****

**Institute of Education and Economic Research**

**Topic:** COMPARISON OF MARKET RISK ON MONGOLIAN FINANCIAL AND FOOD INDUSTRY: PORTFOLIO APPROACH

SOLONGO OCHIRBAL

2021

**Abstract**

Comparing to Security Exchange Commission of United Nations or other developed countries, Mongolian Security Exchange is much younger, only 30 years of development. But in modern days, people participating in the capital market are increasing year by year and it is crucial to decide which asset to invest for beginners. In order to determine less market risk bearing industry, we used beta coefficient and portfolio construction approaches for finance and food industry of Mongolia. 10 companies from the two industries were under consideration. As a result, we find that the final conclusion can differ depending on portfolio construction approach we use. Using the optimally weighted portfolio approach, the food industry bears more market risk than finance industry in Mongolia. Beta coefficients are 0.5 and 0.25, respectively. For risk averse investors, we recommend lower market risk portfolios such as finance industry.

**Table of contents**

[List of figures 5](#_bookmark0)

[List of tables 5](#_bookmark1)

[List of Equations 5](#_bookmark2)

[Introduction 6](#_bookmark3)

[Theoretical Framework 8](#_bookmark5)

[Methodology 13](#_bookmark15)

[Results 16](#_bookmark22)

[Conclusion 19](#_bookmark31)

[Bibliography 20](#_bookmark32)

# List of figures

[Figure 1 Explanation of Beta Coefficient 9](#_bookmark8)

[Figure 2 Tangency portfolio 12](#_bookmark14)

# List of tables

[Table 1 List of stocks under consideration 6](#_bookmark4)

[Table 2 Beta coefficients of individual stocks 16](#_bookmark23)

[Table 3 Ranking of the stocks by their beta 16](#_bookmark24)

[Table 4 Betas of equally weighted portfolios 17](#_bookmark25)

[Table 5 Variance-Covariance matrix of Finance industry stocks 17](#_bookmark26)

[Table 6 Optimal weights of finance industry stocks 17](#_bookmark27)

[Table 7 Variance-Covariance matrix of Food industry stocks 17](#_bookmark28)

[Table 8 Optimal weights of Food industry stocks 17](#_bookmark29)

[Table 9 Beta coefficients of optimally weighted portfolios 18](#_bookmark30)

# List of Equations

[Equation 1 Holding period return 8](#_bookmark6)

[Equation 2 Required rate of return by CAPM 8](#_bookmark7)

[Equation 3 Beta Coefficient 10](#_bookmark9)

[Equation 4 Expected return of a portfolio 10](#_bookmark10)

[Equation 5 Weights of an equally weighted portfolio 11](#_bookmark11)

[Equation 6 Sharpe Ratio 11](#_bookmark12)

[Equation 7 Standard Deviation 11](#_bookmark13)

[Equation 8 Beta Coefficients of each stock 14](#_bookmark16)

[Equation 9 Return of the finance industry equally weighted portfolio 14](#_bookmark17)

[Equation 10 Return of the food industry equally weighted portfolio 14](#_bookmark18)

[Equation 11 Beta coefficients for the finance and food industry equally weighted portfolios14](#_bookmark19) [Equation 12 Expected returns for finance and food industry portfolios 15](#_bookmark20)

[Equation 13 Beta coefficients of finance and food industry portfolios 15](#_bookmark21)

# Introduction

Almost 230 years ago, on the corner of Wall Street and Broadway, the most famous stock exchanging platform known as Wall Street was born. Since the time the concept “stock” was known in the whole world, millions of people have been winning a return or losing their wealth.

In one of the classic example of developing countries, in Mongolia, the first stock exchanging platform named MSE was introduced in 1991, 30 years ago. Through the life time, developers hardly worked on the process and today it is nearly as developed as the stock exchange of big countries. In 2017, the market turnover reached MNT859.2 billion, the highest in its 30 years of history and the TOP-20 index was one of the best performing indexes in the world with 68.9% increase while market capitalization gained 67.4% (KHANGAI, 2019). With regard to 2019, the primary market turnover reached peak in its history.

Currently, 18 stocks from 6 industries are on A-class stocks of MSE and are traded daily on MSE. The A-class stocks are mostly traded and other stocks are relatively thinly traded on the market. 13 of the stocks are from financial and food industry, and other 5 are from 4 different industries. In order to compare market risk of the financial and food industries, we chose the following 10 companies:

|  |  |  |
| --- | --- | --- |
| **Company name in English** | **Ticker symbol** | **Industry** |
| **MIK Holding JSC** | MIK | Financial Service |
| **Ard Insurance JSC** | AIC | Financial Service |
| **BD Securities** | BDS | Financial Service |
| **LENDMN** | LEND | Financial Service |
| **Mandal Insurance** | MDL | Financial Service |
| **Talkh Chiher** | TCK | Food |
| **Milk JSC** | SUU | Food |
| **MahImpex** | MMX | Food |
| **APU** | APU | Food |
| **Tumen shuwuut** | TUM | Food |

*Table 1 List of stocks under consideration*

As food and financial service industries make the 63.2% of the A-class stocks by market capitalization, it is crucial to define which industry has greater risk associated to the market.

