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LATEST NOBEL FOR ECONOMICS (OR NOBLE FINANCE?): A GLIMPSE^{*}

Sentayehu Teferra

ABSTRACT: *The Nobel Prize for economics in 1990 was shared by three U.S. scholars for their contributions to the discipline of corporate finance in the closely related areas of portfolio theory (Harry Markowitz), capital market theory (William F. Sharpe), and the effect of capital structure on market valuation (Merton H. Miller). The most prominent feature shared by the three models is the critical role played by the risk factor in determining the value of financial assets. A glimpse of their contributions:*

Writing about the Nobel Prize for economics in 1990--shared by Harry Markowitz (City University of New York), William F. Sharpe (Stanford University), and Merton H. Miller (University of Chicago)--the *Economist* (October 20, 1990) credited corporate finance for the award with the additional reminder that the recognition had been long overdue. The three scholars were honored for their original and insightful work in the spheres of **portfolio theory** (Markowitz), **capital market theory** (Sharpe), and the **theory of capital structure and market valuation** (Miller). The rallying point of the three models is inquiry into the nature of value in an environment of uncertainty surrounding the outcome of investment decisions, or the risk-return paradigm.

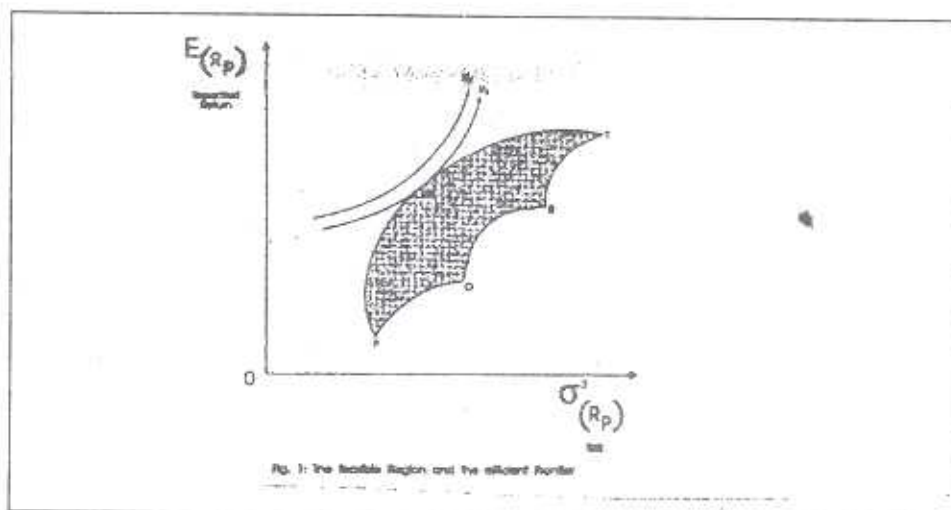
Portfolio Theory

The genesis of portfolio theory perhaps can be traced back to ancient agrarian society--subsequent to the discovery of the chicken or the egg, whichever came first--when something unexpected happened on the way to the market: man dropped the first basket of eggs. Like the apple drop that serendipitously led to the discovery of the theory of gravity by waking napping Newton with a knock on the temple, the drop of the basket of eggs must have inspired the notion of diversification as expressed in the risk of **putting all one's eggs in one basket**. The egg and basket aphorism remained the conventional wisdom of diversification until 1952, when Harry Markowitz hatched portfolio theory to address explicitly the problem of how many eggs to put in how many

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baskets, in his seminal work on **portfolio selection and efficient diversification of investments** [2, 3]. Although portfolio theory in its broadest sense covers all decision environments involving uncertain and interrelated outcomes, it is essentially concerned with the **principles and techniques of efficient diversification** in the context of portfolio of securities.

The portfolio model reduces the attributes of investments to two dimensions: the level of future rewards or **expected rate of return** and the quality of these rewards or the level of **risk** associated with expected rate of return. Visually, securities or portfolios can be described in terms of their rate of return (y-axis) and risk (x-axis) coordinates in a two parameter space, as portrayed in Fig 1.



