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# A hypothesis: Portfolio theory is elegant but useless

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**Portfolio theory is an elegant but useless creature with a prodigious appetite for data. It is the sterile offspring of an unlikely marriage of finance and mathematics.**

## Introduction

According to Sharpe (1970), a portfolio can be defined as "the totality of decisions determining an individual's future prospects." From this definition it is evident that a portfolio can consist of many types of assets such as property and other real assets, as well as financial assets.

The focus of this paper will be concentrated on financial assets which are readily marketable. However, much of what follows can be applied to other assets with some modification. For our purposes, a portfolio is a combination of liquid assets, and portfolio theory deals with the selection and management of these assets.

The objective of this paper is to present the advantages and disadvantages of investor (as opposed to speculator) portfolio theory and compare current practice in the real world with the existing state in theory, in order to test the validity of the initial hypothesis.

It appears that, on most issues, there is usually either vigorous approval of the logic or otherwise equally vigorous disapproval. Rarely is there unanimous agreement on any particular point of theory or interpretation of empirical data. One of the few non-controversial concepts in investment management today is Markowitz's idea that proper diversification reduces risk. But, for several reasons, even this idea becomes controversial upon attempts at practical implementation.

## Underlying logic

Present-day theory of portfolio analysis prescribes a way of thinking about opportunities for investment. Instead of extensive evaluation of a single asset in isolation, the theory prescribes that investment policy can and should be formulated in the following manner: purchase an available asset if and only if that asset, when added to an existing portfolio, will cause a rise in overall personal satisfaction obtained from owning that portfolio. This may be brought about in the following ways:

1. The new asset can cause a net increase in total present expected return on the portfolio;
2. The new asset can cause a net decline in total risk exposure on the entire portfolio;
3. There can be some subjectively acceptable tradeoff between change in total risk and change in total expected return on the portfolio.

The object of optimal asset management is to identify and hold a portfolio which offers the minimum possible dispersion (minimum deviation) for a given or desired expected return. Therefore, in the classic Markowitz sense of portfolio selection, diversification becomes a search for a set of assets whose expected returns are high and where covariances of returns are low, or negative, thereby tending to produce a portfolio which

promises to be both profitable and unlikely to deviate far from expectations.

The formal methods and procedures for portfolio analysis have been documented in detail by many scholars (eg Markowitz, 1959; Sharpe, 1963). It would, therefore, be superfluous to recount these in detail; more important is an understanding of some of the difficulties encountered in actual practice, and of suggestions as to how to overcome the difficulties.

## Conceptual differences between theory and practice

There exists a wide disparity between the theory and practice of portfolio analysis and capital budgeting. The theory has been characterised by increased use of quantitative/mathematical tools and, whilst the practice has no doubt changed at the same time, business executives do not appear to have adopted many of the new techniques (Mao, 1970). The more fundamental differences are outlined below:

### *Concepts of risk*

**Theory** – A central aspect is the concept of risk. Most financial writers argue that firms should choose portfolios rather than projects, and they measure the risk of a portfolio by the variance of its return.\* This approach to the analysis of risk is a straightforward adaptation of Markowitz's quadratic programming model of portfolio selection.

Although the variance is easy to manipulate mathematically, financial writers have not been completely satisfied with the concept of risk. Markowitz (1959) himself had reservations about choosing variance as a measure of risk. Markowitz preferred semi-variance but settled for variance because of its ease of computation.

**Practice** – Business executives tend to consider investment risk as the prospect of not meeting the target rate – and are thus primarily concerned with *downside* deviations from the target rate of return. It appears that when the investment decision involves only a small portion of the resources of a company, risk is thought of as the prospect of not meeting some target rate of return, ie possibility of a loss. Indeed, upside deviations are sometimes referred to as upside potential, implying they are desirable.

However, when the investment concerns a large proportion of the company's resources, risk also involves the danger of insolvency. Further, the emphasis on downside risk indicates that their concept of risk is better described by semi-variance than by ordinary variance. If semi-variance is used by business executives, it may also be a risk concept used by security investors. If so, the definition of the risk of individual securities within a portfolio needs to be adjusted.

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\*Return could refer to either internal rate of return, net present value, payback period or some other measure. The term "return" is purposely left undefined to facilitate the formulation of the argument.

