WILLIAM F. SHARPE

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Financial markets form an indispensable part of well-functioning modern market economies. Their impact upon the development of the main macro-economic parameters such as economic growth, employment and balance of payments has been growing in importance. These markets are a vehicle for transferring savings from different sectors of the economy to firms, which in turn transform them in investments into buildings, equipment, and modern technologies. Financial markets are therefore an important indicator and accelerator of economic development.

The theory of financial markets is relatively new. In commemoration of Alfred Nobel, the Swedish Royal Academy of Sciences gave the prize for economics for the year 1990 to the pioneers in this area, Harry M. Markowitz, William F. Sharpe and Merton Miller, whose research laid the foundations of the economic theory of finance.

William F. Sharpe was born in Boston, Massachussets on June 16, 1934. He received his secondary-level schooling from eminent public schools in Riverside, California. In 1951 he enrolled for the study of medicine and natural sciences at the University of California at Berkeley. After one year, however, he found that his interests lay somewhere else, and so he went to the University of California at Los Angeles, where he chose as his major subjects corporate management, accounting and economics. In 1955 he received the degree of Bachelor of Economics and in 1956 he obtained the academic masters degree.

Sharpe's future career was notably influenced by two UCLA professors. First and foremost it was Professor of Economics Armen Alchian, under whose influence he came to be enchanted by the theory of microeconomics. He taught his students to challenge everything, to concentrate on the main issues and disregard inessential ones, but most importantly, he was able to perfectly defend his own thoughts.

Fred Weston, Professor of Finance, under whose leadership Sharpe worked as a research assistant, not only introduced him to the work of Harry Markowitz, which at that time initiated the revolution in the field of finance, but also recommended him to consult with Markowitz on the topic of his dissertation entitled "Analysis of Portfolio Based on Simplified Model of Relationships Between Securities". Sharpe defended this dissertation in 1961, winning the PhD. degree. At the same time, he moved to Seattle and started to teach finance, microeconomics, statistics, operational research and computer science at the Business School at the University of Washington, where he stayed until 1968.

In his dissertation work, Sharpe dealt in particular with the positive theory of securities market behavior. The closing chapter of this paper contained results similar to those nowadays referred to as the securities market line relationship, but under the restricted conditions of a one-factor model.

In 1963, he published a paper summarizing the normative conclusions from his dissertation work in Management Science, and later on he expanded it for the generalization of the theory of equilibrium contained in the concluding chapter of his dissertation. In terms of its title as well as contents, this paper constituted a basis for what was later termed the Capital Asset Pricing Model (CAPM).

In 1968 W. Sharpe moved to the University of California at Irvin, where he was supposed to take part in an attempt to create a school of social sciences with quantitative and interdisciplinary orientation, which was not particularly successful. That is why he left for the Stanford University Graduate School of Business in 1970. At that time he finished the book called Portfolio Theory and Capital Markets, which summarized his research up to that date, with a focus on the issues associated with the equilibrium of capital markets and impacts on investors' portfolio choice.

In 1973, W. F. Sharpe was appointed the Professor of Finance at Stanford University. He extended his research into the role of the investment policy of funds, focusing on the discharge of obligations with regard to the payment of pension benefits. At that time he wrote his first textbook, Investments, which was published in 1978. It provided a summary of institutional, theoretical and empirical issues in the area of financial market investments and its publication met with great success. Its fourth edition, co-authored by Gordon Alexander, has already been published. The work on this textbook led Sharpe to extend his original theories and conduct new empirical analysis. This resulted in the formation of a binomal process of option pricing, which provides a practical method for valuing instruments involving multiple put options and is widely used today. He also developed a simple, but efficient method – namely a portfolio analysis algorithm.

Apart from theoretical research, W. F. Sharpe also pursued the issue of practical utilization of findings made as part of the economic theory of finance. During the course of his entire research, he cooperated with a number of organizations in the area of investment. He sat on the Board of Directors of numerous investment firms and trusts. He worked as a consultant for Merril Lynch, Pierce, Fenner and Smith and Wells Fargo Investment Advisors. In 1980 he was elected the President of an American financial corporation. His main focus was on decent-

ralized investment management, but he also continued his work on issues relating to the investment policy of pension funds, studied the process of generation of earnings in the American market for shares, as well as the allocation of investors' funds to the main classes of assets. In order to make his findings available to the public at large, he developed a program to optimize software and databases under the title of Asset Allocation Tools.

In 1983 W. Sharpe was involved in the international investment management program offered by the Geneva International Management Institute, and later by the London Graduate School of Business as well as the Nomura School of Advanced Management. He aimed to acquaint domestic and foreign investment specialists practicing in the field of investment with the latest findings of the economic theory of finance.