The **expected rate of return on a portfolio** is a simple **linear** summation of the products of the expected rate of return on individual securities and proportions invested in each of them. But **portfolio risk**, or its surrogate **portfolio variance**, is a subtler and **non-linear** function of three variables: (1) risk or variance of rate of return on securities, (2) **correlation coefficients** or **covariances** between rates of return on securities, (3) and the proportions of investment in each security. Portfolio risk is less than a linear summation of the products of the risk of individual securities and the proportions of investment in each security. The lower the correlation coefficients, the lower the

portfolio risk. A portfolio is said to be **Markowitz efficient** if the lowest risk can be attained for a given level of return, or if the highest return can be achieved for a given level of risk. The **efficient frontier** (curve PMT in Fig 1) is so designated because it meets the Markowitz efficiency test by its **convexity from above**, where each point on the efficient frontier dominates all other investments within its risk or return class.

The primary task of portfolio analysis consists of identifying efficiently diversified portfolios (**efficient frontier**) in a Markowitz sense from possible investment opportunities (**feasible region**). The feasible region refers to all points lying in the shaded umbrella-like area and on its borders in Fig 1. For each point lying on the efficient frontier, a corresponding optimum basket or proportion of investments is generated. The solution of such a portfolio problem involves the optimization of a quadratic objective function (engendered by the non-linearity of portfolio risk) subject to linear constraints, for which Markowitz developed a quadratic programming computer algorithm .

Analogous to the Orwellian *le cochon* paradox, in which all are equal with some more equal than others, all portfolios lying on the efficient frontier are efficient; but some are more efficient than others. The ranking of efficiently diversified portfolios or **portfolio selection** lies in the eyes of the investor, whose responses to bundles of pleasure and pain (**utility function**) are approximated by **utility indifference curves** in a return-risk space (U_1, U_2 in Fig 1). Abnormal behaviours of peripheral social fringes and virtuous saints aside, the general tendency of average people to be more satisfied with more money—albeit with each dollar accompanied by progressively less satisfaction also known as **quadratic utility function** or **diminishing marginal utility**—gives the indifference curve the shape of **convexity from below**.

A unique portfolio among those efficiently diversified lies at the point (M in Fig 1) where the efficient frontier and the indifference curve just touch like two bananas rubbing backs. At the point of tangency, the investor's preference reflected in utility indifference curves (U_1 in Fig 1) just harmonizes with the particular efficient portfolio (M among points lying on the efficient frontier PMT in Fig 1) both sides expressed in terms of the expected rate of return and risk.