As long as every investor on the world is concerned about returns, the unavoidable concept, *risk,* should always be discussed. Among all the types of risk, one which ties price of the underlying with the whole market of it is the *systematic risk* we know. It refers to the variation of return on stocks associated with changes in the return on the market in general.

Through the time, economists and analysts evolved many methods to measure relationship between a stock and the capital market. In this paper, we used the heart of Sharpe- Lintner Capital Asset Pricing Model, which is the *beta coefficient*. Since the CAPM model plays a very important role in establishing the investment portfolio, as Mongolia’s stock market continues to develop, the CAPM model will also be increasingly used in Mongolia. Therefore,

it is necessary to test the applicability and effectiveness of CAPM in an emerging capital market like Mongolia. After 30 years of development, the Mongolian stock market has made great achievements. As an important part of Mongolian securities market, the stock market plays an important role in economic development and social stability.

Comparing to other highly developed countries, Mongolian capital market has much lower turnover, not because of the trading platform or brokers, but caused by low population of only 3.3 million people, and financial knowledge of them. Currently, 1.85 million people have security accounts on brokerage firm (L, 2020). And more than 60% of the accounts are inactive.

Of course there will be significant difference in making comparison by beta of individual stock, or comparing two equally weighted portfolios, or optimally weighted portfolios. In this paper we tried to make comparison of risk of the industries by using all of the 3 approaches mentioned above and the final result will be based on the optimally weighted portfolio comparison.

Unfortunately, there is not any publicly available existing research on this topic in Mongolia. But we do have some studies on usage of *beta* and *portfolio construction* form overseas. For example, a paper named “Systematic Risk at the Industry Level: A Case Study of Australia” studied industrial risks using CAPM, FF3F, FF5F, C4F models. Lining with its previous studies, in conclusion, it stated that “*The verification of beta as a measure of systematic risk varies considerably with the type of portfolio construction, the employed estimation technique, and/or the selection of news about economic condition, which partly contribute to the asset pricing puzzle.”* As concluded, the paper differs on purpose significantly from our research. In other words, it does not conclude which industry is riskier. Another paper named “Considering the DAPM: Low-beta and High-beta Industries” also worked on data of 12 industries of US SEC and concluded the risk of them.

As a result of this paper, we tried to recommend which industry to invest and how should the portfolio be constructed, and how much will the beta be, compared to another portfolio consisting of the other industry.

# Theoretical Framework

*Return calculation:*

A return, also known as a financial return, in its simplest terms, is the money made or lost on an investment over some period of time. A return can be expressed nominally as the change in dollar value of an investment over time. A return can also be expressed as a percentage derived from the ratio of profit to investment. (Hayes, 2020)

Return can be calculated differently by compounding methods. For example, a holding period return can be calculated as final value of the asset increased by benefit it gave at the end of the holding period divided by initial value minus one:

𝑃𝑟𝑖𝑐𝑒 𝑎𝑡 𝑡𝑖𝑚𝑒 𝑡 + 𝑏𝑒𝑛𝑒𝑓𝑖𝑡

𝐻𝑜𝑙𝑑𝑖𝑛 𝑝𝑒𝑟𝑖𝑜𝑑 𝑟𝑒𝑡𝑢𝑟𝑛 =

− 1

𝑃𝑟𝑖𝑐𝑒 𝑎𝑡 𝑡𝑖𝑚𝑒 0

*Equation 1 Holding period return*

Continuously compounded return gets the use of exponential, but this method is an exception for our paper.

*The risk measurement*

Modern academic finance is built on the proposition that markets are essentially rational. The initial model of market rationality is the capital asset pricing model (CAPM). The CAPM developed by Sharpe (1964) and Lintner (1965), marks the birth of asset pricing theory. The CAPM is still widely used in applications such as estimating the cost of capital for firms and evaluating the performance of managed portfolios (Rossi, 2017). The attraction of the CAPM is that it offers powerful, intuitively appealing predictions regarding how to measure risk and of the relationship between expected returns and risk. The model is an idealized depiction of how financial markets price securities and thereby determine expected returns on capital investments.

𝑅𝑒𝑞𝑢𝑖𝑟𝑒𝑑 𝑅𝑒𝑡𝑢𝑟𝑛 = 𝑅𝑓 + 𝛽 ∗ (𝑅𝑚 − 𝑅𝑓)

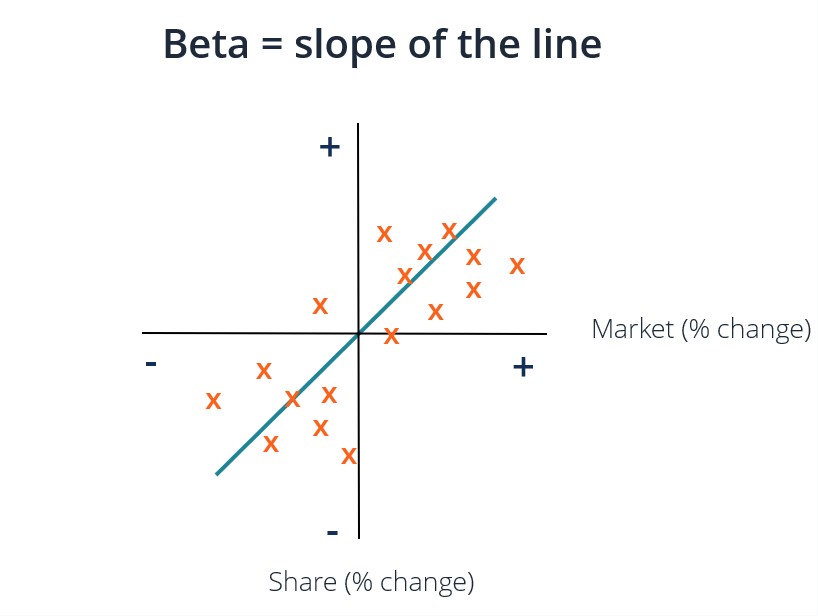
*Equation 2 Required rate of return by CAPM*

