Relation Between Total Risk and Return:
Analysis under a New Paradigm

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Summary

Risk and return do not have the clearcut negative relationship that we assume in our textbook treatment. Industry level studies in different countries have shown that risk and return are positively related above industry median (rate of return) but negatively related below industry median (rate of return). These findings contradict any model along the line of capital asset pricing model. It also is inconsistent with arbitrage pricing model. However, these observations are consistent with the Prospect Theory. I view this phenomenon in the context of anomalies in finance. I explore practical implications in terms of investment strategies.

Relation entre Risque total et rendement : une analyse faite à la lumière d'un nouveau paradigme

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Résumé

Le risque et le rendement n'ont pas entre eux la relation clairement négative que nous supposons dans notre approche théorique. Des études sectorielles effectuées dans plusieurs pays indiquent qu'il existe une relation positive entre risque et rendement au-dessus de la moyenne du secteur (taux de rendement) mais que cette relation est négative en dessous de la moyenne du secteur (taux de rendement). Ces conclusions contredisent tous les modèles d'évaluation des actifs financiers. Elles sont également en opposition avec le modèle d'évaluation selon l'arbitrage. Toutefois, ces observations sont en accord avec la théorie prospective. Je situe ce phénomène dans le contexte des anomalies de la finance. J'en explore les implications pratiques en termes de stratégie d'investissement.

Anomaly in Finance: The Case of Risk and Return Relationship

1 A Neglected Dimension of Anomalies

1.1 Anomalies in Finance

In the 1960s great strides were made by Sharpe (1964), Lintner (1965) and others to gather evidence to support the empirical proposition of the efficiency of the stock market. Arbitrage opportunities would make the capital market react rapidly to any additional flow of information about securities (see, Fama (1965)). This process would force adjustments in the market price of securities. An equilibrium would entail "correct" pricing of securities: all securities would reflect their underlying value.

Anomalous evidence contrary to the efficient market began to appear in the middle of 1970s. The first anomaly, seasonality, of Australian share market data appeared in an article by Officer (1975). It was followed by the evidence from Rozeff and Kinney (1976) for the American market. Basu (1977) identified a P/E ratio anomaly, long popularized by the practitioners. Seasonality was then further expanded to include the day-of-the-week-effect (Keim and Stambaugh (1984)), and the January effect (Berges et al (1984)) among others. Shiller (1981) studied market volatility evidence to disprove market efficiency empirically. He showed that the market volatility is "too high" to be explained by rational utility maximization models (however, Shiller's thesis has not gone unchallenged, see Kleidon (1986)). Each anomaly gave rise to a simple policy implication for asset allocation for investors: By following specific strategies it is possible to outperform the market. As a reaction to these empirical evidence, researchers began to develop new models to incorporate these anomalies. For example, Shiller (1984) made an interesting attempt to incorporate "fads" in share purchase behaviour.

The general thrust of the argument of all these studies were that the actual return seems to be higher (or lower) than what it would have been if returns were predicted with a risk adjustment. However, this kind of modelling did not question the implicit relationship between risk and return. It was presumed that there is always a **positive** relationship between risk and return. Higher risk requires higher return. There was no controversy about that.

The basic paradigm of expected utility maximization was never questioned. However, even to meaningfully write down the capital asset pricing model (CAPM) requires a series of strong assumptions about the underlying decision process. For example, the capital asset pricing model needs either rates of return of assets to be distributed multivariate normally or the utility function to depend on two parameters: mean and variance (or equivalently, on mean and standard deviation). To test the CAPM, we requires an additional set of assumptions about the statistical regularity that governs the underlying stochastic process.

1.2 Deeper Anomalies in Decision Making Under Uncertainty

Financial decision making requires a specification of a process of decision making under uncertainty. In that arena, a deeper set of anomalies were brewing. Decision theorists began questioning the descriptive validity of the axioms of normative models of decision making. Early in the 1950s, Allais (1953) first introduced the problem with the "independence axiom" of the expected utility in the problem of decision making under uncertainty.

In the derivation of the expected utility theorem, decision theorists assumed the following: if a lottery p is preferred to a lottery q, then by adding another independent lottery r to both (in the form of a compound lottery) will not change the preference

relation, that is, the combination of p and r will still be preferred to the combination of q and r. This axiom is known as the "independence axiom".