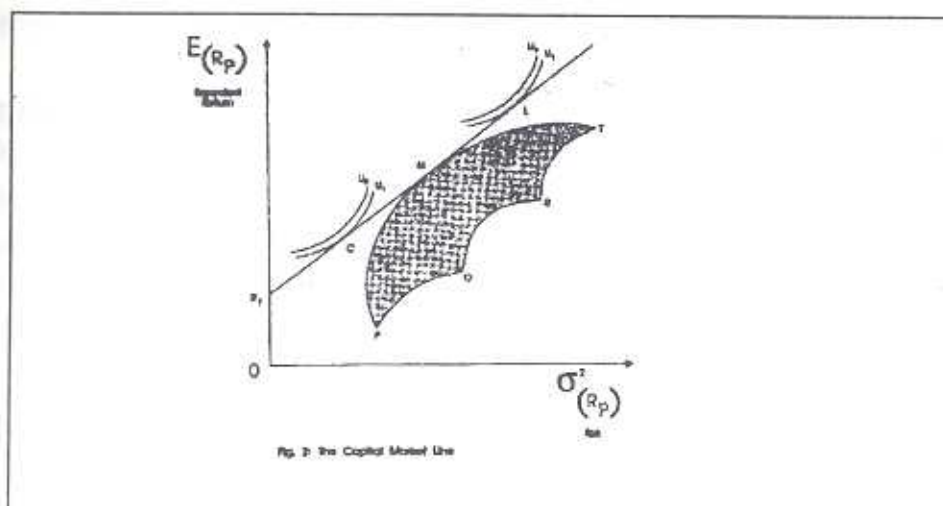
Capital Market Theory

The close kinship between portfolio theory and capital markets is expressed in the tribute paid by William F. Sharpe to his intellectual mentor, with the dedication of his book on *Portfolio Theory and Capital Markets*, "to HARRY MARKOWITZ who taught me portfolio theory and much more" [9]. The two theories focus on a common issue of investment behaviour from normative and positive perspectives. Portfolio theory prescribes rules of conduct for investment behaviour, while capital market theory draws the implications of such behaviour for capital markets and the prices of securities if some conditions are met. Sharpe extended portfolio theory in two important and related respects. First, he simplified the input requirements for portfolio analysis or the task of security analysis with the development of the diagonal or single-index model in which relationships among the rates of return on securities obtain from their common relationships with the rate of return on a common index (GNP, Dow-Jones Index, Standard and Poor's Index, New York Stock Exchange), with significant computational economy over Markowitz's critical line method [6]. Next, he pondered the consistency between portfolio theory and the behaviour of capital markets or the form of interdependence between risk and return in determining the price of securities on stock markets, in his famous model of **capital asset prices under conditions of risk and market equilibrium** [7].

As every shopper has observed from price differences between more or less quantity and low or high quality, value depends on measurable quantity and perceived quality. Similarly, the worth of an investment depends on the quantity and quality of benefits expected from the investment, measured in terms of the expected rate of return and a corresponding risk. By virtue of investor aversion to risk and preference for less risk to more, risk and quality are inversely related; the higher the risk, the lower the quality. Putting all one's eggs in a basket is undesirable for the same reason that more is not better than less to the quality conscious buyer, and a higher return not better than a lower return to the risk conscious investor.

Capital market theory is an inquiry into nature of value with particular focus on capital assets and the form of relationship between the level and quality of expected

benefits from investments--based on an appropriate measurement of risk and return--in determining the prices of securities prevailing on the stock market.



By introducing riskless securities (lending or borrowing at the same interest rate) into the investment decision, Sharpe derived the capital market line, a graphic representation of the functional relationship between risk and return (line R_f CML in Fig 2), with very interesting properties under conditions of capital market equilibrium: (1) the expected rate of return is a linear function of risk for efficient portfolios as reflected in the slope of the capital market line in Fig 2; (2) there is only one efficient portfolio which is located at the point (tangency) where the capital market line and the efficient frontier just caress at point M in Fig 2; (3) the efficiently diversified portfolio is the market portfolio in proportion to the total value of each security relative to that of the market aggregate; (4) the expected rate of return on efficient portfolios is the sum of the pure (riskless) rate of interest (R_f in Fig 2) and the product of the price of risk avoidance and the magnitude of risk measured in terms of the standard deviation or the variance as in Fig 2; (5) investment and financing decisions are independent of each other as depicted by lending portfolios (C in Fig 2) and borrowing portfolios (L in Fig 2).

The standard deviation is an appropriate measure of risk for efficient portfolios; but for inefficient portfolios or a security that do not fall on the capital market line, a more versatile unit of risk is volatility with a scope for both efficient and inefficient portfolios. Volatility is a measure of sensitivity of the rate of return on securities to shifts in those for the whole market index.

The degree of volatility is estimated from the slope of the regression function (**characteristic line**) relating the rate of return on individual securities and the rate of return on the market. Securities and portfolios such as mutual funds are characterized as **defensive** or **aggressive** on the basis of their degree of volatility (**beta coefficient**). A security or portfolio whose **beta** coefficient is less than one is defensive, because a 10% change in return of the index for the whole market is accompanied by a less than 10% change in return on the security or the portfolio. The reverse is the case for aggressive securities or portfolios with a **beta** coefficient of more than one. The **security market line** is a graphic representation of the proportionate relationship between the expected rate of return on securities and the corresponding risk measured in terms of the degree of volatility. The expected rate of return on a risky security is the sum of the rate of return on a riskless investment and the product of the premium for risk on the market portfolio and the volatility of the risky security. The price of risk is thus the penalty or reward in rate of return for a unit of risk avoided or assumed: risk premium normalized by the corresponding measure of risk.

The total risk of a security consists of **systematic** and **unsystematic** elements. Systematic risk is made up of the security's volatility and risk inherent in the market portfolio. Unsystematic risk is uncertainty internal to a security and consists of the difference between total risk in terms of the standard deviation and the corresponding systematic risk. The systematic risk of a portfolio is the weighted average of the risk of its component securities, and derives from uncertainty basic to the whole economy, which no amount of diversification can reduce. On the other hand, unsystematic risk can be completely eliminated through diversification.