In 1986 he founded the Sharpe-Russel Research, a firm targeted at the research and development of procedures intended to help pension funds and foundations in making decisions about the allocation of assets, as well as the provision of consulting services.

In 1989 he became Emeritus Professor of Finance at Stanford University, and mainly focused on research and consulting for his company William F. Sharpe Associates.

W. F. Sharpe holds a number of acknowledgments for outstanding contributions he made while lecturing on and researching into the science of finance. In 1990 he was awarded The Nobel Prize for Economics for the formation of the Capital Asset Pricing Model.

In 1986 he got married. His wife, Kathryn, is a painter and trustee of William F. Sharpe Associates. Sharpe has two children – daughter Deborah and son Jonathan. His hobbies include yachting, opera, as well as American football and basketball matches.

The Contribution of W. Sharpe to the Science of Economics

The contribution W. Sharpe made towards the economic science is very weighty and can be classified as falling under the micro-economic theory of the capital market. According to his own words, he has always stayed within the confines of positive economics, which enabled him to develop a descriptive model of capital asset pricing.

Markowitz's theory of portfolio choice presupposes that the prices of securities are given and, assuming this, it defines a procedure followed by a optimizing investor in his behavior. Therefore the next necessary analytical step was to explain how prices of various assets are determined. The answer – although very simple at first glance, that is by means of demand for and supply of securities – however requires the definition of factors determining this demand and supply. That is why Sharpe concentrated on the determination of economic equilibrium through the price mechanism operating in the capital market. Drawing upon elementary microeconomic theory it holds true that current market prices for any security must always stand at such a level, where the number of each particular security demanded equals the number of this security offered. For this reason, a decisive role in his model is played by the examination of the market portfolio. In Sharpe's view, from among a vast number of factors determining the capital market demand and supply, it is especially an equilibrium relationship between the risk and return that is decisive. He arrived at this conclusion based on a model known as:

The Capital Asset Pricing Model – CAPM

Like any other model, the CAPM relies on certain simplifying assumptions:

- investors appraise their portfolios according to expected return and standard deviation over a certain period of time;
- they have an aversion to risk;
- there is a risk-free rate, at which an investor may lend or borrow money, which is identical for all investors;
- taxes and transaction costs are negligible;
- information is freely and immediately available to all investors;
- investors have homogenous expectations, which means, they have the same attitudes with respect to the expected returns, standard deviation and covariance of securities.

It is evident from the said assumptions that securities are assumed to be perfectly competitive under this model. These assumptions made it possible for Sharpe to examine what happens to the prices of securities if everybody invests in a similar manner, and thus to derive the essence of the resulting equilibrium relationship between the risk and return of any security.

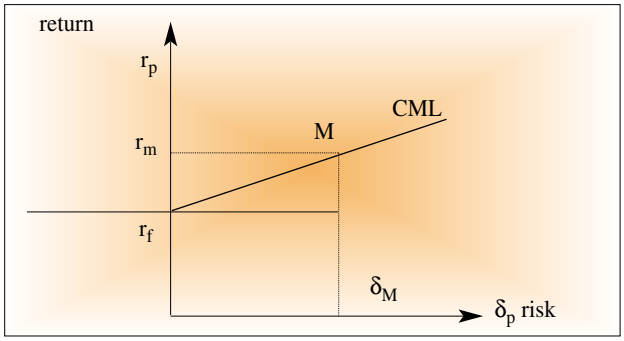
A very important feature of the CAPM is the so-called separation theorem, which reads as follows: an optimum combination of risky securities can be determined without any knowledge about the investor's attitude towards risk and return. The separation theorem relies on the attribute of a linear efficient set, due to which all the portfolios located within the linear effective set consist of a combination of one portfolio solely formed of risky assets, involving either a risk-free investment or risk-free lending. From this it follows that the risky portion of any investor's portfolio is independent of the investor's attitude towards return and risk.

Another important attribute of the CAPM relying on the separation theorem is that at the equilibrium point, any security must have a non-zero share in the portfolio mix. That is to say, if no investments were made into securities with a share in the portfolio of zero, the prices of securities with a zero share would have to drop, thus leading to an increase in the expected return – up to the point at which they acquire a non-zero proportion. When the leveling of prices is stopped, the market reaches an equilibrium state, where it holds true that:

- every investor will want to hold a certain amount of each risky security;
- the current market prices of any security will stand at the level, where the number of shares of each demanded security equals the number of shares offered;
- a risk-free rate is at the level where the total amount of money borrowed equals the amount lent.