Allais found that most people do not abide by this rule. The descriptive validity of this assumption is questionable. Thus, for decision theorists, the normative appeal of the independence axiom lost it's charm. This problem was further illustrated by Edwards (1954) and Ellsberg (1961).

It became obvious to many researchers that the expected utility paradigm needed major overhaul. There were a series of modifications proposed to the expected utility theory (see, Fishburn (1988, chapter 1)). Some of these changes were minor ones. Others set out axioms that took into account many of the violations of the expected utility theory but in the process replaced the theory altogether. A major change in paradigm was proposed by Kahneman and Tversky (1979) in the form of the Prospect Theory. However, not everyone considers the development of Prospect Theory as a major shift in paradigm at all. Yates (1990) calls it a "cousin" of expected utility theory.

1.3 The Prospect Theory

As we shall see below the development of the Prospect Theory was instrumental in explaining some anomalous behaviour in the risk/return relationships. Therefore, it is appropriate to introduce some of the main features of the prospect theory and how it contrasts with the expected utility theory.

Expected utility theory tells us how a decision maker **should** combine utility (value) and probability when they make decisions under risk (uncertainty). If x's represent payoffs of a gamble and p's denote probabilities, the theory posits that the expected utility for the gamble is represented by $EU = \Sigma u(x).p$ where u is such that u is concave. However, Allais and others have shown that choices people do make are

not consistent with the expected utility theory. One consequence of the expected utility theory is that higher risk should always be associated with higher (expected) return.

Prospect theory looks at individual decision making somewhat differently. (1) The combination of utility and probabilities is done as follows: Prospect = $\Sigma v(x).f(p)$. In this sense, it is a generalized weighting scheme. (2) The function f is such that $f(p) > p$ for low values of p and $f(p) < p$ for high values of p (except when p is close to zero or one). (3) The value function v is such that it has an "S shape" around a reference point. Hence, unlike the utility function of the expected utility, it is not concave everywhere.

It is shown by Kahneman and Tversky that many of the routine violations of the expected utility theory can be accommodated by Prospect Theory. What concerns us here is that Prospect Theory's prediction of higher risk associated with higher return above a reference point and higher risk associated with lower return below a reference point is consistent with the observed facts if we interpret the reference point as the median rate of return in an industry.

2 Risk and Return Relationship

In the empirical regularities observed by financial economists, one set of observations was ignored: the high risk of companies did not always come with high reward in the form of high returns. If the commonly used measures of risk and return are any guide, the law of one price should dictate that two assets with the same price (mean return) should have the same risk (standard deviation).

Consider the evidence of risk and return relationship for broad portfolios of stocks. Friend and Blume (1970) quoted by Modigliani and Pogue (1988) produced the following evidence. Friend and Blume constructed ten portfolios based on monthly

data from the New York Stock Exchange of about 3,300 companies. First, they ranked the companies based on their betas over the four years before 1956. Portfolio number one was constructed from the lowest decile of betas (thus, there were about 330 firms in the portfolio), the next decile formed portfolio number two and so on. For each portfolio, the corresponding mean rate of return was calculated. The results are reproduced in the following table.

Table 1: Relationship between mean return and betas
(monthly data 1956-1969 NYSE)

portfolio decile	return (percent)	beta
1	0.95	0.28
2	0.98	0.51
3	1.12	0.66
4	1.18	0.80
5	1.17	0.91
6	1.14	1.03
7	1.10	1.16
8	1.18	1.30
9	1.15	1.48
10	1.10	1.92

Modigliani and Pogue summarize the findings as "results do not show a clear relationship between beta and return. There is little payoff for assuming additional risk within the group of stocks with above-average betas." (p. 1176-7) However, Modigliani and Pogue do not recognize that if we delete the 20% of the stocks with the lowest beta values, there is a very uncomfortable **negative** relationship between mean return and beta!

2.1 Bowman's Studies

The first systematic study of risk and reward relationship in the marketplace was initiated by researchers in Strategic Management. To find the relationship between risk and return, Bowman (1980) argued that return on equity (ROE) and return on assets (ROA) were the relevant variables. Then, he identified the mean return for each firm to be the expected return and variance to be the risk of the firm. Bowman was the first researcher to identify the negative risk and return relationship, and then proceed to study them systematically in subsequent investigations (Bowman (1982, 1984)). He found that by and large, troubled companies took more risk. Higher the trouble, the lower the rate of return, the higher the subsequent risk taking by the firm.