𝑅𝑓 − 𝑅𝑖𝑠𝑘 𝑓𝑟𝑒𝑒 𝑟𝑎𝑡𝑒

𝑅𝑚 − 𝑀𝑎𝑟𝑘𝑒𝑡 𝑟𝑒𝑡𝑢𝑟𝑛

𝛽 − 𝐶𝑜𝑚𝑝𝑎𝑛𝑦 𝑠𝑝𝑒𝑐𝑖𝑓𝑖𝑐 𝑐𝑜𝑒𝑓𝑓𝑖𝑐𝑖𝑒𝑛𝑡 𝑜𝑓 𝑟𝑖𝑠𝑘 𝑎𝑠𝑠𝑜𝑐𝑖𝑎𝑡𝑒𝑑 𝑡𝑜 𝑚𝑎𝑟𝑘𝑒𝑡

The CAPM provides a methodology for quantifying risk and translating it into estimates of expected return on equity (ROE). The principal advantage of CAPM is the objective nature of the estimated costs of equity that the model can yield. Financial managers can use it to supplement other techniques and their own judgement in attempting to develop realistic and useful cost of equity calculations. Although its application continues to generate debate, modern financial theory is now applied as a matter of course to investment management. And increasingly, problems in corporate finance are also benefiting from use of the same techniques (Rossi, 2017).



*Figure 1 Explanation of Beta Coefficient*

As shown on the formula above, the investor’s required return consists of 2 parts which are risk free rate and risk premium. The risk premium is calculated as difference between market risk and risk free rate multiplied by the *beta coefficient* of the company. The Beta coefficient is a measure of sensitivity or correlation of a security or an investment portfolio to movements in the overall market index or benchmark. Generally, the index of one is selected for the market index, and if the stock behaved with more volatility than the market, its beta value will be greater than one. If the opposite is the case, its beta will be a value less than one. A company with a beta of greater than one will tend to amplify market movements (for instance the case for the banking sector), and a business with a beta of less than one will tend to ease market movements.

One of the most popular uses of Beta is to estimate the cost of equity in valuation models. The CAPM estimates an asset’s Beta based on a single factor, which is the systematic risk of the market. The cost of equity derived by the CAPM reflects a reality in which most investors have diversified portfolios from which unsystematic risk has been successfully diversified away. In general, the CAPM and Beta provide an easy-to-use calculation method that standardizes a risk measure across many companies with varied capital structures and fundamentals.

The largest drawback of using Beta is that it relies solely on past returns and does not account for new information that may impact returns in the future. Furthermore, as more return data is gathered over time, the measure of Beta changes, and subsequently, so does the cost of equity.

There are then two ways to determine beta. The first is to use the formula for beta, which is calculated as the covariance between the return of the stock and the return of the index divided by the variance of the index (over a period of three years).

𝛽 =

𝐶𝑜𝑣(𝑅𝑐𝑜𝑚𝑝𝑎𝑛𝑦, 𝑅𝑚𝑎𝑟𝑘𝑒𝑡)

𝑉𝑎𝑟(𝑅𝑚𝑎𝑟𝑘𝑒𝑡)

*Equation 3 Beta Coefficient*

𝛽 − 𝐵𝑒𝑡𝑎 𝑐𝑜𝑒𝑓𝑓𝑖𝑐𝑖𝑒𝑛𝑡 𝑜𝑓 𝑡ℎ𝑒 𝑐𝑜𝑚𝑝𝑎𝑛𝑦

𝐶𝑜𝑣 − 𝐶𝑜𝑣𝑎𝑟𝑖𝑎𝑛𝑐𝑒

𝑉𝑎𝑟 − 𝑉𝑎𝑟𝑖𝑎𝑛𝑐𝑒

𝑅𝑐𝑜𝑚𝑝𝑎𝑛𝑦 − 𝑅𝑒𝑡𝑢𝑟𝑛 𝑜𝑓 𝑡ℎ𝑒 𝑐𝑜𝑚𝑝𝑎𝑛𝑦 𝑢𝑛𝑑𝑒𝑟 𝑑𝑖𝑠𝑐𝑢𝑠𝑠𝑖𝑜𝑛

𝑅𝑚𝑎𝑟𝑘𝑒𝑡 − 𝑅𝑒𝑡𝑢𝑟𝑛 𝑜𝑓 𝑡ℎ𝑒 𝑚𝑎𝑟𝑘𝑒𝑡 𝑖𝑛𝑑𝑒𝑥

The second method is to perform a linear regression, with the dependent variable performance of stock over the data as an explanatory variable and the performance of the index over the same period. The coefficient of the explanatory variable is our beta (the covariance divided by variance). /This method is not used in this paper/

Beta can be seen as a measure of risk: the higher the beta of a company, the higher the expected return should be to compensate for the excess risk caused by volatility. Therefore, from a portfolio management or investment perspective, one wants to analyze any measures of risk associated with a company to gain a better estimation of its expected return.

