ANALYSIS OF THE PORTFOLIO MANAGEMENT METHODS

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ABSTRACT. The research provides a selective overview of existing models since Markowitz model (1952) and synthesizes the academic research to date. Following, a comparison between 5 of these models will be made from the point of view of their advantages/disadvantages and limits. The last part of the research will present the results that will be obtained after applying the models on the Romanian capital market and will also observe which of the five models will be more suitable for the Romanian market.

Keywords: portfolio management, portfolio models

Introduction

In recent years, a growing body of literature in portfolio management has devoted a great deal of attention for this subject. The theoretical foundation to portfolio management was offered by Harry Markowitz at the beginning of the 1950s. The limitations of the original Markowitz model have stimulated the occurrence of extended or modified models – two of the best known (and criticized) being the equilibrium models: CAPM (capital asset pricing model) and APT (arbitrage pricing theory). Alternative optimization methods were also developed; among them must be mentioned: the utility function optimization, conditional value-at-risk optimization, multiple benchmark tracking, scenario-based optimization, robust statistical methods and the Bayesian methods.

Material and methods

The research, in the first part, provides a selective overview of existing models since 1952 (Markowitz model) and synthesizes the academic research to date. The second part refers to some of the models already presented and studies them from the point of view of their advantages/disadvantages and limits. In this part is also presented a comparison of the fifth models (Markowitz, CAPM, APT, Var and Monte Carlo simulation). The last part of the research will present the results that will be obtained after applying the models on the Romanian capital market and will also observe which of the five models will be more suitable for the Romanian market.

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Discussions

In 1952, Harry M. Markowitz published an article entitled “Portfolio Selection”. In this article, he developed the first mathematical model that specified the volatility reduction that occurs in a portfolio as a result of combining investments with different patterns of return. The amazing thing about his accomplishment is that he developed his thesis over a half century ago, long before the advent of the modern computer. His influence on the world of modern finance and investment management has been so profound that he became known as the father of modern portfolio theory and was awarded the Nobel Prize for Economics in 1990.

Before modern portfolio theory, investment management was a two dimensional process focusing primarily on the volatility and return characteristics of individual securities. Markowitz’s work resulted in the recognition of the importance of the interrelationships among asset classes and securities within portfolios. Modern portfolio theory added a third dimension to portfolio management that evaluates an investment’s diversification effect on a portfolio. Diversification effect refers to the impact that the inclusion of a particular asset class or security will have on the volatility and return characteristics of the overall portfolio.

Modern portfolio theory thus shifted the focus of attention away from individual securities toward a consideration of the portfolio as a whole. The notion of diversification had to be simultaneously reconsidered. Optimal diversification goes beyond the idea of simply using a number of baskets in which to carry your eggs. It also places major emphasis on finding baskets that are distinctly different from one another. This is important because each basket’s unique pattern of returns partially offsets the others, with the effect of smoothing overall portfolio volatility.

An alternative view of risk has been derived from extensive work in portfolio theory and capital market theory by Markowitz, Sharpe, and others. These prior works by Markowitz and Sharpe indicated that investors should use an external market measure of risk. Under a specified set of assumptions, all rational, profit maximizing investors want to hold a completely diversified market portfolio of risky assets, and they borrow or lend to arrive at a risk level that is consistent with their risk preferences. Markowitz showed that the variance of the rate of return was a meaningful measure of portfolio risk under a reasonable set of assumptions, and he derived the formula for computing the variance of a portfolio. This portfolio variance formula indicated the importance of diversifying your investments to reduce the total risk of a portfolio but also showed how to effectively diversify.

Following the development of portfolio theory by Markowitz, two major theories have been put forth that derive a model for the valuation of risky assets. One of these two models is the capital asset pricing model (CAPM). The background on the CAPM is important at this point in the book because the risk measure implied by this model is a necessary input for our subsequent discussion on the valuation of risky assets. The presentation concerns capital market theory and the capital asset pricing model that was developed almost concurrently by three individuals. Subsequently, an alternative multifactor asset valuation model was proposed, the arbitrage pricing theory (APT).
Several authors have contributed to the Capital Asset Pricing Model (CAPM). Sharpe (1963, 1964) is considered to be the forerunner and received the Nobel Prize in 1990. Treynor (1961) independently developed a model that was quite similar to Sharpe’s. Finally, Mossin (1966), Linter (1965, 1969) and Black (1972) made contributions a few years later.

