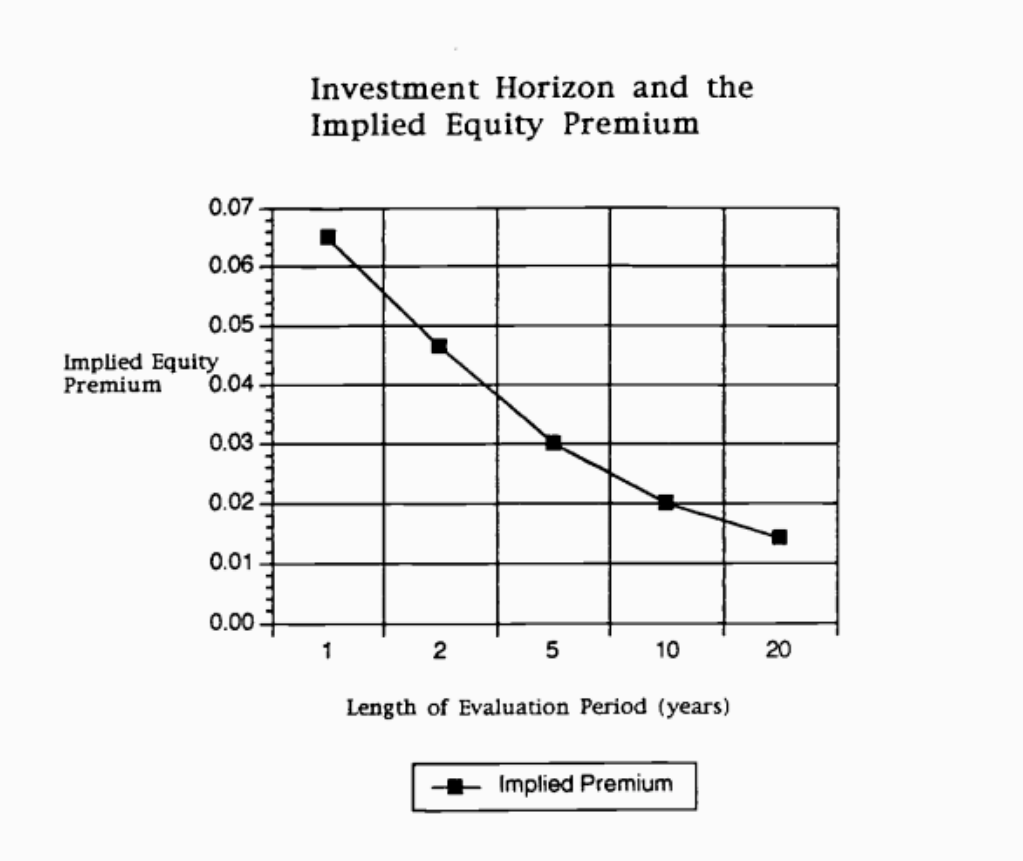


Table 3.1: equity premium and evaluation period relation. Benartzi and Thaler, 1995.

The chart shows the results of the analysis of this problem using real stocks returns, and real 5 years bonds returns as comparative activity. The equity premium used as parameter results in being 6.5% a year and is coherent with a one-year evaluation period. If the evaluation period is 2 years, the equity premium would fall to 4.65%. For 5,10 and 20 evaluation periods a year, the correspondent figures would be 3%, "% and 1.4%.

The authors declare in fact that: "*One way to think about these results is that for someone with a 20 years investment horizon, the psychic costs of evaluating the portfolio annually are 5.1% per year! That is, someone with a 20 years horizon would be indifferent between stocks and bonds if the equity premium were only 1.4% and the remaining 5.1% is potential rents payable to those who are able to*

resist the temptation to count their money often. In a sense, 5.1% is the price of excessive vigilance"[42]

Concluding we can sum up saying that the alternative proposal of Benartzi and Thaler has its roots in the application of the prospect theory. They, hence, argue that an explanation based on myopic loss aversion could clarify the problem. The two economists speculate that investors evaluate their portfolio with a myopic perspective, meaning on a reduced time frame on which they are characterized by loss aversion[43].

The time frame of reference implied in Benartzi and Thaler estimates, based on an equity premium of 6% is approximately one year. Benartzi and Thaler model would be capable of reproducing the results of a high stocks returns exceeding the riskless return, based on "reasonable" values for the model's parameters.

Benartzi and Thaler's idea was recently extended to a dynamic model by Barberis and Huang in 2001.