### Methods of incorporating risk

**Theory** – Let us accept variance as a measure of risk. How does current theory incorporate risk into investment analysis such that, given two investments with different return and different risks, the factors can be adjusted to reach a single figure with which to compare the investments? Two methods are used: the certainty equivalent approach and the risk adjusted discount rate. Whichever approach is used, the investor must also decide between the single project or the portfolio framework of investment selection.

**Practice** – The main problem here is the uncertain nature of the forecasts available to the executive. The real difficulty is the search for a reliable probability distribution of returns to base the decision upon. Thus, if a theorist begins his analysis with an assumed probability distribution, he has assumed away one critical aspect of the problem involved.

Further, although firms do use the portfolio approach to investment, the method of implementation and the reasons for its use differ from current theory. According to current theory, the investor obtains cash flows for the set of investments and, from these, derives the means, variances and covariances of the returns. He then chooses that portfolio of investments which gives the best combination of risk and return. However, in reality, since these project analyses are submitted *independently* by separate divisions of a company, no allowance is made in the risk assessment for the covariances between projects, ie they are thought of in isolation.

### Criteria for investment selection

**Theory** – Thus far the term *return* has been used in its generic sense, without defining it as internal rate of return (IRR), net present value (NPV), payback period or accounting profit, so that focus could be directed on the concept of risk. Current theory regards IRR or NPV as a better measure of return than either of the other two. Although theorists have advocated IRR and NPV for measuring return, they are aware that the majority of businesses still use the payback period and/or the accounting profit criterion (National Association of Accountants, 1967).

**Practice** – Mao (1970) found that in choosing between two investments, the application of an IRR (or NPV) criterion may result in the acceptance of those investments which have a higher level of earnings, but which also produce an erratic earnings per share pattern. Since the price-earnings ratio tends to vary directly with the stability of earnings, the strict application of an IRR criterion does not guarantee the maximum value for the firm. Mao (1970) contends that the payback period is primarily a risk measure, and this may account for its widespread use in practice.

### Practical problems in implementation

Firstly, using the original Markowitz model, the input data requirements are voluminous for portfolios of practical size (Cragg and Malkiel, 1968). Estimates of covariance are difficult to obtain and, if obtained, often have doubtful precision and reliability (Dietz, 1966).

Sharpe's (1963) single index model helps to alleviate this difficulty but another problem arises in that many analysts, in actual practice, also use this single index model to *explain* expected returns for an individual security.

It is true that *the market* does influence individual returns

(Fama, 1968) but it is also true that the sum of individual returns constitutes *the market*. Thus, since the individual returns interact to determine the market, a more general simultaneous system of equations may be more appealing for characterising price behaviour in financial markets (Fama, 1968).

A method of establishing the return on an individual security is by way of the Capital Asset Pricing Model, an offspring of portfolio theory – more about this later.

Secondly, because variance is used as *the* measure of risk, the model, if applied mechanically, as it often is in actual practice, can lead to wrong investment decisions (Renwick, 1969). It is important to note that variance is a useful surrogate for risk on account of its statistical properties. However, the formal definition of risk is: *a known probability distribution of possible outcomes*. Thus, variance fails to capture some elements of risk such as probability of loss or probability of bankruptcy. For a detailed analysis of risk, the reader is referred to Arditti (1967).

Further, because many analysts often think in terms of modal (ie most likely) values instead of mean values when anticipating returns, and fail to make the appropriate conversion, inputs to the model in practice often contain wrong or biased information.

Robichek, Cohn and Pringle (1972) documented their research into returns on alternative investment media and the implications thereof for portfolio construction. According to Robichek *et al* (1972), the reasonableness of predicting expected returns, standard deviations, and inter-investment coefficients is crucial to the success of a portfolio analysis. If mean returns and covariances tend to remain stable over time, then an analysis of *ex post* results will have value when it comes to making *ex ante* predictions. However, it is by no means safe to assume stability of these parameters over time, and considerable attention to this question is both justified and necessary.

