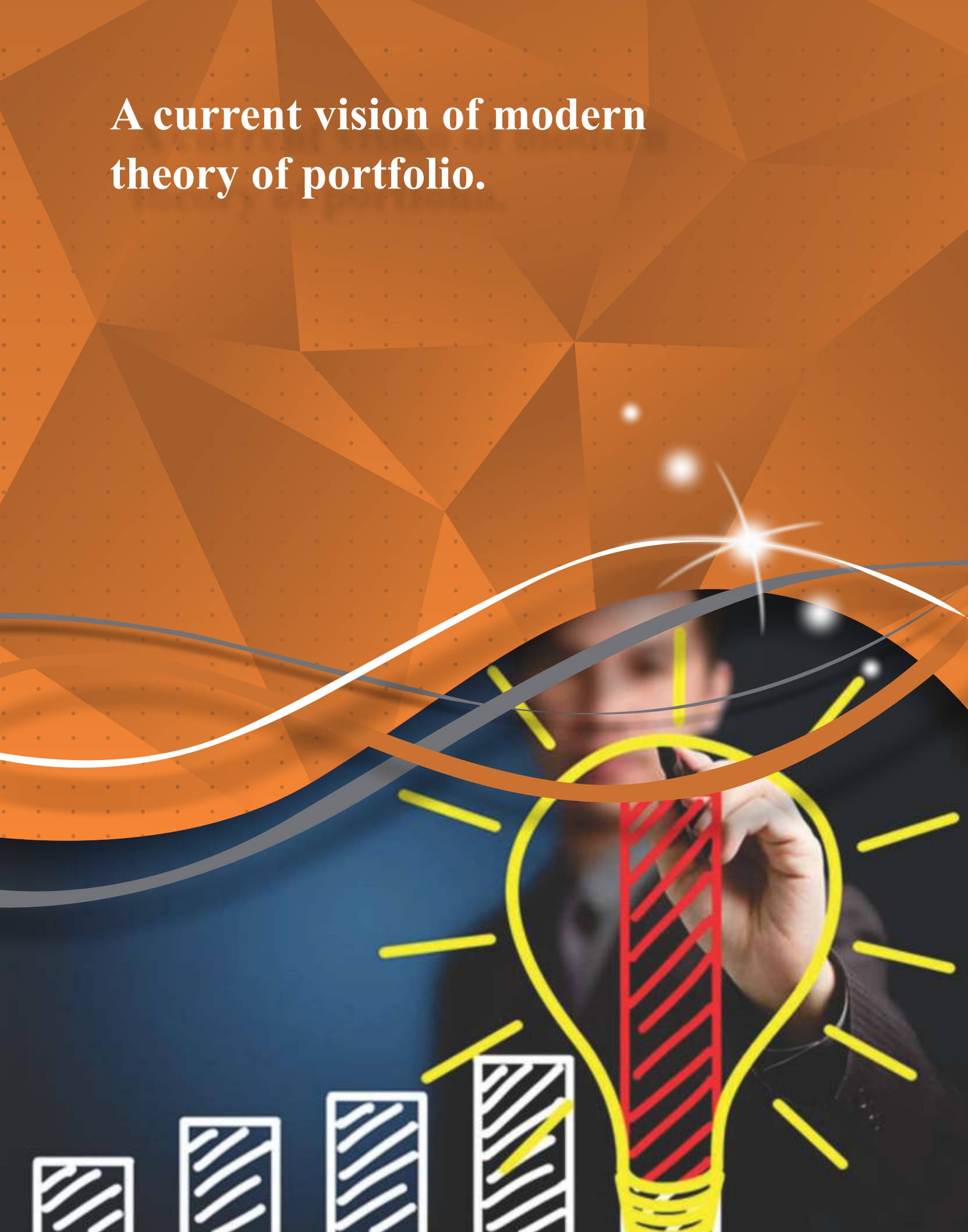


**A current vision of modern  
theory of portfolio.**



## A current vision of modern theory of portfolio. Una visión actual de la teoría moderna de selección de cartera.

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### Abstract

The Theory of Portfolio Selection was established by Harry Markowitz in the writing of his doctoral dissertation in statistics in 1952. This innovative approach laid the foundations of Modern Portfolio Theory, and is based on the assumption that investors seek maximum expected return for a given level of risk, and minimal risk for a given level of expected return. This article will present a current view of the Modern Portfolio Theory, through a literature review that will build a framework, which will provide some important definitions for the understanding of an investment optimum portfolio.