This behaviour was completely unexpected. The result of the behaviour was a negative correlation between risk and return for the class of troubled firms. Bowman christened it "the risk-return paradox" as it was clearly violating basic assumptions about a firm's expected behaviour. Bowman's original paper of 1980 offered a few tentative conjectures about the cause of finding a negative risk and return relationship. Bowman concluded that "The important linkage between the descriptive theory of security markets and the normative theory of corporate capital is rather poorly understood."

In the subsequent paper of 1982, Bowman offered a more substantive explanation of the negative risk and return relationship. Specifically, he brought in the Prospect Theory of Kahneman and Tversky (1979) to explain risk and return relation.

2.2 A Remark on the Measure of Risk

One obvious criticism of Bowman's study of risk return relationship is that it considers only total risk: in the tradition of CAPM, the systematic risk is more

important than the total risk. It is argued that in the capital market where trading of various securities are possible, anomalies of risk and return relationship can be eliminated quickly. Therefore, no negative risk and return relationship would be observed between systematic risk and return. As we have seen in the study of Friend and Blume, this presumption is false.

In fact, recent evidence has shown that even ardent advocates of beta have become disillusioned with it. Fama and French (1991) have the following comment on their summary of beta as an explanatory variable for risk: "The relationship between beta and average returns for 1941-1990 [for the stocks listed in the New York Stock Exchange] is weak, perhaps non-existent, even when beta is the only explanatory variable." Therefore, using beta (instead of the standard deviation) to salvage the positive relationship between risk and return seems to be ruled out.

There are several advantages of using the accounting measures as well: (1) Accounting data is more directly under managerial control regardless of the level of analysis (e.g., corporate versus business). (2) Accounting level data is used frequently by the regulatory agencies. (3) Private firms (and state controlled firms) only have accounting measures of performance. (4) For divisions of firms, only accounting measures are relevant.

2.3 A Sociobiological Explanation

Biologists and psychologists have long been studying various animal behaviour and comparing them with human behaviour. There are parallels. Not only are there parallels in the form of social behaviour of humans, there are parallels in organizational behaviour as well.

Risk aversion (or lack thereof) has been studied by psychologists and behavioral ecologists. For example, Hamm and Shettleworth (1987) ask "Do animals prefer a

variable outcome or a constant outcome if both have the same mean?" (p. 376). Clearly, it is a question of preference of higher variance over a lower variance with the same mean. In reviewing the literature, these researchers found that animals choose the constant outcome (or be risk averse) when the expected daily intake exceeds expected daily energy requirement; on the other hand, animals choose variable outcome (or be risk taking) when the expected daily intake falls short of daily energy requirement. This behaviour is quite consistent with the prospect theory if daily energy requirement is the "target" or "status quo" quantity.

It is tempting to draw the parallel between the behaviour of the firm and that of animals. There are some potential connections. However, before carrying the comparison too far, the exact nature of comparison must be fully understood.

Implicit parallelism between animals and individuals is abound in behavioral finance. Consider the following passage from Patel et al. (1991): "Migrating birds and trekking wildebeest all know the travelling in a group offers protection. Financial players also may migrate in herds, as when firms increase their debt equity, S&Ls invest in junk bonds, and banks increase their Third World debt holdings." (p. 234) The authors use the analogy but never explain why the parallel should hold.

Some researchers have attacked the problem of comparing individual behavior with animals head on. John Kegal and his associates devote their entire research program on animal experimentations. Kegal (1987), in a review of the literature of animal experiments in economics writes "The fundamental limitation inherent in animal experiments is the possibility that the results obtained with animal species are not applicable to humans." (p. 158) Later, he argues that "It is not clear that conscious optimization has anything to do with the mechanism underlying human agents' economic performance or that economic agents have to optimize consciously in order to satisfy the predictive implications of economic theory." (p. 160)

Therefore, most researchers seem to go back to Milton Friedman's position on the relevance of economic theory for explaining behavior: If the behavior is consistent with a simple model of optimization, we should entertain the model. In this sense, if the same model explains the behavior of animals, individuals and organizations, there is all the more reason to adopt that model.