Barberis and Huang speculate that the representative investor investing in financial markets has a utility fucniton characterized, like in the case of Benartzi and Thaler, by loss aversion; we also assume a type of mental accounting under which the negative impact of a loss on the utility function is greater if the loss is preceded by negative returns of the original investment. These speculations are reflected on the utility function: [44]

$$u(C_t, x_t) = \frac{C_t^{1-\gamma}}{1-\gamma} + \mathrm{E}\left[\frac{C_{t+1}^{1-\gamma}}{1-\gamma} + b_0 \rho v(x_{t+1})\right]$$

[42] Benartzi and Thaler, 1995
[43] Based on the experimental results of Kahneman and Tversk in 1981
[44] Barberis and Huang (2001)

Where:

- Ct is consumption at time t,
- xt+1 is the gain or loss relative to the original investment,
- $b_0\rho$ is a scaling factor,
- The function $v(\cdot)$ represents the loss aversion component:

$$v(x_{t+1}) = \begin{cases} x_{t+1} & \iff \quad x_{t+1} \geq 0 \\ \lambda x_{t+1} & \iff \quad x_{t+1} < 0 \end{cases}$$

The parameter $\lambda > 1$ creates the loss aversion effect, making it so that a Xt+1 < 0 loss has an impact of $\lambda xt+1$, greater than a gain of $xt+1$.

λ also changes depending to the gain or loss $xt+1$ being preceded by losses or gains, giving accoutn of the mental accounting hypothesis made by Barberis and Huang (2001). The consideration of this dynamic aspect of the evaluation of risky investment decisions by investors allows Barberis and Huang to replicate the high excessive return of stocks, proposing in this way a solution to the equity premium puzzle, in the context of a more general model compared to the one of Benartzi and Thaler (1995).

As seen is possible to find through behavioral finance, explanations to a phenomenon that standard models cannot support or address. The reference to Barberis and Huang has the objective to emphasize how this subject is nowadays moving and offering ideas for more dynamic and newer models.

Conclusion

Concluding, the equity premium puzzle is the lack of coherence between the theoretical model and the quantitative results of these models applied to empirical data. This lack of coherence is mainly due to what the economists take in consideration as reasonable level of relative risk aversion; even if it was initially observed in the U.S., different studies have demonstrated that it exists in other countries. There is a wide literature about this topic like Mehra and Prescott paper of 2003 where they did a survey providing a revision of the available literature on the puzzle. Their paper summarizes the historical experience for U.S. and other industrialized countries.

There many other hypothesis and proposal to solve the equity premium puzzle but the most consistent seems to be the behavioral one. My dissertation has gone through behavioral finance model which take in consideration the complexities of human behavior when facing risky and uncertain conditions, hence according to the conditions the investor could have a different approach to the same problem.

All the behavior explanations have in common that the agent's preferences are defined compared to a reference point. The fathers of this theory are Kahneman and Tversky about whom I briefly talked about, who gave a new descriptive perspective to economics.

As of today the proposals based on behavioral finance are the best at explaining the equity premium puzzle because there is something in finance which goes beyond rules and paradigms: the behavior of individuals or the "animal spirits" of which Keynes wrote in The General Theory back in 1936.

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Riassunto Tesi

"Equity Premium Puzzle: A Behavioral Persepctive"

Introduzione:

Nella parte introduttiva della tesi ho fornito informazioni di base e l'antefatto per poi procedere all'analisi più specifica nei capitoli successivi.

In finanza l'equity premium puzzle rappresenta l'osservazione empirica dei rendimenti nei mercati azionari che nell'ultimo secolo sono sempre stati maggiori rispetto ai rendimenti dei bond governativi. Il premio azionario medio è stato di circa il 6% mentre il rendimento a breve termine medio dei bond di circa l'1%.

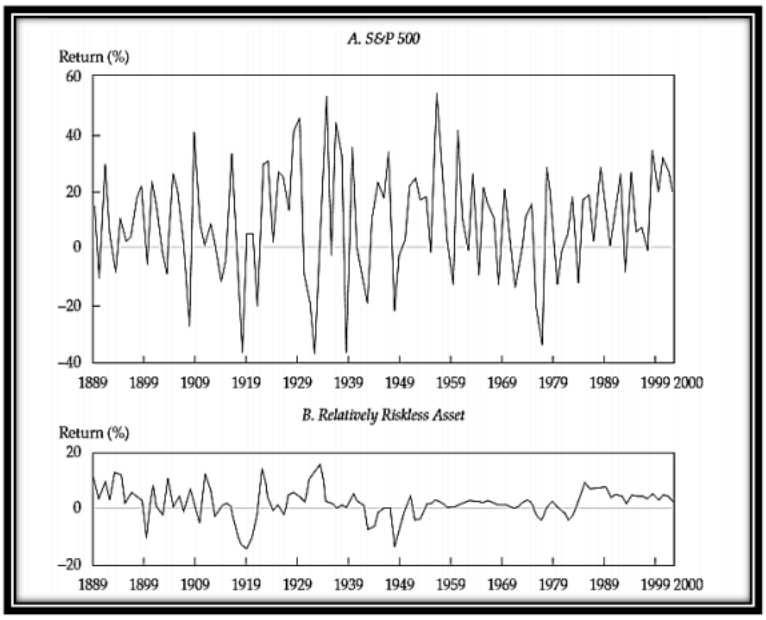

Table 0 "S&P returns and riskless activities returns"
Mehra and Prescott (1985)

Durante gli anni ci si è chiesti cosa ci fosse dietro ad un differenziale così ampio e se le teorie economiche tradizionali potessero spiegare il fenomeno.