**Keywords:** *diversification, efficient border,*

*profitability, risk and optimum portfolio.*

### Introduction

Modern Portfolio Theory (MPT hereinafter by its acronym in English) and the principles of diversification made by Harry Markowitz in his thesis "Portfolio Selection" in 1952, now face new challenges. Low returns and high volatility of stock prices in the capital markets of developed economies have pushed investors to new investment instruments and markets that offer higher returns, but with higher risks, such as emerging economies.

In the last 60 years it has been developed different research projects that guide the investor and will simplify investment decisions in highly

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volatile and speculative markets. Among the works in which this article is based, it is worth highlighting the contributions of Markowitz (1952), Tobin (1958) and Sharpe (1964). These contributions lead to the optimal portfolio can be found using mainly the line of capital market to select the optimal portfolio in the efficient frontier.

Zubeldia, Zabalda and Zubiaurre (2002), through an empirical study to verify if the model of Markowitz was able to provide portfolios that offer higher returns and lower risk portfolio represented by the index IBEX35 and the index IGBM. Ramirez and Fernandez (2008), to construct optimal portfolios applied modern portfolio theory, first to 20 stock indices in the world and subsequently to 27 stocks selected from the Hang Seng Index (HSI) stock market of Hong Kong. Gomez and Garcia (2014) developed a model to determine the risk profile and investment horizon of a stock investor, according to their investment needs and available funds in the Colombian and international markets.

Geambasu, Sova, Jianu, and Geambaşu (2013), using PMPT for quantifying risk, the investor can distinguish between the real risk of obtaining returns lower than his expectation and the premium of obtaining higher returns than expected paying for his courage of performing the investment.

Given its importance and impact that Modern Portfolio Theory has had in the areas of economics and corporate finance, this article will present a current view of this theory, and through review and reconstruction of research, it has

aimed to detect, get and consult bibliographic information, which will build a framework, through which some important definitions will be provided to consider when determining an optimal investment portfolio.

### **Literature Review**

The base of Modern Portfolio Theory (MPT hereinafter by its acronym in English) was established in 1952 by Harry Markowitz in writing his doctoral thesis in statistics. The MPT uses several basic statistical measures to develop a portfolio plan. These measures are expected returns and standard deviations of returns in both securities and portfolios, as well as the correlation of returns. The conclusions of his thesis entitled "Portfolio Selection" (1952), was first published in "The Journal of Finance". Later, with the publication of his book, *Portfolio Selection, Efficient Diversification of Investments* (1959) exposed and developed his theory in more detail. Three decades later, Markowitz won a Nobel Prize for his contribution to the Modern Portfolio Theory to the fields of economics and corporate finance.

In the last 60 years it has been developed different research projects that guide the investor and will simplify investment decisions in highly volatile and speculative markets. Among the works in which this article is based, it is worth highlighting the contributions of Markowitz (1952), Tobin (1958) and Sharpe (1964). These contributions lead to the optimal portfolio can be found using mainly the line of capital market to select the optimal portfolio in the efficient frontier.

In February of 1958, the economist James

Tobin in his essay "Liquidity Preference as Behavior Toward Risk," to "Review of Economic Studies", concluded the "Efficient Frontier" and "Capital Market Line" which are concepts based in the works of Markowitz. The model of Tobin suggested that market investors, regardless of their level of risk tolerance, maintain portfolios in the same proportion as long as they maintain the same expectations for the future. In this article, James, created the concept of dominance of a combined portfolio of risky assets and risk-free asset and concludes that investment portfolios differ only in their relative proportions of stocks and bonds.

In the mid-sixties, as a result of the work previously done by Markowitz and Tobin, three economists - William Sharpe, John Lintner and Jan Mossin - developed another important capital markets theory, the Capital Asset Pricing Model (CAPM). The CAPM provided an evolutionary and significant step in the theory of equilibrium capital markets, allowing investors to value securities based on the systematic risk or market risk. Sharpe (1964) advanced significantly in the concepts of Efficient Frontier and Capital Market Line derived from CAPM, later won a Nobel Prize in Economics for his outstanding contributions. A year later, Lintner (1965) derives the CAPM from the perspective of an issuer of shares. Finally, Mossin (1966), independently determined the CAPM and quadratic utility functions.