*Portfolio construction*

Portfolio construction is a widely-used theory on how investors can construct investment portfolios to maximize expected returns and minimize risk. The practice of portfolio construction includes implementing an asset allocation strategy, which involves balancing investment risk and return by adjusting the percentage of a portfolio allocated to each asset class (Sandhar, Jain, & Kushwah, 2018).

Expected return of a portfolio is a return which and investor expects to earn from holding a portfolio for an amount of time. The portfolio expected return is calculated as sum of the expected returns from each asset multiplied by their weights:

𝑛

𝐸𝑥𝑝𝑒𝑐𝑡𝑒𝑑 𝑅𝑒𝑡𝑢𝑟𝑛 = 𝑤𝑎 ∗ 𝑅𝑎 + 𝑤𝑏 ∗ 𝑅𝑏 + 𝑤𝑐 ∗ 𝑅𝑐 + ⋯ = ∑ 𝑤𝑖 ∗ 𝑅𝑖

𝑖=1

*Equation 4 Expected return of a portfolio*

Portfolio weight is one of the most important measurements, which defines the risk and return of the whole portfolio. Portfolio weight is the percentage of an investment portfolio that a particular holding or type of holding comprises. The most basic way to determine the weight of an asset is by dividing the dollar value of a security by the total dollar value of the portfolio (Chen, 2020). There are many portfolio construction methods such as equally weighted portfolio construction, optimal risky portfolio and etc.

Modern portfolio theory (MPT) is a theory on how risk-averse investors can construct portfolios to maximize expected return based on a given level of market risk. Harry Markowitz pioneered this theory in his paper "Portfolio Selection," which was published in the Journal of Finance in 1952.1 He was later awarded a Nobel Prize for his work on modern portfolio theory.

Modern portfolio theory argues that an investment's risk and return characteristics should not be viewed alone, but should be evaluated by how the investment affects the overall portfolio's risk and return. MPT shows that an investor can construct a portfolio of multiple assets that will maximize returns for a given level of risk. Likewise, given a desired level of expected return, an investor can construct a portfolio with the lowest possible risk. Based on statistical measures such as variance and correlation, an individual investment's performance is less important than how it impacts the entire portfolio. MPT assumes that investors are risk-averse, meaning they prefer a less risky portfolio to a riskier one for a given level of return. As a practical matter, risk aversion implies that most people should invest in multiple asset classes. (Chen, Modern Portfolio Theory (MPT), 2021)

In an equally weighted portfolio, all the assets in it has the same weight. Which means the return and risk of every single asset affects equally to the portfolio constructed by those.

𝑤𝑎 = 𝑤𝑏 = 𝑤𝑐 = 𝑤𝑑 …

*Equation 5 Weights of an equally weighted portfolio*

The optimal risky portfolio does not only define a weight, but also it maximizes the additional return over risk free rate per standard deviation, a risk measurement by fluctuation. The measurement which must be maximized, we mentioned above is named Sharpe-Ratio.

The Sharpe ratio was developed by Nobel laureate William F. Sharpe and is used to help investors understand the return of an investment compared to its risk. The ratio is the average return earned in excess of the risk-free rate per unit of volatility or total risk. Volatility is a measure of the price fluctuations of an asset or portfolio. Subtracting the risk-free rate from the mean return allows an investor to better isolate the profits associated with risk-taking activities. The risk-free rate of return is the return on an investment with zero risk, meaning it's the return investors could expect for taking no risk. (Fernando, 2020)

𝑅𝑝 − 𝑅𝑓

𝑆ℎ𝑎𝑟𝑝𝑒 𝑅𝑎𝑡𝑖𝑜 =

𝜎𝑝

*Equation 6 Sharpe Ratio*

𝑅𝑝 − 𝑅𝑒𝑡𝑢𝑟𝑛 𝑜𝑓 𝑡ℎ𝑒 𝑝𝑜𝑟𝑡𝑓𝑜𝑙𝑖𝑜

𝑅𝑓 − 𝑅𝑖𝑠𝑘 𝑓𝑟𝑒𝑒 𝑟𝑎𝑡𝑒

𝜎𝑝 − 𝑆𝑡𝑎𝑛𝑑𝑎𝑟𝑑 𝑑𝑒𝑣𝑖𝑎𝑡𝑖𝑜𝑛 𝑜𝑓 𝑡ℎ𝑒 𝑝𝑜𝑟𝑡𝑓𝑜𝑙𝑖𝑜

the standard deviation is a measure of the amount of variation or dispersion of a set of values. A low standard deviation indicates that the values tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the values are spread out over a wider range.