2.4 Evidence that Target Matters

Setting up targets by decision makers is a fact of life. What is even more clear is that targets are mobile. They depend on the circumstance. However, it has been shown by repeated experiments with individuals, that targets shift in a predictable way. Take the following example from Crum et al (1980). There are four "gambles". A positive number in the gamble represents a gain and a negative number represents a loss. The gambles are named GI, GII, GI' and GII' respectively. In each gamble described below, the numbers represented are in the following format: (x,p; y,q; z,r) where x, y and z are dollar numbers and p, q and r are the associated probabilities (with p+q+r=1):

GI: ($14, 0.5; -$30, 0.1; -$85, 0.4)

GII: (-$20, 0.3; -$30, 0.5; -$45, 0.2)

GI': ($74, 0.5; $30, 0.1; -$25, 0.4)

GII': ($40, 0.3; $30, 0.5; $15, 0.2)

Crum et al asked different groups of individuals to choose between GI and GII. The overwhelming majority chose GI. On the other hand, when it came to a choice between GI' and GII', the majority chose GII'. It seems that the majority liked the "safety first" rule: make sure of some positive gain before anything else. GI was chosen over GII because GII was a "sure loss" in the sense that all possible outcomes had a negative dollar value. Similarly, the choice GII' was a "sure gain", no chance of

losing any money. However, once we notice that GI' was obtained by adding $60 to GI and GII' was obtained by adding $60 to GII', it becomes clear that such preferences are inconsistent with the standard form of expected utility hypothesis.

This example clearly demonstrates the importance of target to individual decision making. It is only natural to extend the concept to the behaviour of the firm and posit targets for them.

One routine form of analysis of the firm is "ratio analysis" (Foster (1978)). Various ratios (such as profitability ratio, return on equity, return on assets) are calculated for a firm and compared against a "norm". The norm typically takes the form of the industry median. If a firm has a particular ratio "better than" the industry median, it is considered to be a "good thing" for the firm. Therefore, the analysis performed by all researchers in this area entails an assumed target of industry median (rate of return).

However, the choice of target is not unique. March and Shapira (1992) takes the first step towards a debate of the type of target we need to consider. They compare five different models in a simulation exercise. Specifically, they look at how risk taking is affected by (1) threats to survival; (2) existence of resources in excess of current aspirations (or targets); (3) proximity to the target; (4) the ownership of resources; (5) self confidence.

2.5 Fiegenbaum and Thomas's work

Fiegenbaum and Thomas (1986, 1988) brought together a series of pre-prospect theory research and dissected them using behavioral decision theory methodology. They also analyzed data from 2,322 companies in 85 industries over a period of twenty years: 1960-1979. They performed an analysis by splitting the entire period into five year and ten year "windows". Their finding was that for an overwhelming

majority of industries, the dominant relationship between risk and return is negative for below industry median and positive for above industry median.

Fiegenbaum (1990) extended Fiegenbaum and Thomas's results further in several directions: (1) A new COMPUSTAT database produced data for 3,300 companies during 1977-84 segmented by activities in different industries. Thus, he was able to "decontaminate" his dataset from cross industry holdings by diversification. (2) Instead of simply finding correlations, he estimated the relationships between risk and return for each industry for two groups of firms: ones that have above median returns and ones that have below median returns. (3) He compared the risk and return relationships that exist above median categories with the ones that exist below median. He found that the below median categories had "steeper" slopes than above median categories. This finding was then related to a further confirmation of the Prospect Theory (see, however, Sinha (1992)).

2.6 International Evidence supporting Bowman's thesis

The evidence cited so far are US data. There may be some peculiarities of the US economic institutions that make the unexpected relationship between risk and return hold (tax laws, for example). Therefore, it is important to "diversify" and study the relationships between risk and return in other countries under a different set of conditions. There are two sets of evidence available so far outside of the US: Jegers (1991) for the Netherlands and Sinha (1992) for Australia. Neither of these studies are simple replications of the earlier studies. Hence, I shall discuss them in greater detail.

In addition to replication of the results of Fiegenbaum and Thomas, Jegers looks at additional variables: (a) For measures of return, he uses cash flow on equity and cash flow plus financial outlays on total assets (that is, over and above the measures of return on asset and return on equity); (b) For measures of risk, he argues that there

is no a priori reason to use the absolute measure of variance (or equivalently, standard deviation). Hence, he also measures the coefficient of variation.

