Risk-return analysis of the investment portfolio of two stocks, under the Markowitz model. Case study: Two multinational companies listed on the Mexican Stock Exchange

Análisis de riesgo rendimiento de portafolio de inversión de dos acciones, bajo el modelo de Markowitz. Estudio de caso: Dos empresas multinacionales que cotizan en la Bolsa Mexicana de Valores

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Abstract

Investment in productive and financial assets are a decision made as an alternative to direct resources to bring greater value and higher performance to an economic entity. The objective of this article is to analyze the return risk of the stocks of two companies listed on the Mexican Stock Exchange (BMV), presenting the case of the companies Grupo Bimbo, SAB de CV, and GRUMA, SAB de CV, both companies listed on the Mexican Stock Exchange, belonging to the industrial sector specifically the food and beverage sub-sector, being the most representative companies of this sector. The return on the portfolio is 0.27256% and the risk is 0.0121862, with an investment of 50% in each of them. The period analyzed was from 2015 to 2018. It is important to base decision-making by considering the risk analysis and performance of financial assets in where you wish to invest, in addition to relying on other analyzes such as fundamental and technical analysis, among others.

Investment portfolio, Risk, Performance

Resumen

La inversión en activos productivos y financieros, son decisiones que se presentan como alternativa para canalizar recursos hacia aquella que genere un mayor valor y rendimiento a un ente económico. El objetivo de la presente investigación es analizar el riesgo rendimiento en un portafolio de dos acciones de empresas cotizadas en la Bolsa Mexicana de Valores (BMV), presentando el caso de las empresas Grupo Bimbo, S.A.B de C.V., y GRUMA, S.A.B de C.V., ambas empresas cotizan en la Bolsa Mexicana de Valores, y pertenecen al sector industrial, específicamente al subsector de alimentos y bebidas, siendo ambas empresas las más representativas de ese sector. El rendimiento del portafolio es de .27256% y el riesgo es de .0121862, con una inversión de 50% en cada una de ellas. El periodo analizado fue de 2015 a 2018. Es importante fundamentar la toma de decisiones considerando el análisis del riesgo y rendimiento de los activos financieros en donde se desea invertir, además de apoyarse en otros análisis como el análisis fundamental y técnico entre otros.

Portafolio de inversiones, Riesgo, rendimiento

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1. Introduction

Operation, financing and investment decisions by economic entities require a thorough analysis, due to the use of financial resources. Investment in productive and financial assets are decisions that are presented as an alternative to channel resources towards the one that generates greater value and performance to an economic entity. This decision will depend on the following factors: investment objective, amount of financial resource available, timing, risk profile of the investor and expected return.

The objective of this research is to analyze the return risk in a portfolio of two shares of companies listed on the Mexican Stock Exchange (BMV), presenting the case of the companies Grupo Bimbo, SAB de CV, and GRUMA, SAB de CV, both companies belong to the food and beverages sector and are part of the sample of companies that issue the BMV Price and Quotation Index. The risk and return were determined by applying Harry Markowitz's portfolio theory (1952), calculating the indicators of mean, variance, standard deviation, covariance, correlation and beta of each of the stocks individually, as well as in as a whole, as well as the CPI.

The efficient frontier was determined, assigning investment percentages for each one of the actions and obtaining the investment mix that maximizes yield and minimizes risk. It is of the utmost importance for investors to analyze the risk and return that, based on their risk profile and available financial resources, allow the optimization of their portfolio.

2. Theoretical foundation

In selecting an investment portfolio, the mix of financial assets that optimizes risk and return should be considered. For this reason the investor must analyze the degree of risk that he would be willing to assume and the return to be obtained. This work will address the portfolio theory of Markowitz (1952), which describes the process for an investor to allocate a percentage of their resources in financial instruments that allow them to obtain the maximum return at a lower risk.

Investment portfolios

One of the objectives of investors is to maximize profits by minimizing risk, this is possible, through the construction of investment portfolios, which represent the selection and conjunction of two or more financial assets that are listed on the financial markets - capital, debt, derivatives and currencies-, with the purpose of diversifying and optimizing risk and return. The financial assets that make up the investment portfolio have their own characteristics in terms of term, profitability and risk, compensating each other for profitability and risk (Grajales, 2009; Véliz, Cervantes and Carmona, 2012).