1

𝜎 = √

𝑁

𝑛

∑(𝑥𝑖 − 𝜇)2 , 𝑤ℎ𝑒𝑟𝑒 𝜇 =

𝑖−1

𝑛

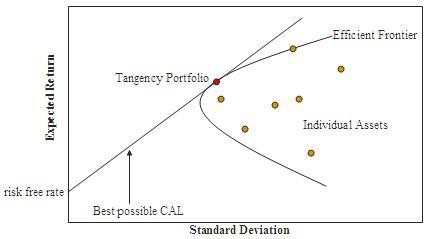
1

𝑁 ∑ 𝑥𝑖

𝑖−1

*Equation 7 Standard Deviation*

In order to maximize the Sharpe ratio, optimally weighted portfolio approach constructs an efficient frontier. The efficient frontier is the set of optimal portfolios that offer the highest expected return for a defined level of risk or the lowest risk for a given level of expected return. Portfolios that lie below the efficient frontier are sub-optimal because they do not provide enough return for the level of risk. Portfolios that cluster to the right of the efficient frontier are sub-optimal because they have a higher level of risk for the defined rate of return. (Ganti, 2020)



*Figure 2 Tangency portfolio*

The tangency point of efficient frontier and capital asset line must be the optimally weighted portfolio.

# Methodology

Our main purpose is to determine the riskier one of the finance and food industry, then provide an investment plan by constructed portfolio which is used on comparison. In order to achieve this, following few steps should be taken:

1. Choosing the appropriate companies;
2. Selecting analysis time horizon and collecting data of the companies chosen;
3. Construct a monthly time series of returns by using the price data;
4. Find the beta coefficients of individual stocks by determining covariance between assets and market (MSE TOP-20). The first conclusion must arise from here;
5. Construct an equally weighted portfolio of two industries, then find and compare betas for each of portfolios;
6. Construct an optimally weighted portfolio which maximized the share ratio, then find and compare betas for each of portfolios;

## Data collection and selection:

The MSE keeps the trading data of Mongolian stocks on its website which is publicly available. The mostly traded stocks are A-class stocks of MSE and it consists of 18 stocks from 6 industries. 13 of the stock are from finance and food industry. In order to make the comparison sound, we chose equal number of stocks from the 2 industries. 6 of each could be possible but 2 of companies, which are “Bodi insurance” and “Monos food”, publicly traded too later than others, on Jun 2020 and May 2019, respectively. As the available public data on those 2 companies is too short, we chose 10 companies, 5 from finance industry and 5 from food industry which are shown on introduction section.

Time horizon of the data is from January of 2012 to December of 2020, 9 years. Unfortunately, 5 of the companies under consideration began business or became publicly available lately. MIK data begins on Jan 2016, AIC on Oct 2018, LEND on Mar 2018, MDL on Sep 2018, TUM on Feb 2019.

## Finding the monthly returns:

To find the monthly returns, we used the holding period return formula provided on the theoretical framework section. The number of data in the series constructed by returns is lower by 1, compared to original price data.

*Finding beta coefficients for each of the individual stocks*

To determine the betas, we followed the beta calculation formula provided by the CAPM model for each of the stocks:

𝛽𝑀𝐼𝐾

𝛽

= 𝑣𝑎𝑟(𝑅𝑀𝐼𝐾,𝑅𝑇𝑂𝑃20)

𝑉(𝑅𝑇𝑂𝑃20)

= 𝐶𝑜𝑣(𝑅𝐿𝐸𝑁𝐷,𝑅𝑇𝑂𝑃20)

𝛽𝐴𝐼𝐶

𝛽

= 𝑣𝑎𝑟(𝑅𝐴𝐼𝐶,𝑅𝑇𝑂𝑃20)

𝑉(𝑅𝑇𝑂𝑃20)

= 𝐶𝑜𝑣(𝑅𝑀𝐷𝐿,𝑅𝑇𝑂𝑃20)

𝛽𝐵𝐷𝑆

𝛽

= 𝑣𝑎𝑟(𝑅𝐵𝐷𝑆,𝑅𝑇𝑂𝑃20)

𝑉(𝑅𝑇𝑂𝑃20)

= 𝐶𝑜𝑣(𝑅𝑇𝐶𝐾,𝑅𝑇𝑂𝑃20)

𝐿𝐸𝑁𝐷

𝑉(𝑅𝑇𝑂𝑃20)

𝑀𝐷𝐿

𝑉(𝑅𝑇𝑂𝑃20)

𝑇𝐶𝐾

𝑉(𝑅𝑇𝑂𝑃20)

𝛽𝑆𝑈𝑈

= 𝑣𝑎𝑟(𝑅𝑆𝑈𝑈,𝑅𝑇𝑂𝑃20)

𝑉(𝑅𝑇𝑂𝑃20)

𝛽𝑀𝑋𝑋

= 𝑣𝑎𝑟(𝑅𝑀𝑋𝑋,𝑅𝑇𝑂𝑃20)

𝑉(𝑅𝑇𝑂𝑃20)

𝛽𝐴𝑃𝑈

= 𝑣𝑎𝑟(𝑅𝐴𝑃𝑈,𝑅𝑇𝑂𝑃20)

𝑉(𝑅𝑇𝑂𝑃20)

𝐶𝑜𝑣(𝑅𝑇𝑈𝑀, 𝑅𝑇𝑂𝑃20)

𝛽𝑇𝑈𝑀 =

𝑉𝑎𝑟(𝑅

𝑇𝑂𝑃20)

*Equation 8 Beta Coefficients of each stock*

After finding the beta coefficient by formulas provided above, the individual betas can be compared to each other in order to determine which company has higher risk associated to the Mongolian capital market.