Jegers finds that his results and that of Fiegenbaum and Thomas are strikingly similar for both below median and above median groups: for below median rates of return, most industries have a negative risk and return relationship and for above median rates of return, most industries have a positive risk and return relationship.

Sinha's research does not closely follow Fiegenbaum and Thomas's (1988) paper. Instead, it focuses on Fiegenbaum (1990) article. It confirms broad findings of Fiegenbaum for Australian data. However, it raises questions about the strength of relations above target and below target. Specifically, he shows: (1) The relationship between risk and return above median is weaker than the relationship below median. (2) There is little relation between above target relations and below target relation. This observation confirms what was observed by Cohen et al (1987) for individuals (Sinha's results are for firms). (3) The results are sensitive to extreme values in risk and return (as is to be expected from linear regressions).

3 Loose Ends

The discussion about the evidence in favour of a negative risk may convey an impression that the evidence is universal and it is accepted as such. However, that is not the case. A set of studies in the 1970s found that by and large there is a positive relationship between risk and return (for example, Conrad and Plotkin (1968), Hurdle (1974)). However, these earlier studies suffered from two major drawbacks: (1) The number of firms studied were small and the length of time they were observed was not long (compared with later studies); (2) The classification of the firms used was different. Specifically, the firms in each industry were not divided in "above median" and "below median" categories. As a result, the positive relation between

risk and return swamped the negative risk and return relation overall producing a positive risk and return relationship. More substantive criticism of the methodology came from Wiseman and Bromiley (1991).

3.1 Wiseman and Bromiley's detrending

Wiseman and Bromiley argue that Fiegenbaum and Thomas (1986, 1988) fail to take into account trends in returns in the data. Autocorrelation in the data produces non-stationarity of the series. Hence, estimates of means and variances are suspect. Consequently, the negative or positive relationship between mean and variance among a number of firms in a given industry may be spurious rather than a result of a substantive corporate behaviour.

Wiseman Bromiley do find trends in the data. They also find that a simple first order autoregressive filtering removes the trend quite well. Most importantly, after detrending, the resulting set still retain the negative risk return relationship below median return vindicating the results of Fiegenbaum and Thomas.

3.2 Potential for Further Studies

The potentials are far reaching. Obviously, replications in other countries will be useful to see how widespread the relationship really is. Also, decontamination of data by analyzing divisions of companies will extend the results.

A more substantive approach would be to build a theory of portfolio selection based on descriptive theories of decision making (such as the prospect theory). However, there are some analytical problems with such an approach. For example, absence of concavity everywhere for a utility function will lead to corner solutions. As a result, demand for some types of assets will be unbounded.

Prospect theory was very successful in dealing with a number of issues in decision making under uncertainty. However, it is not the only model to explain

risk taking below a threshold. There are other competing models such as Regret Theory of Loomes and Sugden (1982), Skew Symmetric Bilinear Utility Theory of Fisburn (1982) and local expected utility theory of Machina (1982). These theories are competitors of the prospect theory. What we need to establish is how we could find if one theory is superior to another in some sense.

4 Policy Implications

4.1 Junk Bonds in Portfolio

In the late 1980s, it became fashionable to put junk bonds in the portfolios of institutional investors (especially in the US). Even otherwise conservative pension funds and insurance companies added such high risk assets in their portfolios. The idea was, of course, to capture the high returns we usually associate with high risk. This strategy did not work for a large number of managers. What they got instead was high risk without the high return. In the light of Bowman's study of risk seeking by troubled firms, this outcome is not unexpected.

4.2 Aggressive Investment Strategies

It is usually asserted that investors need to keep a "balanced" portfolio. Operationally, it usually entails a fraction of the total portfolio being filled with assets that have large betas. This recommendation is often made for "aggressive investment strategies". The idea, is of course, higher risk will bring in higher return. However, as we have seen earlier, this is not the case. Higher risk does not necessarily mean higher return. Hence, portfolios with some assets that have high betas may not be a good bet after all.

5 Conclusion

Anomalies in finance have been taken seriously only over the past fifteen years. Many of the observations that violate various forms of market efficiency do not offer vary many alternative explanations.

The observed negative risk return relationship is very different in that respect. There is a structured theory underlying the observations. Hence, more work in this area will be quite fruitful.

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