Modern Portfolio Theory is composed by the Theory of Portfolio Selection of Harry Markowitz (1952) and William Sharpe contributions to the theory of price formation in financial assets (1964) known as the Capital

Asset Pricing Model (CAPM). Basically, the MPT is an investment framework for the selection and construction of investment portfolios based on maximizing the expected return of the portfolio and the simultaneous minimization of investment risk.

Modern Portfolio Theory includes numerous assumptions about markets and investors, some are explicit, while others are implicit. Markowitz built his contributions to the theory of Selection Portfolio on the following basic assumptions: 1) Investors are rational (looking to maximize performance and minimize risk), 2) Investors are only willing to accept higher amounts of risk if they are compensated by higher expected returns, 3) investors receive on time all relevant information relating to their investment decision, 4) Investors can borrow or lend unlimited amounts of capital at a risk free rate of interest 5) Markets are perfectly efficient, 6) markets do not include transaction costs or taxes, 7) it's possible to select those values which their individual performance is independent of other portfolio investments.

Since its appearance, the Modern Portfolio Theory of Markowitz has been a fundamental theoretical reference in selecting portfolios, leading to multiple developments and referrals. From this moment, the article will deepen on the aspects and elements in which the Modern Portfolio Theory is based.

### **A. Expected Performance**

For Ross, Westerfield and Jaffe (2012) the expected return of a portfolio is the weighted average of the expected returns of individual securities, which frequently are calculated using

the historical behavior of returns. However, the disadvantage that occurs when using the historical behavior of returns to forecast expected returns is uncertainty over what period of time will be used to take the sample. Even, there is no correct answer concerning on which period must use (5 years, 10 years, a longer period of time) due to the volatility and uncertainty facing the markets. However, it is reasonable to assume that if a market or a stock has experienced a healthy and consistent performance under various economic and political conditions, past performance can be considered a fair barometer of future performance of the market or action.

In the same vein, Richard O. Michaud (1989) concluded that the use of historical parameters as estimators of the expected parameters introduced significant bias, which makes that efficient portfolios provided by the model are mainly formed with high yield assets, reduced variance and low correlation with other assets, which leads to form portfolios concentrated in a few titles and this made them unattractive to investors. However, this problem can be solved by introducing restrictions which limit the maximum percentage of the budget to be allocated to each title.

### **B. Risk**

Risk can be defined as the possibility that the actual performance of an investment differs than expected. The Portfolio Selection Theory of Harry Markowitz says that the essential aspect regarding the risk of an asset is not the risk of each value in isolation, but the contribution of each of these to the portfolio's risk. From the point of view of the portfolio, the overall risk of a title can be divided into two basic components:

systematic risk (also called non-diversifiable risk, market risk or common risk) and unsystematic risk (also called diversifiable risk, specific risk or idiosyncratic risk). The MPT assumes that these two types of risk are common to all portfolios.

Systematic risk cannot be eliminated and have a high impact on a large number of assets, and is represented by uncertainty about general economic conditions such as GDP, interest rates or inflation. In contrast, unsystematic risk can be significantly reduced through diversification of securities within a portfolio and affects to a specific single asset or a small group of assets. However, in practice, the profitability of different assets is correlated with at least some degree, leading to unsystematic risk can never truly be eliminated completely, regardless of how many types of assets are added to a portfolio.

The risk component of the MPT can be measured using various mathematical expressions and is reduced through the concept of diversification, which aims to properly select a weighted set of investment assets that together represent a lower risk compared to the investment in a single asset. Diversification is, in fact, the basic concept of the MPT and directly relies on the conventional wisdom of "not putting all your eggs in one basket".

### **C. Relationship between Risk and Return**

Regarding the relationship between performance and the expected risk is common to argue that the expected return of an asset should be positively related to risk, in fact, investors remain only risky asset if its expected return outweighs the risk. The risk represents the

possibility that the actual performance of an investment differs from expected and is calculated by the standard deviation, an absolute measure of risk, which measures the dispersion (variance) of returns around the average or expected of an active. The higher the standard deviation, the greater risk, so investors demand a higher return as an incentive to risk their capital, in other words, the higher the risk, investors demand more in terms of a risk premium (it would be expected that an investment produce an excess of return compared to the risk-free rate).