## Constructing equally weighted portfolios and comparing betas of them

Equally weighted portfolio construction process must be done as process on the theoretical framework. At step 3, we constructed time series of returns.

For finance industry portfolio, we averaged the returns of 5 companies from the industry for each month. The average values provide monthly expected returns for the portfolio.

1

𝑅𝐹𝑖𝑛𝑎𝑛𝑐𝑒 𝑎𝑡 𝑚𝑜𝑛𝑡ℎ 𝑡 = 5 (𝑅𝑀𝐼𝐾𝑡 + 𝑅𝐴𝐼𝐶𝑡 + 𝑅𝐵𝐷𝑆𝑡 + 𝑅𝐿𝐸𝑁𝐷𝑡 + 𝑅𝑀𝐷𝐿𝑡)

*Equation 9 Return of the finance industry equally weighted portfolio*

Portfolio of the food industry is constructed exactly the same as finance industry.

1

𝑅𝐹𝑜𝑜𝑑 𝑎𝑡 𝑚𝑜𝑛𝑡ℎ 𝑡 = 5 (𝑅𝑇𝐶𝐾𝑡 + 𝑅𝑆𝑈𝑈𝑡 + 𝑅𝑀𝑋𝑋𝑡 + 𝑅𝐴𝑃𝑈𝑡 + 𝑅𝑇𝑈𝑀𝑡)

*Equation 10 Return of the food industry equally weighted portfolio*

As find the return of the portfolios for each month, we can calculate betas for each portfolio.

𝐶𝑜𝑣(𝑅𝐹𝑖𝑛𝑎𝑛𝑐𝑒, 𝑅𝑇𝑂𝑃20)

𝛽𝐹𝑖𝑛𝑎𝑛𝑐𝑒 =

𝑉𝑎𝑟(𝑅

𝑇𝑂𝑃20)

𝐶𝑜𝑣(𝑅𝐹𝑜𝑜𝑑, 𝑅𝑇𝑂𝑃20)

𝛽𝐹𝑜𝑜𝑑 =

𝑉𝑎𝑟(𝑅

𝑇𝑂𝑃20)

*Equation 11 Beta coefficients for the finance and food industry equally weighted portfolios*

After finding the betas, we can conclude which industry has a higher market risk by comparing the betas.

## Constructing optimally weighted portfolios and comparing betas of them

The expected return of a portfolio constructed by finance industry companies simply look like (𝑅𝐹𝑖𝑛𝑎𝑛𝑐𝑒) = 𝑤𝑀𝐼𝐾𝑅𝑀𝐼𝐾 + 𝑤𝐴𝐼𝐶 𝑅𝐴𝐼𝐶 + 𝑤𝐵𝐷𝑆𝑅𝐵𝐷𝑆 + 𝑤𝐿𝐸𝑁𝐷𝑅𝐿𝐸𝑁𝐷 + 𝑤𝑀𝐷𝐿𝑅𝑀𝐷𝐿

Theories and books usually provide formulas to determine weights for only 2 or 3 assets which are simple. In our case, the number of assets included in a portfolio is 5. The weights must satisfy the condition to maximize the Sharpe ratio.

As long as MSE does not allow short trading on stocks, we exclude any negative return stocks from the portfolio if any exists.

As programming tools to define weights, Java, Python, R Studio and even Microsoft Excel Solver function can be used. Among those, the simplest approach is the Solver function and we use it in order to determine optimal weights, satisfying the efficient frontier and capital asset line.

The tangency points of 2 frontiers of 2 industries provide optimal weights of the portfolios.

After defining the weights, the expected return of portfolios for each month will be found as:

𝐸(𝑅𝐹𝑖𝑛𝑎𝑛𝑐𝑒) = 𝑤𝑀𝐼𝐾𝑅𝑀𝐼𝐾 + 𝑤𝐴𝐼𝐶 𝑅𝐴𝐼𝐶 + 𝑤𝐵𝐷𝑆𝑅𝐵𝐷𝑆 + 𝑤𝐿𝐸𝑁𝐷𝑅𝐿𝐸𝑁𝐷 + 𝑤𝑀𝐷𝐿𝑅𝑀𝐷𝐿

𝐸(𝑅𝐹𝑜𝑜𝑑) = 𝑤𝑇𝐶𝐾𝑅𝑇𝐶𝐾 + 𝑤𝑆𝑈𝑈 𝑅𝑆𝑈𝑈 + 𝑤𝑀𝑋𝑋𝑅𝑀𝑋𝑋 + 𝑤𝐴𝑃𝑈𝑅𝐴𝑃𝑈 + 𝑤𝑇𝑈𝑀𝑅𝑇𝑈𝑀

*Equation 12 Expected returns for finance and food industry portfolios*

As find the return of the portfolios for each month, we can calculate betas for each portfolio.

