STRATEGIC PORTFOLIO OPTIMIZATION

A Comprehensive Analysis of the Indonesian Stock Market and Gold Investments (2008-2022)

FINAL PROJECT

In partial fulfilment of the requirements
for the master's degree
from Institut Teknologi Bandung

By
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INSTITUT TEKNOLOGI BANDUNG
October 2023

ABSTRACT

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By
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This final project provides a rigorous empirical analysis of portfolio optimization utilizing the Sharpe ratio on Gold asset and some selected Indonesian stock market based on basic ratio of fundamental analysis (TOWR, PTBA, INKP and ITMG). The study attaches real data spanning from 2008 to 2017 to define portfolio allocations based on the Sharpe ratio. Subsequently, these allocations are back tested against the market data from 2018 to 2022, utilizing various investment strategies: **No rebalancing, yearly rebalancing, six-monthly rebalancing and 3-monthly rebalancing**, with the aim of concluding the most profitable strategy. This rebalancing strategy was assumed no transaction fee and to simplify the calculation.

The study employs a robust methodology, systematically analyzing historical returns, volatility, and correlations of chosen stocks listed on the Indonesia Stock Exchange (IDX) and gold asset prices. By leveraging modern portfolio theory (MPT) and the Sharpe ratio, optimal portfolio allocations are distinguished for the first study period (2008-2017), which form the basis for the subsequent back testing phase.

In the backtesting phase, the determined portfolio allocations are tested against actual market developments from 2018 to 2022. The study scrutinizes the performance of each portfolio under the four distinct rebalancing strategies to ascertain their impact on the portfolio's risk-adjusted returns. The aim is to identify which strategy yields the highest profitability while effectively managing risk, particularly in the dynamic and often volatile context of the Indonesian financial market.

The findings of this research are anticipated to reveal crucial understandings into the effectiveness of different rebalancing strategies in enhancing portfolio performance. The study provides a detailed comparative analysis of the realized profits and risk-adjusted returns of each strategy, offering valuable recommendations for investors seeking to optimize their portfolios within the Indonesian stock market and gold assets.

In conclusion, the 6-month rebalancing was the best strategy giving highest return with minimum risks based on composition defined from Sharpe ratio methodology.

Keywords: *Asset Portfolio Optimization, Investment strategy, Jakarta Stock Exchange.*

ABSTRAK

STRATEGI OPTIMASI PORTFOLIO

Analisa Komprehensif Optimasi Portfolio Investasi dari Pasar Saham Indonesia dan Emas Periode 2008-2022

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Proyek akhir ini menyajikan analisa empiris mengenai optimalisasi portofolio dengan menggunakan sharpe rasio untuk beberapa pilihan saham dari pasar saham Indonesia (TOWR, PTBA, INKP dan ITMG) yang dihasilkan dari analisa fundamental dan aset emas. Studi ini menggunkan data dari tahun 2008-2017 untuk menentukan alokasi portofolio berdasarkan sharpe rasio. Selanjutnya, alokasi portfolio ini diuji kembali terhadap data pasar dari tahun 2018-2022, dengan menggunakan berbagai strategi investasi: no rebalancing, yearly rebalancing, 6-monthly rebalancing dan 3-monthly rebalancing, dengan tujuan untuk menentukan strategi yang paling menguntungkan. Strategi rebalancing ini mengasumsikan tidak ada biaya transaksi untuk menyederhanakan perhitungan.

Studi ini menganalisis secara sistematis sejarah pengembalian investasi, volatilitas, dan korelasi dari beberapa saham yang terpilih yang terdaftar di Bursa Efek Indonesia (IDX) dan harga aset emas. Optimal alokasi portfolio didapatkan berdasarkan actual data pasar dari tahun 2008-2017 dengan menggunakan metode sharpe ratio.

Dalam fase backtesting, alokasi portofolio ini kemudian diuji terhadap data pasar dari tahun 2018-2022. Studi ini mengkaji kinerja setiap portofolio dengan beberapa strategy investasi. Tujuannya adalah untuk mengidentifikasi strategi mana yang menghasilkan keuntungan tertinggi dengan memperhatikan factor resiko.

Temuan dari penelitian ini diharapkan dapat menambah pemahaman mengenai efektifitas dari berbagai strategi investasi dalam meningkatkan kinerja portofolio. Studi ini menyediakan analisis komparatif yang rinci mengenai keuntungan dan pengembalian yang disesuaikan dengan risiko dari setiap strategi, menawarkan rekomendasi berharga bagi investor yang berupaya mengoptimalkan portofolio di pasar saham Indonesia dan aset emas.

Sebagai kesimpulan, rebalancing enam bulanan merupakan strategi terbaik yang memberikan pengembalian tertinggi dengan risiko minimum berdasarkan komposisi yang ditentukan oleh metodologi rasio Sharpe.

Keywords: Asset Portfolio Optimization, Investment strategy, Jakarta Stock Exchange.

STRATEGIC PORTFOLIO OPTIMIZATION

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This final project is dedicated especially to my lovely wife, andmy beloved family who always support me.

ACKNOWLEDGEMENTS

Praise be to Allah SWT, the Almighty and the Most Merciful, as it is through His guidance and mercy that I have been able to successfully complete my final project and fulfill the requirements of my Master of Business Administration program at Bandung Institute of Technology. Throughout the process of writing this final project, I have received invaluable support and motivation. Therefore, I would like to express my deepest gratitude and appreciation to the following individuals:

1. Dr. Subiakto Soekarno, MBA, RFA, QWP, CFP, my final project advisor, whose assistance, patience, guidance, and dedicated time have been instrumental in the completion of this final project.
2. I would also like to extend my sincere appreciation to all my colleagues in BLEMBA66 Qatar, who have consistently demonstrated openness and collaboration during our class lectures, assignments, and final project preparations.
3. Furthermore, I would like to express my gratitude to all the esteemed lecturers of the SBM ITB, whose profound knowledge and expertise have greatly enriched my learning experience. I am also grateful to the staff of SBM ITB for their kindness, assistance, and unwavering support throughout my years of study.