In the theory of Markowitz portfolio selection, risk is synonymous of volatility, the higher the volatility of the portfolio, the higher the risk; Therefore, volatility refers to the amount of risk or uncertainty related to the size of changes in the value of a title, and is measured through a series of tools that include: 1) the calculation of expected return, 2) the variance of expected return, 3) the standard deviation of expected return, 4) the covariance of a portfolio, and 5) the correlation between investments (Ross, Westerfield and Jaffe, 2002). Each of these measures of risk / volatility are discussed below:

#### **Variance of portfolio returns.**

As mentioned above, there are several ways to determine the volatility (risk) of returns of a title, and the two most common measures are the standard deviation and variance, which is a measure of the squared deviations of performance of a value compared to its expected performance.

In the context of a portfolio, the variance measures the volatility of an asset or group of

assets (the higher variance the greater volatility). As in the formula for the expected performance, the variance of a portfolio of several assets may be considered as an extension of the formula of two active variance. When several assets are held together in a portfolio, those assets that decrease in value are often offset by the increase in assets in the portfolio, thereby minimizing the risk. Therefore, the total variance of a portfolio of assets will always be less than the weighted average of the variances of individual assets that comprise it.

The comments from analysts indicate that the variance of a portfolio decreases as the number of assets in the portfolio increases, significantly improving the efficient frontier. Therefore, maintaining portfolios composed by a larger number of assets allows investors to reduce risk more effectively, because the performance of such assets tend to cancel each other, suggesting that the variance of portfolio returns will be less than the weighted average of the variances of the individual values.

#### **Standard deviation.**

Another common measure of volatility (risk) is the standard deviation of an asset. The model "Portfolio Selection" of Markowitz is based on the general assumption that investors make their investment decisions based on the returns and risk, therefore, most investors consider the risk they assume when buying an asset, is to receive lower than their expected returns. The greater the standard deviation, the greater the potential risk and the higher the return required, therefore, the standard deviation of an asset is the square root of the variance.

### **Covariance of returns.**

The variance and standard deviation assess the variability of a shares, however, if it is required to measure the relationship between the performance of a share and the performance of another, it must determine its covariance or correlation, concepts that evaluate the way they relate two random variables. The covariance is a statistical measure that deals with the relationship between returns of two shares, if returns are related positively with others, their covariance is positive, if they are negatively related, the covariance is negative, and if they are not related, covariance must be zero. Markowitz says: "We must avoid investing in securities with high covariance each other".

### **Correlation coefficient of returns**

The correlation coefficient determines the degree to which two variables are related. This statistical measure addresses some of the difficulties of analyzing units of squared deviation presented by the covariance of returns.

The MPT attempts to analyze the interrelationship between different investments and employs statistical measures such as correlation to quantify the effect of diversification on portfolio performance. The correlation coefficient simply divides the covariance by the standard deviations of a pair of values, therefore, if the correlation between the values is positive, then the variables are positively correlated, if negative, then they are negatively correlated, and if the correlation is zero, then the variables are uncorrelated.

The degree of risk reduction depends on the variance of the different assets, in particular the

correlation between investment asset and its weight in the portfolio. To the extent that an investment portfolio that consists of securities that are not correlated or have low correlation with each other, the overall risk of the portfolio, measured by their fluctuations over time, will become better. When there are perfectly negatively correlated, there will always be a strategy of portfolio (represented by a particular set of proportions of the portfolio) to eliminate the risk entirely. However, the negative correlation is usually not really happen to ordinary shares.

Moreover, the magnitude of the benefits of international diversification depends mainly on the stock market correlations. In recent years there have been several studies, which have shown that correlations between international stock markets have increased sharply over the past 40 years. Dennis P. Quinn and Hans-Joachim Voth (2008) concluded that over the past century, financial liberalization was accompanied by a higher correlation of domestic stock markets to foreigners. Furthermore countries remained open economies levels higher than those presented in closed economies correlation. That's why in more and more countries which are open to foreign capital, correlations tend to grow, thus deteriorating the potential gains from diversification, which reduces the attractiveness and desirability of international diversification. However, despite the increase of fluctuations in equity markets, investors can still make considerable profits through diversification, when prefixed foreign investment on local, as these have lower correlations compared to domestic investment.