𝐶𝑜𝑣(𝑅𝐹𝑖𝑛𝑎𝑛𝑐𝑒, 𝑅𝑇𝑂𝑃20)

𝛽𝐹𝑖𝑛𝑎𝑛𝑐𝑒 =

𝑉𝑎𝑟(𝑅

𝑇𝑂𝑃20)

𝐶𝑜𝑣(𝑅𝐹𝑜𝑜𝑑, 𝑅𝑇𝑂𝑃20)

𝛽𝐹𝑜𝑜𝑑 =

𝑉𝑎𝑟(𝑅

𝑇𝑂𝑃20)

*Equation 13 Beta coefficients of finance and food industry portfolios*

After finding the betas, we can conclude which industry has a higher market risk by comparing the betas.

# Results

## Beta coefficients of individual assets

Beta coefficients of individual stocks are an important measure to conclude which industry is riskier and we can even define the riskiest stock among the 10 stocks under analysis.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **MIK** | **AIC** | **BDS** | **LEN D** | **MD L** | **TCK** | **SUU** | **MX X** | **APU** | **TU M** |
| **Covar with TOP 20** | 0.33  % | 0.10  % | 0.22  % | 0.16  % | 0.14  % | 0.15  % | 0.20  % | 0.14  % | 0.34  % | 0.21  % |
| **Variance** | 1.61  % | 0.51  % | 0.99  % | 1.17  % | 0.26  % | 0.51  % | 0.83  % | 0.58  % | 0.67  % | 0.76  % |
| **Var of TOP 20** | 0.36  % |  |  |  |  |  |  |  |  |  |
| **Beta** | **0.91** | **0.29** | **0.60** | **0.44** | **0.37** | **0.42** | **0.55** | **0.38** | **0.93** | **0.58** |

*Table 2 Beta coefficients of individual stocks*

As shown on the table above, the most market-risk bearing stocks are APU and MIK. The highest-lowest beta ranking is shown as:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Beta** | **Rank** | **Industry** |
| **APU** | 0.93 | 1 | Food |
| **MIK** | 0.91 | 2 | Finance |
| **BDS** | 0.60 | 3 | Finance |
| **TUM** | 0.58 | 4 | Food |
| **SUU** | 0.55 | 5 | Food |
| **LEND** | 0.44 | 6 | Finance |
| **TCK** | 0.42 | 7 | Food |
| **MXX** | 0.38 | 8 | Food |
| **MDL** | 0.37 | 9 | Finance |
| **AIC** | 0.29 | 10 | Finance |

*Table 3 Ranking of the stocks by their beta*

The ranking shows the lowest market risk bearing stocks are from financial industry. But it is too early to conclude that food industry in Mongolia is riskier than finance industry.

## Equally weighted portfolio comparison

In and equally weighted portfolio, all the assets in it affect portfolio return exactly the same way.

The expected monthly returns for BDS and LEND are lower than zero. So, the stocks were eliminated from the portfolio. On the other hand, TUM from food industry bears return lower than zero and is also an exception for the portfolio.

|  |  |  |
| --- | --- | --- |
| **Industry** | **Finance** | **Food** |
| **Covariance** | 0.214% | 0.208% |
| **Beta coefficient** | 0.59 | 0.57 |

*Table 4 Betas of equally weighted portfolios*

The table above shows estimation of beta coefficient constructed by positive return bearing stocks from each industry.

The beta of the finance industry is slightly higher than the food industry which implies the market risk for the finance industry in Mongolia has slightly higher risk compared to Mongolian food industry.

## Optimally weighted portfolio comparison

To construct an optimally weighted portfolio, we need variance-covariance matrix of the stocks. Firstly, the variance-covariance matrix of the finance industry is:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **MIC** | **AIC** | **BDS** | **LEND** | **MDL** |
| **MIC** | 1.64% | 0.33% | 0.26% | 0.32% | 0.32% |
| **AIC** | 0.33% | 0.53% | 0.02% | 0.11% | -0.02% |
| **BDS** | 0.26% | 0.02% | 1.00% | 0.33% | -0.08% |
| **LEND** | 0.32% | 0.11% | 0.33% | 1.21% | 0.16% |
| **MDL** | 0.32% | -0.02% | -0.08% | 0.16% | 0.27% |

*Table 5 Variance-Covariance matrix of Finance industry stocks*

And the weights for the finance industry portfolio is found as:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tickers** | **MIC** | **AIC** | **BDS** | **LEND** | **MDL** |
| **Weight** | 14% | 61% | 0% | 0% | 24% |

*Table 6 Optimal weights of finance industry stocks*

As mentioned on the previous result, the expected monthly return for BDS and LEND are negative, the weights of them in the portfolio equals to 0.