This model is the first to introduce the notion of risk into the valuation of assets. It evaluates the asset return in relation to the market return and the sensitivity of the security to the market. It is the source of the first risk-adjusted performance measures. Unlike the empirical market line model, the CAPM is based on a set of axioms and concepts that resulted from financial theory.

The capital asset pricing model (CAPM), which is a model that indicates what should be the expected or required rates of return on risky assets. This transition is important because it helps you to value an asset by providing an appropriate discount rate to use in any valuation model. Alternatively, if you have already estimated the rate of return that you think you will earn on an investment, you can compare this estimated rate of return to the required rate of return implied by the CAPM and determine whether the asset is undervalued, overvalued, or properly valued.

The latter was developed by Sharpe in order to simplify the calculations involved in the Markowitz model and thereby render it more operational. The next step in financial modeling was to study the influence of the behavior of investors, taken as a whole, on asset prices. What resulted was a theory of asset valuation in an equilibrium situation, drawing together risk and return.

It provides a powerful description of the relationship between volatility and expected return in an efficient capital market. As is the case with most models, simplifying assumptions are made to abstract the essence of the relationship being modeled.

Various extended models of the original CAPM have been developed since the mid-1960s, as well as other models concerning security pricing. For example, Arbitrage Pricing Theory asserts that multiple factors, in addition to market volatility, are involved in security pricing. The CAPM has been criticized on the basis of its unrealistic assumptions and as not providing a completely accurate description of real-world security pricing. It nevertheless remains a powerful model that highlights the importance of diversification and the relationship between no diversifiable volatility and security expected returns.

In 1976, Ross proposed a model based on the principle of valuing assets through arbitrage theory (Roll and Ross, 1980). This model, called the Arbitrage Pricing Theory (APT) model, is based on less restrictive assumptions than the CAPM. While the CAPM assumes that asset returns are normally distributed, the APT does not hypothesis on the nature of the distribution. The APT model does not include any assumptions on individuals’ utility functions either, but simply assumes that individuals are risk averse. This simplification of the assumptions allows the model to be validated empirically.
The chief difference between the CAPM and the APT is that the latter specifies several risk factors, thereby allowing for a more expansive definition of systematic investment risk than that implied by the CAPM’s single market portfolio.

The arbitrage pricing theory (APT) is an interesting and powerful alternative to the CAPM for forecasting expected returns. The APT postulates a multiple-factor model of excess returns.

The APT requires less stringent assumptions than the CAPM and produces similar results. This makes it sound as if the APT is a dominant theory. The difficulty is that the APT says that it is possible to forecast expected stock returns but it doesn't tell you how to do so. It has been called the "arbitrary" pricing theory for just this reason. The CAPM, in contrast, comes with a user's manual. The APT states that each stock's expected excess return is determined by the stock's factor exposures. For each factor, there is a weight (called a factor forecast) such that the stock's expected excess return is the sum over all the factors of the stock's factor exposures times the factor forecasts.

Next to this is important also the study of other two models: Value-at-Risk and Monte Carlo simulation.

While the term “Value at Risk” was not widely used prior to the mid 1990s, the origins of the measure lay further back in time. The mathematics that underlies VaR was largely developed in the context of portfolio theory by Harry Markowitz and others, though their efforts were directed towards a different end – devising optimal portfolios for equity investors. In particular, the focus on market risks and the effects of the co-movements in these risks are central to how VaR is computed.

In financial mathematics and financial risk management, **Value at Risk (VaR)** is a widely used measure of the risk of loss on a specific portfolio of financial assets. For a given portfolio, probability and time horizon, VaR is defined as a threshold value such that the probability that the mark-to-market loss on the portfolio over the given time horizon exceeds this value (assuming normal markets and no trading in the portfolio) is the given probability level.

The definition of VaR is nonconstructive, it specifies a property VaR must have, but not how to compute VaR. Moreover, there is wide scope for interpretation in the definition.

Supporters of VaR-based risk management claim the first and possibly greatest benefit of VaR is the improvement in systems and modeling it forces on an institution. In 1997, Philippe Jorion wrote: ‘The greatest benefit of VAR lies in the imposition of a structured methodology for critically thinking about risk. Institutions that go through the process of computing their VAR are forced to confront their exposure to financial risks and to set up a proper risk management function. Thus the process of getting to VAR may be as important as the number itself’.