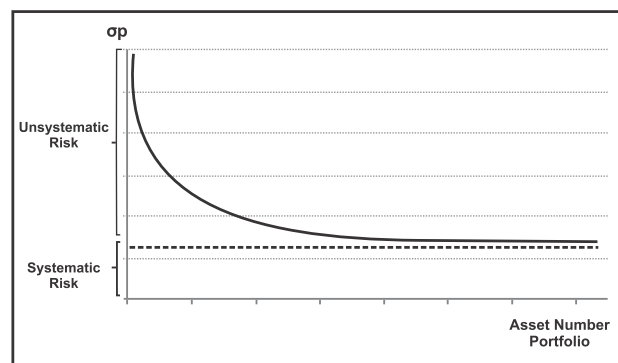
In line with previous research, Kais Fadhlou, Makram Bellalah and Amine Lahiani (2011) conducted an empirical review of the impact of equity market integration in the efficiency of international diversification. To do this, first examined the evolution of the correlation of 31 stock indices of 5 developed countries (United States, Canada, Britain, France and Japan) and 26 emerging countries (Indonesia, Korea, Malaysia, Pilipinas, Sri Lanka, Taiwan, Thailand, Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela, Czech Republic, Hurgaría, Poland, Russia, China, India, Pakistan, Jordan, Turkey, Israel, Egypt and Morocco). This test showed the presence of a low correlation between emerging and developed markets and, therefore, the low correlation demonstrates that international diversification is still considered as an alternative efficient allocation in terms of volatility reduction and performance improvement. In contrast, the correlation between developed markets is higher and therefore diversification gains are less important. Second, different methods related to the cointegration tests (multivariate bivariate), which showed that some economic blocks are composed mainly of developed markets, which leads to decrease the attractiveness of international diversification were applied. The end result of the research showed that the developed countries obtain better international diversification of their portfolios in emerging markets rather than in developed markets.

#### D. Diversification

Diversification is the main foundation of the theory "Portfolio Selection" of Markowitz and MPT, and is a concept of risk reduction that

involves the distribution of investments among various financial instruments, sectors and other investment categories. In simpler terms, it relates to the known popular adage "If the basket falls, all eggs are broken" if placed in more than one basket, the risk that all eggs are broken is radically reduced. Diversification can be achieved by investing in different stocks, different asset classes (eg, bonds, real estate, etc.) and / or commodities such as gold or oil. However as discussed above, the decreased risk only occurs in the component of unsystematic risk, diversification does not affect systemic risk, therefore, the total risk is not zero will be reduced (Chart 1).

Chart 1. Risk Statistics depending on the number of active. Source: Own chart



Fuente: Los autores

The purpose of diversification is to maximize return and minimize risk by investing in different assets that react differently to the same event. For example, the negative news related to the crisis of European sovereign debt, caused by the crisis that erupted in the US in 2007, so it caused stock markets to move down significantly. At the same time, the same news had a positive effect on the price of certain commodities like gold, which peaked in September 2011. It is therefore important that strategies to diversify a portfolio



not only include actions different sectors, but should also include different asset classes, eg: bond, debt and commodities.

An important aspect of the effect of diversification is the relation between correlations and portfolio, therefore, when the correlation is imperfect active (positive, negative), the result of diversification effect is achieved. It is an important and effective strategy to reduce risk without compromising profitability, therefore, any smart investor which is risk averse is going to diversify its portfolio in some way. Markowitz (1952) argues that diversification can not eliminate all risk. As noted above, investors face two types of risk: systematic risk and unsystematic risk, therefore, unsystematic risk is part of the risk equation and can be reduced or eliminated, since the bases this type of risk are events that are unique to a particular company, while the systematic risk (market risk) can not be eliminated or reduced through diversification, as it is due to external factors such as recessions, high rates interest, inflation, which systematically affect most businesses.

Investing internationally offers greater diversification than do national. Regarding international diversification of assets, there is a permanent consensus among practitioners and academics alike, and claim that it can provide great benefits. Donald R. Lessard (1973) made a contribution to the diversification and studies showed quarterly returns during the period 1958-1968, over 110 common shares of the stock markets of Argentina, Brazil, Chile and Colombia. Through a multivariate analysis showed that the risk of a diversified portfolio

consisting of shares of the four countries mentioned is less than the risk of investing solely in shares of each country. Lessard concluded that form a portfolio with shares of the four stock markets would be valuable for its members to the extent that it would be possible to take advantage of risk diversification.