For the food industry, the results are:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **TCK** | **SUU** | **MXX** | **APU** | **TUM** |
| **TCK** | 0.51% | 0.13% | 0.06% | 0.17% | 0.00% |
| **SUU** | 0.13% | 0.83% | 0.08% | 0.23% | 0.20% |
| **MXX** | 0.06% | 0.08% | 0.59% | 0.15% | 0.01% |
| **APU** | 0.17% | 0.23% | 0.15% | 0.68% | 0.24% |
| **TUM** | 0.00% | 0.20% | 0.01% | 0.24% | 0.80% |

*Table 7 Variance-Covariance matrix of Food industry stocks*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tickers** | **TCK** | **SUU** | **MXX** | **APU** | **TUM** |
| **Weight** | 22% | 49% | 24% | 5% | 0% |

*Table 8 Optimal weights of Food industry stocks*

As the weights were found, portfolios are ready to be constructed for each of the industry.

|  |  |  |
| --- | --- | --- |
| **Industry** | **Finance** | **Food** |
| **Covariance** | 0.000902 | 0.001845 |
| **Beta coefficient** | 0.25 | 0.50 |

*Table 9 Beta coefficients of optimally weighted portfolios*

The table above shows covariance with the market for each of the portfolios constructed by optimal weights and betas for each of the portfolios.

The estimated beta for finance industry is 0.25, while food industry is 0.5 which is two times higher from the finance industry. Comparing this to one we found in equally weighted portfolio, the results are totally different.

A rational investor prefers optimally weighted portfolio than an equally weighted one. Thus, considering the market risk, the rational investor would prefer finance industry in Mongolia. Because the food industry has two times higher beta than the finance industry implying that market movement affects highly to the food industry stocks in Mongolia.

# Conclusion

From the beginning of the research work, we hoped that this research on Mongolian two big industries can help investment decisions for risk averse investors in Mongolia.

It is hard to blindly say which industry bears higher market risk without any number for any economists. The beta coefficient approach we used in order to define the riskier industry helped a lot to recommend an investment decision.

As shown on the final result, the beta coefficient of food industry is higher than that of finance industry, which means the market risk of food industry is higher than finance industry in Mongolia.

During the research, we found that the portfolio construction approach we use is the most important feature of result. On an equally weighted portfolio, the coefficients were almost equal to each other, where beta of finance industry was slightly higher than food industry, implying that finance industry bear a little bit more market risk than food industry in Mongolia. Furthermore, in the individual beta calculation section, we found that the riskiest stock was APU which is a food industry company, while the lowest beta companies were MDL and AIC which are the finance industry stocks.

From the individually calculated beta coefficients, we can predict the conclusion as food industry bears more market risk. However, the equally weighted portfolio shows finance industry bears a bit more market risk than food industry.

The portfolio construction approach a rational investor would use is definitely the optimal risky approach, we assume. The optimally weighted portfolio showed that beta coefficient of the food industry is significantly higher than that of finance industry. So, comparing the optimally weighted portfolio approach to other two comparison approaches we used, the results can differ significantly following the approaches we use.

For further research to compare other industries than food and finance, researchers need data with reliable and long time horizon. Currently, other hundreds of stock in B-class or C- class are too thinly traded to make conclusion.

Comparing to other stock exchange commissions in highly developed countries, Mongolian turnover is much more low, not because of the platform development or broker, but because of the population, and financial knowledge of people in the nation as mentioned in the introduction section.

In order to extend this kind of industrial market risk comparing researches in Mongolia, the capital market must be more active. To achieve an active capital market, financial market knowledge of the nation and individual money surplus after consumption must be sufficient. So that, individuals can directly invest into capital market using some of their surplus instead of saving all.

We hope that in 10-15 years, Mongolian capital market turnover will be much higher and number of actively traded stocks increase dramatically to be able to use any analytical approaches without any struggle.

# Bibliography

Chen, J. (2020, 3 30). *Portfolio Weight*. Retrieved from Investopedia: https://[www.investopedia.com/terms/p/portfolio-weight.asp](http://www.investopedia.com/terms/p/portfolio-weight.asp)

Chen, J. (2021, 3 1). *Modern Portfolio Theory (MPT)*. Retrieved from Investopedia: https://[www.investopedia.com/terms/m/modernportfoliotheory.asp](http://www.investopedia.com/terms/m/modernportfoliotheory.asp)

Fernando, J. (2020, 12 8). *Sharpe Ratio*. Retrieved from Investopedia: https://[www.investopedia.com/terms/s/sharperatio.asp](http://www.investopedia.com/terms/s/sharperatio.asp)

Ganti, A. (2020, 3 4). *Efficient Frontier*. Retrieved from Investopedia: https://[www.investopedia.com/terms/e/efficientfrontier.asp](http://www.investopedia.com/terms/e/efficientfrontier.asp)

Hayes, A. (2020, 9 6). *Return*. Retrieved from Investopedia: https://[www.investopedia.com/terms/r/return.asp](http://www.investopedia.com/terms/r/return.asp)

KHANGAI, A. (2019). *MSE - About Us*. Retrieved from MSE.

Nguyen, T. C., Vu, T. N., Vo, D. H., & McAleer, M. (2020). Systematic Risk at the Industry Level: A Case Study. 1-12.

Rossi, M. (2017). The Capital Asset Pricing Model: A critical literature review. *ResearchGate*. Sandhar, S. K., Jain, N., & Kushwah, R. (2018). OPTIMAL PORTFOLIO CONSTRUCTION: A CASE STUDY

OF NSE. *International Journal of Emerging Technologies and Innovative Research*, 512-520.