Negli anni ’80 due economist, Mehra and Prescott si sono resi conto che il premio azionario era troppo alto se rapportato alla rischiosità associata a quei titoli. Dal 1985 parliamo quindi di “Equity Premium Puzzle”.

Il giudizio degli investitori è basato sul fatto che il prezzo delle azioni varia molto più spesso e molto più diversamente rispetto ad investimenti più sicuri come i bond statali, ma allo stesso tempo è evidente come nel lungo periodo abbiano garantito rendimenti migliori. Il punto cruciale è che le azioni generano molti più profitti degli altri tipi di investimento, ma essendo considerate rischiose dagli investitore, nella maggior parte dei casi sono presenti in piccola parte nei portafogli di investimento. La teoria economica tradizionale suggerisce che gli investitori dovrebbero sfruttare l’opportunità di arbitraggio data dalla differenza tra il premio azionario e il rendimento medio dei bond governativi, essendo attratti dal premio di rischio così alto e generando un’alta domanda di azioni, che in tal modo ridurrebbe il rendimento atteso e di conseguenza il premio per il rischio. Ma i dati empirici dicono il contrario, e cioè di come gli investitori siano spaventati dalla rischiosità delle azioni.

Capitolo Primo:

Nel primo capitolo ho dato una definizione del problema, affrontandolo dalle sue origini , analizzando il background teorico e i vari tentativi storici di risoluzione o spiegazione logica dell'Equity Premium Puzzle.
La prima definizione di Equity Premium Puzzle di Mehra e Prescott nel 1985 era quella di un'incapacità del modello tradizionale CAPM di produrre il vasto premio azionario rilevato nei dati degli stati uniti dal 1889 al 1978.
Visto che le azioni hanno un rischio implicito più alto dei bond dovrebbero anche avere un ritorno potenziale adeguato per ricompensare gli investitori che disposti a prendere il rischio.
Mehra e Prescott sostengono ciò da un punto di vista teorico ma non riescono a sostenerlo da un punto di vista empirico, visto che nei dati raccolti per gli stati uniti, le azioni non sono abbastanza più rischiose dei bond per giustificare il premio azionario rilevato. Per questo se da una parte il premio azionario può apparire ovvio come concetto, e ben sostenuto da formule matematiche, dall'altra parte se applicato ai dati empirici diventa un "puzzle".

Capitolo Secondo:

Nel secondo capitolo della tesi ho introdotto la finanza comportamentale, spiegandone i concetti chiave necessari per comprendere la soluzione comportamentale proposta all'equity premium puzzle.

Prendendo in considerazione la teoria del valore di mercato, questa implica che nel lungo termine le aziende vengano analizzate sulla base dell'output che producono, sulla crescita e sui fondamentali che però non variano tante volte e tanto velocemente quanto il prezzo delle azioni delle stesse aziende in borsa. I mercati finanziari infatti non sono stabili, caratteristica associata alle aspettative per il futuro degli investitori. Keynes nella sua Teoria Generale alludeva già agli "spiriti animali" per spiegare il comportamento di un individuo avente come forza trainante il suo personale intuito per avere successo, senza perciò avere dietro ad ogni sua scelta un'analisi economica scientifica e razionale.

Con le teorie economiche classiche questo comportamento non è razionalmente comprensibile, ma la finanza comportamentale fornisce delle teorie non presupponendo la perfetta razionalità degli individui ma al contrario riconoscendo la presenza innegabile di individui irrazionali nella società.

Capitolo Terzo:

Nel terzo capitolo della tesi ho fornito una possibile soluzione all'equity premium puzzle attraverso la finanza comportamentale e precisamente attraverso le teorie proposte da Benartzi e Thaler.

Benartzi e Thaler propongono due approcci, per il primo propongono un modello nel quale l'investitore deve distribuire ricchezza tra azioni e bonds, nel quale si assume che guadagni e perdite siano variazioni positive e negative della ricchezza personale. L'avversione alle perdite miope è il risultato dell'analisi di aspetti psicologici tipici dell'investitore come:

l'avversione alle perdite, che è la tendenza irrazionale degli individui di essere più sensibili alle perdite rispetto che ai guadagni; la contabilità mentale, che è la tendenza degli individui ad analizzare le informazioni in base a vari meccanismi, tra cui la frequenza temporale della ricezione di informazioni: e cioè che un investitore che controlla il proprio portafoglio di investimento troppo spesso, tenderà a porre più attenzione sulle perdite rispetto ad un investitore che controlla raramente il proprio portafoglio di investimento e quindi troverà le azioni, in quanto strumenti di investimento rischiosi e che oscillano spesso, poco interessanti.