The theory regarding the construction of portfolios is the "modern theory of portfolio selection" by Harry Markowitz (1952), based mainly on diversification, a basic concept for the construction of an optimal investment portfolio that maximizes risk-return. In this sense, Mendizábal, Miera and Zubia (2002) mention that Markowitz developed his model considering the rational behavior of investors, who want profitability - profits - at the lowest risk. Therefore, he assumes the effectiveness of a portfolio, if the return is higher than the investment risk; In this sense, Grajales (2009) mentions in reference to Markowitz that the design of a portfolio seeks to guarantee a certain profitability according to a particular level of risk that the investor is willing to assume.

One of the main characteristics of investment portfolios is diversification, that is, investing in different financial assets in order to maximize profitability and minimize risk. Contreras, Stein and Vecino (2015) refer to the modern portfolio theory as a model for portfolio selection, since it considers diversification, building efficient portfolios or the efficient frontier of assets with more risk. In the same sense, Banda, González and Gómez (2003) refer to the diversification of assets as the strategy to maintain a balanced investment, reducing the risk due to changes in the prices of financial assets-volatility-. The Markowitz model considers the investment in different assets, in order to reduce the variations in profitability and consequently in risk, they also consider that for an efficient portfolio, it is necessary to distribute the risk of the different investment alternatives in the different financial assets that comprise it, trying to ensure returns.

This option of compensating the losses of some assets with the gains of others is known as diversification and is based on the fact that asset prices do not evolve identically (Grajales, 2009).

In relation to the portfolio theory of Markowitz (1952), (Mascareñas, 2018; Ruiz and Sardi, 2013) mention the following assumptions of this theory: 1) The performance of a financial asset or portfolio will be measured by the average return ($\bar{x}$). 2) The risk of the financial assets of a portfolio is measured by the variance (σ^2) or standard deviation (σ). 3) The investor will select portfolios with higher profitability and lower risk. On the other hand, Mascareñas (2018) adds that this theory proposes the formation of efficient portfolios, through the search for higher returns at a minimum level of risk.

Risk - Performance

As mentioned above, the purpose of investment portfolios through the diversification of financial assets is to reduce risk, which is the probability of suffering damages or losses. Arias, Rave and Castaño (2006) refer that risk is associated with uncertainty, which is not eliminated, however it is possible to manage it, and it is important to design strategies to control and minimize it. On the other hand, they point out that the risk is classified as: 1) Systematic, which is a non-diversifiable risk, which is due to political, economic, fiscal and social factors that affect the global market of a country. This type of risk is beyond the control of the investor. It is the country risk and it is inevitable. 2) Not systematic, it is exclusive to a particular company, it does not depend on economic, political and other factors. It is company risk and it is diversifiable, that is, it can be avoided.

The risk of a security is considered between systematic and unsystematic risk. The market compensates the systematic risk, but not, the unsystematic one. By building a portfolio with several uncorrelated values, it will be eliminated or markedly reduced. The statistical measure used to measure risk in financial markets is the variance σ^2 and the standard deviation σ (which is simply the square root of the variance) of the distribution of returns (Cruz, Restrepo and Medina, 2008).

On the other hand, they point out that a portfolio composed of several securities will offer an average return equal to the average of the returns of the assets that compose it. It is extremely important to weigh the average yield of each asset that makes up a portfolio with respect to the percentage of investment in it..

On the other hand, Gomero (2017) mentions that in the construction of equity investment portfolios, it is important to consider the correlation of financial assets in order to measure whether the risk is high to low. The correlation can be from -1 to 1. When the correlation is -1 there is greater risk coverage, because the risk is offset between the assets that make up the portfolio. On the other hand, when the correlation is positive, a greater risk is assumed, the closer it is to 1, the portfolio will have a greater exposure to risk. The perfect correlation is -1, because the risk is neutralized. In addition to the risk measured by the variance and standard deviation of a financial asset individually, in an investment portfolio the variance and standard deviation of the portfolio must be calculated, as well as the covariances and correlation, in table 1 each of these are explained statistical measures and their respective formula.