Given perfect divisibility of securities and a rational behaviour in equilibrium, efficiently diversified portfolios should contain no unsystematic risk. Hence, risk premium on capital assets is explained only by systematic risk. The expected rate of return on *a*

security is the sum of the risk free-rate of return and a premium for the corresponding systematic risk. The inverse of the expected rate of return on a security or its capitalization rate is the price-earnings ratio which is the multiplier of the earnings per share determining the security's price.

Capital Structure and Market Valuation

In the theory of corporate finance, the frequency of reference to the **Modigliani-Miller hypotheses** on capital structure and valuation--abbreviated as the **M-M model**--is surpassed only by citations of Marx and Engels on socialism. Since its first publication in the *American Economic Review* in 1958, the controversy generated by this celebrated and classic article, co-authored by Franco Modigliani and Merton H. Miller, has been responsible for stimulating rigorous academic inquiry into the theory of corporate finance more than any other piece of work in the field [4].

The designation of Franco Modigliani, Nobel Laureate for Economics in 1985, as the founding father of corporate finance as an academic discipline, was a most fitting tribute. Those students to whom Miller has always been known as founding half-father of corporate finance, from the hyphenated reference to the joint effort as the **M-M model** in the financial literature, must feel pleased by his recognition five years after his colleague.

Capital structure essentially refers to the proportion of long-term sources of finance consisting of debt (fixed return) and equity (variable return) in the capitalization of a firm. An important distinction between the two sources of capital lies also in the tax status of interest on debt as a deductible expense item and non-deductibility of income accruing to stockholders. In the theory of corporate finance, the protagonists on capital structure are those who support or reject the validity of optimum capital structure. According to the advocates of optimum debt-equity mix (leverage-dependent hypothesis), the value of the firm or its cost of capital depends on its capital structure. The opposite view point (leverage-independent hypothesis), led by Modigliani and Miller as the standard bearers, totally rejects the effect of capital structure on the value of the firm

or its cost of capital. The position of the leverage-independent hypothesis is articulated in the famous **M-M Propositions** (after Modigliani-Miller):

Proposition I

Under conditions of competitive market equilibrium, commodities which are perfect substitutes must sell for the same unit price. If a product like milk can be classified into different grades in terms of butter content as a measure of quality, the same quality of milk must sell for the same price per unit volume if equilibrium prevails on the commodity market.

According to the M-M scenario, if firms could be classified into equal classes in terms of the quality or risk of their earnings, if they were allowed to borrow at the same interest rate as individuals, and if there were no corporate taxes, their value would only be affected by the level of expected earnings, under conditions of equilibrium in capital markets. **Within a homogeneous risk group, capital structure has no influence--whatsoever--on the value of firms or their cost of capital.** The value of the firm varies only with the level of expected earnings. The capitalization rate is constant for firms within the same risk class, and is defined by the cost of capital for an all-equity capital structure or no leverage. In the event of disparity between the equilibrium price and current price of securities, the **arbitrage** mechanism, involving substitution between corporate and personal leverage, is invoked to restore their parity.

Proposition II

Within a homogeneous risk class, the yield (expected rate of return) on a share of common stock varies in direct proportion to the degree of leverage. The expected rate of return on the equity of a leveraged firm ($E(R_1)$) in a risk class is the sum of the expected rate of return appropriate for an unleveraged firm ($E(R_0)$) in the same risk class and a premium for **financial risk**. As set forth in the second term in the equation below, financial risk is directly proportionate to the debt-equity ratio (D/S) or the degree of leverage.

$$E(R_i) = E(R_u) + [E(R_u) - r] (D/S)$$

When a random variable like the expected rate of return on an investment is reduced by a non-random constant such as fixed interest rate, the range of possibilities (dispersion) in the return accruing to equity widens. Hence, the introduction of debt into the capital structure of a firm is accompanied by increase in both the level of return and risk on common stock. Financial risk refers to incremental risk of return on equity associated with leverage relative to a zero base. An increase in earnings per share arising from more debt is offset by a decrease in its quality reflected in a drop in the earnings multiplier or a rise in the capitalization rate so that leverage effects are effectively neutralized. In the case of overvalued or undervalued securities on account of capital structure in a perfect capital market, arbitrage is cybernetically triggered to correct a divergence between equilibrium and market prices. The effect of the relatively lower cost of interest is washed out by the rising cost of equity with leverage to maintain the composite cost of capital constant irrespective of capital structure.