### Assumptions of general portfolio theory

According to Koutsoyiannis (1982) general portfolio theory is based on the following assumptions:

1. Capital markets are efficient in that the prices of securities reflect all available information and that prices of individual securities adjust very rapidly to new information;
2. The goal of the rational investor is to choose the portfolio which maximises his expected utility;
3. The utility derived from a portfolio depends on its mean (expected) return and its standard deviation;
4. The decision-maker is risk averse;
5. The decision-maker can rank the various portfolios on the basis of their expected return and standard deviation (risk), with a set of indifference curves.

Dealing with the first assumption listed above (and the one the writer deems to be one of the most important), several studies have provided evidence that capital markets are efficient. The various tests are well summarised (see Koutsoyiannis, 1982). Fama (1970) deals with the weak, semi-strong and strong forms of the efficient market models and concludes that, in short, the evidence in support of the efficient markets model is extensive and that (somewhat uniquely in economics) contradictory evidence is sparse. This is not to mean that all issues are closed as, for instance, attention needs to be given to the development and testing of models of market equilibrium under uncertainty.

The other very important assumption is the assumption that the firm's management (when dealing with firm investors) can express its risk preference in the form of a set of indifference curves with the usual properties. In other words, the firm-portfolio approach assumes that there exists a collective managerial function which gives rise to indifference curves similar to those of an *individual* investor. In fact, a group utility function can be derived only under very restricted assumptions (Wilson, 1968). Thus, according to Koutsoyiannis (1982), the *practical* importance of this approach is questionable, given the amount of information required. However, Van Horne *et al* (1977) argue that the framework for evaluating combinations of risky investments implied by the firm-portfolio approach is *quite useful* even if the managerial utility function is not defined, in that managers can use subjective judgement (based on return/risk trade-off) once the various options are plotted on a two-dimensional scattergram. Koutsoyiannis (1982), however, disagrees with this argument, citing Wilson (1968), whose research concludes that a group utility function could be derived only under very restricted assumptions.

**Assumptions of the stockholder-portfolio approach: The capital asset pricing model (CAPM)**

The CAPM is a refinement of the general portfolio theory and is based on the following assumptions:

1. Investors have homogeneous expectations, ie investors view the opportunity set of individual securities in the same way with respect to expected return and risk of each asset, and the correlations of the returns among all pairs of securities;
2. Capital markets are perfect, with no transaction or other costs, no taxes and (costless) information to all traders, who are price takers. Furthermore, capital markets are efficient;
3. Investors have identical time horizons;
4. Investors can borrow and lend funds at the riskless market interest rate.

While these restrictions may appear to be severely limiting, they are similar to those made in the standard economic theory of the firm and in the basic models of Modigliani — Miller, Gordon and others. Further, the critical extensions in the literature that seek to relax the basic CAPM assumptions yield results that are generally consistent with the basic theory (Weston and Brigham, 1979). In addition, according to Weston and Brignam (1979), the CAPM has been used in several property rate assessment cases and civic court actions in the USA, where its advocates have stood up well under expert cross-examination.

According to Koutsoyiannis (1982), when the above assumptions are relaxed, the CAPM can be used for an approximate estimation of the return-risk trade-off for individual securities or portfolios, but that *the model loses its precision*. Koutsoyiannis (1982) goes on to conclude that the presence of market imperfections and other assumptions render the CAPM strictly inapplicable. Some authors (eg Mayo, 1971) have developed models in which some of the assumptions of the CAPM are relaxed. Such theoretical work shows that the CAPM is fairly robust, in that its predictions are not substantially different as compared with those obtained when the assumptions are fulfilled. However, in general, the more serious the imperfections, the less precise and clear the model becomes.

**Empirical evidence**

Most advanced capital budgeting procedures appear to be used or seriously considered by a small number of firms, mostly large firms and in industries with high investment rates and rapid changes (Klammer, 1972). Most other firms tend to rely on methods which are simpler and theoretically less satisfactory (eg the payback method).

According to a survey conducted and documented by Klammer (1972), the percentage number of firms having full-time capital budgeting staff rose from 45% in 1959 to 56% in 1970. Surprisingly, only 31% of the respondents said they were using some specific, formal method of dealing with (analysing) risk. In fact, only 13% acknowledged determining probability distributions in risk analysis and only 3% undertook the measuring of the covariance of investments. When questioned about the use of management science techniques generally, the results were as follows:

	1970	1959
Computer simulation	28%	4%
Probability theory	32%	5%
Decision theory	9%	3%
Utility theory	4%	0%

Interestingly enough, firms in the heavy industry sector reported the heaviest use of advanced techniques.