	Individual	Portfolio
Average performance ($\bar{x}$) The return on the portfolio is the expected weighted sum of each share that makes up the portfolio.	$\bar{X} = (S(x_i)/n$	$\bar{X}_p= W_i \bar{X}_i + W_j \bar{X}_j$
Variance (s^2) The variance measures the risk in quadratic terms of the expected return of the portfolio.	$s^2 = \sum ((x_i - \bar{x}_j)^2)/n$	$s_p^2 = W_i^2 s_i^2 + W_j^2 s_j^2 + 2 W_i W_j COV_{ij}$
Standard deviation s The standard deviation is the square root of the variance and shows the risk of the portfolio.	$s = \sqrt{S(x_i - \bar{x}_j)^2)/n}$	$s_p = \sqrt{W_i^2 s_i^2 + W_j^2 s_j^2 + 2 W_i W_j COV_{ij}}$
Covariance (COV) The covariance shows the degree to which the returns on financial assets move together. If the covariance is positive, it means that when one of the assets rises, the other also rises; If, on the contrary, the covariance is negative, it implies that when asset A increases, asset B decreases and vice versa. If the covariance is close to zero, it means that the two assets are independent.	$s^2 = (S(x_i - \bar{x}_j)^2)/n$	$COV_{ij} = \frac{\sum (x_i - \bar{x}_i)(x_j - \bar{x}_j)/n}{s_i s_j}$
Correlation (CORR) Measures the degree of association between the returns of two assets.	$CORR_{ij}=COV_i / s_i s_j$	
Beta		$b= COV_{im} / s_m^2$

Table 1 Statistical formulas to calculate risk and return
Source: Self Made

Efficient frontier

When calculating the individual risk and return of each share, as well as of the portfolio, it is important to determine the efficient frontier, through combinations of different investment percentages for each of the assets that make up the portfolio, thus seeking to maximize the profit for a certain level of risk. When graphing the efficient frontier, the “X” axis represents the risk and “Y” the expected return respectively (Ortiz, Chirinos and Hurtado, 2010; Puerta, 2010).

Graphic 1 Efficient frontier

Source: Self Made

Note: Each of the points of the Efficient Frontier Graphic represents the combination of risk - return at a given percentage share of resources.

Empirical studies

Cruz, Restrepo and Medina (2008) carried out an investment portfolio made up of six shares of the Colombian market, for this purpose they applied the methodology of Markowitz (1952). The results were as follows: expected return of the portfolio 1.0948417%, with a risk of 1.4797984%, it is observed that the risk of the portfolio is greater than the return, despite the fact that the shares that make up the portfolio show a trend towards profitability. They recommend diversifying the investment in different actions, avoiding concentrating the investment in a single asset, reducing the risk, on the other hand they point out that the efficient frontier presents the most optimal combination of investments.

Gomero, Bazuda and Bazán (2017) mention that the volatility of variable income financial assets makes it necessary to use statistical measures to quantify risk and return for decision making. For this purpose, they applied a statistical model in order to develop high and low risk portfolios, they used historical information of different stocks of different stock indices, showing that through the use of statistical measures, such as: standard deviation and correlation, in addition to determine how stocks behave in the face of changes in the stock market, measured through the Beta of assets. The results of the portfolio were the following: standard deviation of asset .0032 and portfolio .0111 and correlation 1.51 and beta .76. With the application of the statistical model based on Markowitz, they demonstrated the structuring of portfolios with different levels of risk.

3. Methodology

The objective of this research is to analyze the return risk in a portfolio of two shares of companies listed on the Mexican Stock Exchange (BMV), presenting the case of the companies Grupo Bimbo, S.A.B de C.V., and GRUMA, S.A.B de C.V. and Subsidiaries, considering the periods 2018, 2017 and 2016.

Description of the companies

Grupo Bimbo, S.A.B de C.V.

According to Grupo BIMBO SAB de CV, it is the largest Mexican bakery in the world, with 194 plants around the world, with a presence in North America, Latin America, Europe, Asia and Africa. Its main products are box bread, pastries, cookies, English muffins, bagels, salty snacks, confectionery, among others, with more than 100,000 brands and 133,000 employees.

The mission of the company is the following "Delicious and nutritious food in the hands of all", that is why it has more than 3,000,000 points of sale and more than 58,000 routes. The company's shares are listed on the Mexican Stock Exchange under the ticker symbol BIMBO and on the OTC market of the United States of America through ADR level 1 under the ticker BIMBO Y.

GRUMA, S.A.B. de C.V.