There are three basic approaches that are used to compute Value at Risk, though there are numerous variations within each approach. The measure can be computed analytically by making assumptions about return distributions for market risks, and by using the variances in and covariances across these risks. It can also be estimated by running hypothetical portfolios through historical data or from Monte Carlo simulations.
The first two steps in a Monte Carlo simulation mirror the first two steps in the Variance-covariance method where we identify the markets risks that affect the asset or assets in a portfolio and convert individual assets into positions in standardized instruments. It is in the third step that the differences emerge. Rather than compute the variances and covariances across the market risk factors, we take the simulation route, where we specify probability distributions for each of the market risk factors and specify how these market risk factors move together.

**Monte Carlo methods** are a class of computational algorithms that rely on repeated random sampling to compute their results. Monte Carlo methods are often used when simulating physical and mathematical systems. Because of their reliance on repeated computation and random or pseudo-random numbers, Monte Carlo methods are most suited to calculation by a computer. Monte Carlo methods tend to be used when it is unfeasible or impossible to compute an exact result with a deterministic algorithm.

Monte Carlo methods are useful for modeling phenomena with significant uncertainty in inputs, such as the calculation of risk in business. It is a widely successful method in risk analysis when compared to alternative methods or human intuition.

The name "Monte Carlo" was popularized by physics researchers Stanislaw Ulam, Enrico Fermi, John von Neumann, and Nicholas Metropolis, among others; the name is a reference to the Monte Carlo Casino in Monaco where Ulam's uncle would borrow money to gamble. The use of randomness and the repetitive nature of the process are analogous to the activities conducted at a casino.

Random methods of computation and experimentation (generally considered forms of stochastic simulation) can be arguably traced back to the earliest pioneers of probability theory, but are more specifically traced to the pre-electronic computing era. The general difference usually described about a Monte Carlo form of simulation is that it systematically "inverts" the typical mode of simulation, treating deterministic problems by first finding a probabilistic analog. Previous methods of simulation and statistical sampling generally did the opposite: using simulation to test a previously understood deterministic problem. Though examples of an "inverted" approach do exist historically, they were not considered a general method until the popularity of the Monte Carlo method spread.

**Conclusions**

Thus, Markowitz's optimization model turns out to be particularly appropriate for handling the problem of asset allocation, because the number of asset classes is limited. The number of calculations to be carried out thus becomes reasonable. The input data are the means and the variances, estimated for each asset class, and the correlations between the asset classes. The model provides the optimal percentage to assign to each asset class to obtain the best return for a given level of risk. This optimization can be produced by defining the constraints linked to the manager's investment style: for example, holding a minimal percentage of stocks in the portfolio.
The capital asset pricing model (CAPM), although much maligned, remains as perhaps the most popular tool for quantifying and measuring risk for equities in academic circles and in the investment industry in the USA, but is less popular with the UK investment community. The main attraction of the CAPM is the simplicity of its predictions. However, according to detractors of the model, the simplicity is achieved at the expense of a realistic view of how financial markets work.

The APT describes the mechanism of arbitrage whereby investors will bring an asset which is mispriced, according to the APT model, back into line with its expected price. APT thus assumes "arbitrage in expectations" - that arbitrage by investors will bring asset prices back into line with the returns expected by the model portfolio theory. The APT along with the capital asset pricing model (CAPM) is one of two influential theories on asset pricing. The APT differs from the CAPM in that it is less restrictive in its assumptions. It allows for an explanatory (as opposed to statistical) model of asset returns. It assumes that each investor will hold a unique portfolio with its own particular array of betas, as opposed to the identical "market portfolio". In some ways, the CAPM can be considered a "special case" of the APT.

Value at Risk is a technique used to estimate the probability of portfolio losses based on the statistical analysis of historical price trends and volatilities and it measures the potential loss in value of a risky asset or portfolio over a defined period for a given confidence interval.

Var can also be estimated by running hypothetical portfolios through historical data or from Monte Carlo simulations.

Monte Carlo simulation represents a problem solving technique used to approximate the probability of certain outcomes by running multiple trial runs, called simulations, using random variables. Its power comes from the freedom you have to pick alternate distributions for the variables. In addition, you can bring in subjective judgments to modify these distributions.
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