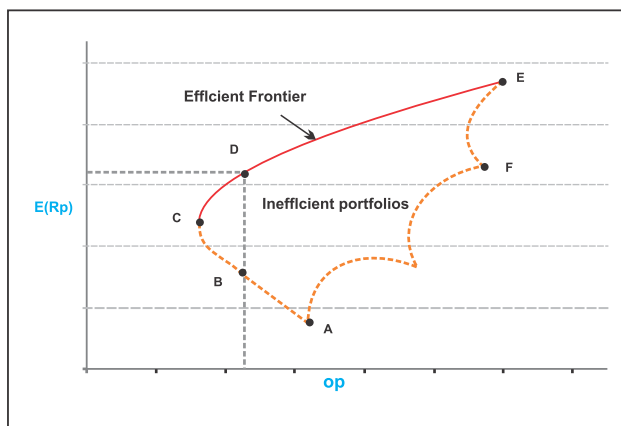
In the academic literature professor Bruno H. Solnik (1974) showed the benefits of international diversification of shares comparing a portfolio of securities of United States versus a portfolio composed of securities in the United States and abroad. For this investigation Solnik analyzed weekly closing prices of more than 300 US stocks, the United Kingdom, Germany, France, Italy, Belgium and the Netherlands during the period 1966-1971 and concluded that the specific or idiosyncratic risk of an international portfolio decreased compared to a local portfolio for all points on the Efficient Frontier.

### **E. Efficient Frontier**

The feasible set (also known as opportunity set) represents all portfolios that could form a group of N shares. The points A, B, C, D, E, F, in Chart 2 are examples of such portfolios. A portfolios located on the thick line between points C and E are called efficient portfolios, because it unites all combinations of efficient portfolios titles, in other words, those are the portfolios with the highest expected return for a given level of risk. Point C represents the minimum variance portfolio, that is the combination of securities in this portfolio represent the lowest possible risk. Likewise, the point B represents an inefficient portfolio, a person would not invest in a portfolio B simply

because the portfolio D is better (offers a higher expected return to the same level of risk). Inside the efficient frontier, the level of risk aversion of an investor (preference for risk and return) will influence the choice of minimum variance of Portfolio C or maximum expected return of portfolio E (Markowitz, 1952).

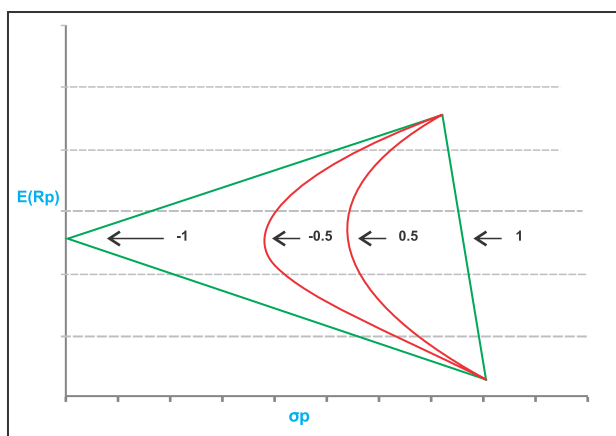
Chart 2. Set Feasible and Efficient Frontier.



Fuente: Los autores

In a line of efficient frontier formulated base on two assets can observe and analyze the behavior of the total portfolio risk for different scenarios correlation (chart 3).

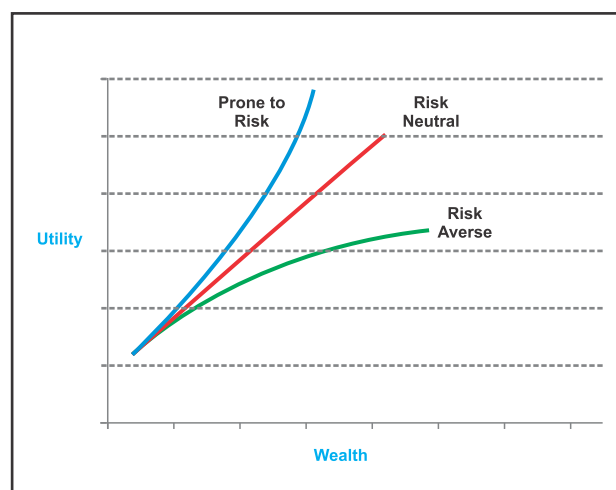
Chart 3. Risk Portfolio for different values of Correlation