GRUMA, S.A.B. de C.V., is one of the largest producers of nixtamalized corn flour and tortillas in the world. Its brands are leaders in most of the markets where it has a presence, with participation in the United States of America, Mexico, Central America, Europe, Asia and Oceania. Series B shares are listed on the BMV trading under the ticker GRUMAB. The analysis period was for the years 2015, 2016, 2017 and 2018. For this purpose, the daily prices of the shares (1003 data) of the companies studied were downloaded from yahoo.finance.com, later the price variations were determined and the yields, with these data average yield, variance and standard deviation were calculated, in order to obtain the yield and individual risk of each action of the companies.

The formation of the investment portfolio was carried out based on the portfolio theory of Harry Markowitz (1952), calculating the return of the portfolio, variance and deviation of the portfolio, as well as covariance and correlation of the actions of GBIMBO (A1) and GRUMA (A2) and with respect to the price index and quotations of the Mexican Stock Exchange (IPC). In addition, the risk and return were calculated, weighing a participation from 0% to 100% in each of the actions, thus obtaining the efficient frontier and selecting that percentage participation where the risk and return of the portfolio is optimized.

4. Results

Below are the results of individual return risk of the stocks that make up the portfolio and the portfolio itself, measured through expected return, standard deviation, covariance, correlation and beta.

A-1 A-2	BIMBO A GRUMA B		
Assigned proportion	0.5	0.5	
	A1	A2	Market
Expected return	0.008215%	0.048004%	0.000233%
Variance	0.000243	0.000234	0.000075
Standard deviation	0.015582	0.015288	0.008673
Covariance			
Correlation			
BETA	0.829972	0.524526	

Table 2 Individual performance risk of the BIMBO, GRUMA and IPC shares of the BMV
Source: Self Made

Table 2 shows the expected return, variance, standard deviation and Beta of the shares of Grupo BIMBO and GRUMA individually, as well as the market represented by the Index of Prices and Quotations (IPC) of the Mexican Stock Exchange , for the period 2015-2018. The expected performance for BIMBO; GRUMA and IPC is .008215%, .048004% and .000233% respectively, meanwhile the risk (σ) is .015582, .015288 and .008673 for BIMBO, GRUMA and IPC. On the other hand the Beta (β) that measures the behavior of a share's performance with respect to the market is .829972 and .524526 for BIMBO and GRUMA shares respectively, observing that the performance of BIMBO shares is closer to the Stock Market index than GRUMA.

A-1 A-2	BIMBO A GRUMA B		
Assigned proportion	0.5	0.5	
	(A1,A2)		
	Portfolio	IPC , A1	IPC, A2
Expected return	0.027256%		
Variance	0.000149		
Standard deviation	0.012186		
Covariance	0.000059	.000062	0.000039
Correlation	.246589	0.461944	0.297547

Table 3 Performance risk of the portfolio made up of the shares of BIMBO, GRUMA
Source: Self Made

Table 3 shows the risk and return of Grupo BIMBO and GRUMA's portfolio, generating an expected return of .027256% and a risk of .012186, the correlation of both is .246589, meaning that the returns of both stocks behave in the same direction. With respect to the IPC, the BIMBO share is more correlated with the IPC .4619 in relation to GRUMA .2975.

Graphic 1 Efficient risk and return frontier of Grupo BIMBO and GRUMA's share portfolio
Source: Self Made

In Graphic 1, the efficient frontier is shown, which is made up of the possible combination of the proportion invested in each of the shares that make up the portfolio.

The X axis is represented by risk and the Y axis by performance. The point where the risk-return ratio is optimized is the one corresponding to the investment of 50% in each of the shares of the companies, thus obtaining a return of .027256% and a risk of .0121862.

5. Conclusions

The objective of the construction of investment portfolios of financial assets, aims to optimize the risk and return relationship, that is, the point where risk is minimized and returns are maximized in a specific share of resources, using the portfolio theory of Markowitz (1952). For the purposes of this work, a portfolio of two shares was designed, GRUPO BIMBO and GRUMA, both companies are listed on the Mexican Stock Exchange, and belong to the industrial sector, specifically the food and beverage subsector, both companies being the most representative of that sector. During the period analyzed (2015-2018) the portfolio yield is .27256% and the risk is .0121862, with an investment of 50% in each one of them. Grupo BIMBO's share has a higher correlation with the IPC of the Mexican Stock Exchange with respect to GRUMA. It is important to base decision-making by considering the risk and return analysis of the financial assets where you want to invest, in addition to relying on other analyzes such as fundamental and technical analysis among others.

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