This will result in a portfolio mix known as a market portfolio. The market portfolio (M) plays a key role in the CAPM and is defined by Sharpe as follows: it is a portfolio formed of investments in all securities in such proportions that a portion invested in an individual security corresponds to its relative market value. The relative market value of a security equals aggregate market value of the security divided by the sum of aggregate market values of all securities.

An efficient set is formed of an investment in the market



portfolio associated with a required number of risk-free loans or borrowings. With the use of the CAPM it is possible to determine a relationship between the risk and return of efficient portfolios.

The efficient portfolios diagram is defined by a line comprising different combinations of risk and return obtained through the combination of market portfolio with risk-free loans or borrowings. This CAPM linear efficient set is known as a capital market line (CML):

The M point represents a market portfolio, r_f represents a risk-free interest rate and rp and δ_p stand for expected value and standard deviation of an efficient portfolio. Efficient portfolios chart is a line which starts at rf and passes through M. Any portfolios employing a portfolio other than the market portfolio, and risk-free loans and borrowings would lie below the CML. The CML angular coefficient equals the difference between an expected return of the market portfolio and the expected return of a risk-free security $r_m - r_f$ divided by the difference between their risks. That is why a line characterizing the CML has the following shape: $r_p = r_f + \delta_p [(r_m - r_f)/\delta_m]$.

The capital market equilibrium can be characterized by two key values. The first one equals a section on the vertical axis of the CML (i.e. the risk-free rate) and is frequently referred to as the compensation for waiting. The second value is defined by the CML angular coefficient and is frequently referred to as the compensation for a unit of risk. That is why the capital market is basically a place where trading is done at prices determined by supply and demand relative to time and risk. Since the CML represents an equilibrium relationship between the expected return and standard deviation of efficient portfolios, individual securities will always be represented below this line, since an individual security held separately does not constitute an efficient portfolio.

When using the CAPM, every investor would want to know the standard deviation of his market portfolio, since it is going to influence the amount of his investments. The contribution of any security towards the market portfolio standard deviation depends on the magnitude of its covariance with the market portfolio. The covariance between a security and the market portfolio – δ_{im} is therefore an essential rate of risk for the security, which means that securities having higher values of δ_{im} will be considered, from the point of view of investors, to be securities contributing towards the market portfolio overall risk to a greater extent, but should not be considered as more risky than securities with lower standard deviations. This is due to the fact that securities with greater values of δ_{im} will have to yield proportionally greater return in order for investors to become interested in their purchase. In the opposite case these securities would be eliminated from the portfolio, which would however lead to an increase in the market portfolio expected return relative to the standard deviation. The prices of securities would then not be at equilibrium. That is why the equilibrium relationship between the risk and return had the precisely the following shape: $r_i = r_f + [(r_m - r_f)/\delta^2_m] \delta_{im}$

This relationship between the covariance and expected return is known as a securities market line (SML), which can also be expressed as: $r_i = r_f + (r_m - r_f)\beta_i$, where the β_i coefficient is defined as $\beta_i = \delta_{im}/\delta_m{}^2$.

The Beta factor – β_i of a security is an alternative way of expressing the security's covariance risk. One of the properties of Beta is that the Beta portfolio is a weighted average of Betas of individual securities forming this portfolio, where the respective weights are represented by proportions at which investments are made in individual securities. This is why the Beta factor constitutes the essential rate of risk for a security. This means that the Beta portfolio is calculated according to the relationship: $\beta_p = \Sigma_i{}^N{}_{=1} X_i \beta_i$.

The equilibrium relationship expressed by SML is based on the impact of investors' adjustments to securities holdings on prices. If a set of securities prices is given, investors will calculate expected returns and covariances, and then determine their optimum portfolios. If the number of securities demanded in the aggregate differs from the number of securities offered, a pressure to increase or decrease their prices arises. Investors will reevaluate their securities holdings until consistency between the number demanded and offered is reached. Individual securities are valued according to their contribution towards the market portfolio standard deviation, where this contribution can be measured with the use of the Beta factor. This is how the securities are priced under the CAPM.

The best known works of W. F. Sharpe

What makes the contribution of W. F. Sharpe's work even more valuable is the fact that he always reflected upon the practical utilization of the theory of finance. That is why he published a great number of articles in different periodicals. It would take several pages to list them all. Thence we shall only refer to his most important summary works:

- The Economics of Computers (1969)
- Portfolio Theory and Capital Markets (1970)
- Introduction to Managerial Economics (1973)
- The capital asset pricing model: A multi-beta interpretation (1977)
- Investments (1978)
- Asset Allocation Tools (1985)
- An algorithm for portfolio improvement (1987)
- Fundamentals of Investments (1989)