Fuente: Los autores

In the above graph it is evident that if the correlation is quite positive, that is 1, the efficient frontier line becomes a straight shape  $y = mx + b$  positively sloped, if the correlation is between -1 and 1 (greater than -1 and less than 1), the efficient frontier is a parabolic curve and equation that represents it is  $y = ax^2 + bx + c$ ; but if the correlation is quite negative, that is -1, line touches the efficient frontier "y" at the point of minimum variance and this is the intercept of the two lines that form.

Chart 4. Behavior of Marginal utility as attitude to risk



Fuente: Los autores

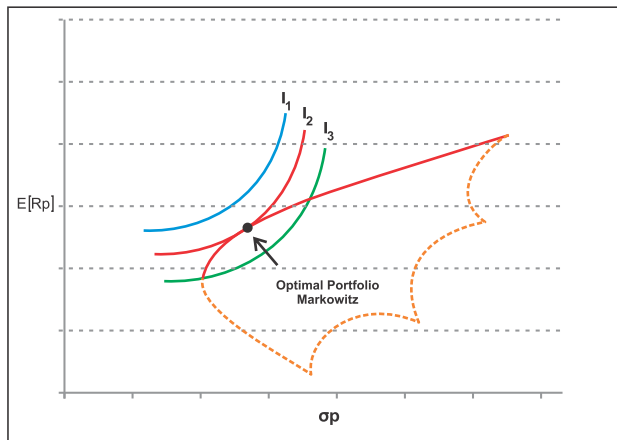
For Gordon, Sharpe & Bailey (2003), each investor has a utility function of the unique wealth. That is, it will get a unique increase of utility and marginal utility of the wealth it will be different for each investor and depend on the level of wealth they own before increasing.

According to the attitude held by the investor against the risk, the marginal utility will take different behaviors (Chart 4), for Lopez (SF), an adverse investor to risk will have a diminishing function of marginal utility, that is, the same value increased of wealth will produce a lower

level of return. In contrast, a risk-prone investor, have a function of increasing marginal utility, that is, the same value of increased wealth will produce a greater increase in utility. A risk-neutral investor will have a constant utility function, i.e., the same increase in wealth will produce an equal level of utility.

To Markowitz (1952), the optimal portfolio for an investor depends on its utility curve or indifference, which is different for each investor, and it will depend on its risk profile. The indifference curve risk investor establishes the relationship between risk and expected returns and provides the same utility (satisfaction) to the investor.

Chart 5. Selecting an optimal portfolio of Markowitz



Fuente: Los autores

The theory of Markowitz portfolio selection is based on two implicit assumptions: insatiability and risk aversion, the insatiability assumes that investors prefer higher levels of terminal wealth and not the lower levels. And risk aversion indicates that investors always choose the portfolio with the lowest standard deviation, that is investors do not want to make fair play,

likewise, it is important to note that according to the insatiability and risk aversion, a map of curves generated standard deviation indifference to each investor with different combinations of performance and risk, which will be located in different parts of the efficient frontier line. Therefore, the optimal portfolio of Markowitz is at the point of tangency between the indifference curves of the investor and the efficient set (Chart 5).

Needless to say, the efficient frontier is objective and quantifiable, whereas the indifference curves are subjective, and, therefore, difficult to measure.

### III. Conclusions

This article allowed a literature review relating to Modern Portfolio Theory, addressing some academic research that helped to analyze the basic principles on which this theory is based. It has been nearly sixty years since the economy novel Harry Markowitz presented his “Portfolio Selection” Theory and is unlikely to disappear its popularity and success in the future. Since its appearance, it has been a fundamental theoretical reference in selecting portfolios, leading to multiple developments and referrals. Their theoretical conclusions became the springboard for the development of other theoretical analysis in the field of investment theory.

Despite its theoretical success, it is important that their use in practice, including portfolio managers and investment analysts, is not as wide as it is created. However, the essence of MPT is that the market is hard to beat and those who

succeed in doing so are those who diversify their portfolios effectively and take above-average investment risks.

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