Proposition III

As every merchandise peddler in any community knows, the wares must sell--at least--for the cost paid for them to avoid being worse off than before the transaction or to grow. Therefore, the cost of a merchandise is the minimum price that must be charged to maintain the worth of the mobile enterprise. Similarly, the feasibility of an investment is judged by relating its expected return to the cost of capital for the firm. The cost of capital is the minimum expected rate of return required on an investment if--at least--the minimum value attained by the firm prior to the investment must be maintained, and is defined by the cost of capital for a non-leveraged firm.

Later Correction

The preceding propositions were couched in a taxless environment where interest expense is not tax deductible. After relaxing that particular assumption in an article published in the American Economic Review in 1963, Modigliani and Miller modified

their position slightly on the effect of capital structure on the cost of capital or the value of a firm when corporate income taxes are taken into consideration [5]. In such a setting, the cut-off rate for return on investments becomes the weighted average cost of capital incorporating income tax effects.

As an abstraction of reality, the value of a model lies more in its predictive or explanatory power rather than the realism of its basic assumption, according to the methodology of positive economics [1]. By that standard, the M-M model of no interdependence between capital cost of a firm and its financing decision has proved mightier over time with a broadening consensus; and the introduction of tax effects as a special case does not diminish its general soundness.

Significance for Foreign Investments

The two-parameter, mean-variance or risk-return, paradigm employed by the portfolio and capital market models for investment analysis and evaluation, originally developed for securities as decision variables, is a very fundamental concept with relevance for other forms of decision variables with outcomes characterized by chance or random variables summarized by the expected value and the variance. Hence, the implications of portfolio theory and capital asset model for foreign direct investments and transnational corporations merit some reflection.

Portfolio problems are similar in terms of their objectives, based on optimization of the trade-off between risk and return, and differ to the extent of limiting conditions or constraints governing the decision variables. Conditions of divisibility vary extremely between perfect or near-perfect divisibility for securities to lumpiness--varying from imperfect divisibility to complete indivisibility--for capital assets and firms such as direct foreign enterprises. Another critical difference is the availability and cost of information distinguishing the perfect market of securities from the imperfect market of foreign direct investments. The portfolio approach has been suggested for capital budgeting in which indivisibility of some capital assets is accommodated by introducing integer constraints and for conglomerate diversification [10, 11, 12, 13]. Similarly, in the case of foreign subsidiaries composing the portfolio of the holding parent transnational corporation, full ownership of some subsidiaries desired by the investor and some minimum level local

equity participation required by some host countries can be incorporated as fractional or integer equalities or inequalities. Other factors remaining constant, among different forms of portfolios, efficiency of diversification varies directly with the degree of divisibility of the decision variables. Hence, portfolios of securities are more Markowitz-efficient than those of physical assets and business entities.

Against such background the parent holding transnational corporation can be viewed as a portfolio of local and foreign subsidiaries and affiliated companies whose attributes may be described in terms of the three parameters: rate of return on the equity of each firm, a corresponding measure of risk and interrelationships or covariances among these returns. The distribution of investments among subsidiaries and affiliated companies, disclosed in the annual reports of some TNCs, is the structure of the parent portfolio in a historical sense, and may not be the most efficient combination. As a prospective model, portfolio analysis actually seeks solution to an optimum allocation of investments among subsidiaries and affiliated companies on the basis of expectations.

Transnational corporations are the primary source of securities traded on the major world stock exchanges, whose price formation has been observed to show a definite and direct interdependence between levels of risk and return on investments according to capital market theory, including an empirical study involving evaluation of mutual fund performance by Sharpe [8]. This implies that transnational corporations acting according to the Markowitz rule would evaluate the desirability of foreign direct investment by its incremental contribution to the risk and return complexion of the parent portfolio.

If investment opportunities from Africa open to foreigners were ranked by their risk and return prospects, capital will flow to those countries offering relatively high return within their risk class, or relatively low risk within their return class. When the risk-return outlook in Eastern Europe is perceived to be more enticing than that of Africa, all capital flows to the former. All variables entering into the decisions of foreign investment including political stability, economic and investment policy, product market, level and growth of income, raw material and labour markets, taxes, foreign exchanges, incentives, contractual clauses, infrastructure, etc., in the end reduce to implications for risk and return. Risk and return are the stuff of which all investments are made; and in

the final analysis, foreign direct investments flow to countries with more efficient frontiers.

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