Klammer (1972) concluded that the use of complex investment tools is increasing, albeit slowly, and that traditional methods, such as the payback method, are declining in popularity.

Mao and Helliwell (1969) conducted interviews with the operating and financial management of three Canadian companies. Admittedly, a sample size of three does not permit conclusive statements to be made but does provide areas for discussion.

Since the executive committees of the companies concerned evaluate all projects, they are in a good position to employ the portfolio approach. In fact, because all of the firms had more acceptable projects than their budgets would incorporate, capital rationing alone would force them to adopt it. Moreover, they were aware of the risk implications of the portfolio approach.

Although the committees employed the portfolio approach, neither the kind of data they received nor their concept of risk allowed them to understand fully the benefits of diversification. Moreover, their aversion to risk tends to exclude from consideration all but the relatively safe investment prospects. In other words, the proposals top management receive do not contain the figures necessary for valuating project risks formally on a portfolio basis. This raises the question of what top management considers as investment risk and whether they take into account the correlation between projects in the measurement of risk. In all three companies, risk is understood as the variability of investment returns but the emphasis of the decision-makers falls heavily on the probability of loss.

Further, there is evidence that whilst executives may not understand the formal theory of diversification, they do know that diversification reduces risk. They do not understand, however, that, unlike return, the risk of a portfolio is not a linear function of the individual risks making up the portfolio.

Mao and Helliwell (1969) went on to make the following recommendations:

1. That much more research must be done on the market rate of substitution between risk and return before companies could use this concept in their decisions. Indeed, it may turn out that the risk characteristic of equity shares cannot be measured in such a way as to derive any useful estimate of the price of risk-bearing.
2. A better definition of risk at the conceptual level is necessary. It will probably become necessary to deal with inter-temporal as well as inter-project and inter-program covariances.
3. The theory of optimal capital structure must be made more specific and some quantification made of the consequences of alternative financing patterns if businessmen are to analyse investment and financing as inter-dependent decisions.

The writer took the step of approaching various institutions/firms continuously involved in investing, with a view to establishing the current state-of-the-art of portfolio theory as practised in South Africa. Obviously, the sample size precludes the drawing of definitive conclusions. The results are tabulated below:

Firm/Institution	Use of portfolio theory	Remarks
1. Firm of stock Brokers (1)	Non-existent	Determine the asset value of the company per share. This is used as a yardstick for comparing the strength of a company in relation to market prices.
2. Life insurance company (1)	Yes	Undertake "beta" studies, relative risk studies and risk/return trade-off. Market is not perfect so portfolio theory not wholly applicable. Growing awareness of portfolio theory. Acts as a discipline. No computer simulation.
3. Firm of stock brokers (2)	Yes	Use portfolio theory – calculate beta's – published in reports.
4. Firm of stock brokers (3)	Non-existent	Use a purely subjective approach. Each partner may view the market differently.
5. Life insurance company (2)	Non-existent	Each investment is decided upon on its own merits (return, risk, etc). Aim primarily at debentures. (Blue-chips)
6. Life insurance company (3)	Yes	Used in portfolio selection.

From the above, it can be seen that the use of portfolio theory in South Africa does not appear to be widespread as yet, but is certainly undertaken by some institutions. A formal research survey would be needed to establish the exact extent of the usage.

### Conclusion

The writer is of the opinion that attention should be directed to the words *useless* and *sterile* in the initial hypothesis, as these words encapsulate the issues at hand.

It is felt that no definitive conclusions can be drawn regarding the *potency* of portfolio theory, but serious drawbacks are the semantic and statistical barriers that exist, preventing the average businessman from coming to grips with the approach.

Indeed, this same point is made by Barr Rosenberg, the Berkeley professor who is one of the reigning "guru's" of portfolio theory, in arguing its merits. *If you were to explain in English and in neutral language the principles by which a portfolio is constructed under portfolio theory, one would find that many people who regard themselves as traditionalists would agree. So I think there is more aversion to the language used, and to the computers, than there is to the conceptual framework.*

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