In conclusion, I acknowledge that this project still has its limitations, therefore, I humbly welcome any criticism and suggestions that may contribute to its improvement. It is my sincere hope that this thesis will prove beneficial to all parties involved.

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LIST OF ABBREVIATIONS AND SYMBOLS

ABREVIATIONS	Name
IDX	Indonesia Stock Exchange
IHSG	Index Harga Saham Gabungan (IDX Index)

SYMBOLS	Name
Rf	Risk free rate
Rm	Average return of the market
Rp	Average return of the investment
σp	Standard deviation

Chapter I Introduction

Portfolio optimization is a crucial domain in financial management, enabling investors to allocate their assets effectively to maximize returns while mitigating risks. The pursuit of achieving the optimal balance between risk and return forms the core of investment strategies, with various metrics and models being employed to attain this equilibrium. This thesis researches into portfolio optimization using the Sharpe ratio on selected stocks in the Indonesian stock market and gold assets, thereby contributing to the address on investment strategies in emerging markets.

I.1 Background

This final project is specifically meant for an investor who plans to start investing in The Indonesian stock market. With over 800 stock in Indonesian Stock Exchange, stock selection was very critical. Therefore, this final project will explaining on how to select the company based simple and basic ratio of fundamental analysis such as **growth revenue, annual gross profit margin, gross profit growth, average net profit margin and average dividend yield**. Furthermore, analyzing the impact of gold in to the portfolio to diversify the asset will also be shown.

Once we defined the asset for investments, the actual market data from 2008-2022 was used. The Sharpe Ratio is used as basis to define portfolio asset allocation. This project is used actual market data from 2008-2022. With defined asset allocation, the back test utilizing various investment strategy (no rebalancing and rebalancing) was then reviewed and analyzed. The summary and recommendation will be shown.

Sharpe ratio, developed by William F. Sharpe, measures the performance of an investment compared to a risk-free asset, considering the inherent risk. It is instrumental in identifying the investment that yields the highest return for a given level of risk, making it pivotal for portfolio optimization.

I.2 Business Issue

In the ever-evolving financial landscape, investors and portfolio managers constantly grapple with the challenge of optimizing asset allocation to ensure robust returns, particularly in volatile markets like Indonesia. The primary business issue addressed in this thesis revolves around identifying the most efficacious investment strategy among no rebalancing, yearly rebalancing, six-monthly rebalancing and 3-monthly rebalancing, using the Sharpe ratio as the guiding principle.

Given the diverse nature of the selected assets and the inherent market volatilities, determining an effective rebalancing strategy is paramount. The outcome of this research aims to address the fundamental uncertainties in investment strategies, providing empirical evidence and insights to aid investors in making informed decisions and optimizing their portfolios in the Indonesian stock market and gold assets. Additionally, this study endeavors to fill any existing gaps in literature pertaining to portfolio optimization in emerging markets, thereby fostering a deeper understanding of asset allocation and rebalancing strategies in these unique financial environments.

I.3 Research Questions and Research Objectives

This final project will answer for following research questions as below:

1. How does portfolio optimization using the Sharpe ratio on selected Indonesian stocks and gold assets influence investment returns and risk?
2. How does gold impacted the portfolio return and risk?
3. Which rebalancing strategy : no rebalancing, yearly rebalancing, six-monthly rebalancing or three-monthly rebalancing – yields the most profitable outcomes?
4. How does market volatility in the Indonesian stock market affect the performance of the portfolio under different rebalancing strategies?

The research objectives of this study are to do the following:

1. Stock screening criteria based on some fundamental analysis aspect and select the best four assets.

- Fundamental analysis criteria used: revenue growth, annual gross profit margin, gross profit growth, average net profit margin and average dividend yield.

2. To define portfolio allocation based on Sharpe ratio.
   - Employ the Sharpe ratio to define optimal portfolio allocation for selected Indonesian stock and gold asset based on real data from 2008-2017.
3. To backtest portfolio with various rebalancing strategies.
   - Backtest the predetermined portfolio allocations against market data from 2018-2022 using different rebalancing strategies: no rebalancing, yearly rebalancing, and six-monthly rebalancing.
4. To Evaluate the Impact of Rebalancing Strategies on Portfolio Performance
   - Assess the effectiveness of each rebalancing strategy in terms of risk-adjusted returns and profitability to identify the most advantageous investment approach.
5. To Provide Recommendations for Investors.
   - Develop empirically driven recommendations for investors seeking to optimize their portfolios within the Indonesian stock market and gold assets based on the findings of the study.

I.4 Research Scope and Limitation

The research is centered around selected stocks from the Indonesian stock market using some fundamental aspect (revenue growth, gross profit margin annual, gross profit growth, average net profit margin and average dividend yield) where TOWR, ITMG, PTBA and INKP was selected. The stock selection criteria may not providing the best asset to invest. The objective is mainly for project show case. Selecting gold other than other asset is mainly due to fact that gold is one of safe heaven to diverse array of asset for portfolio optimization.

The study utilizes real data spanning from 2008 to 2017 for determining portfolio allocations based on the Sharpe ratio and backtests these allocations against

market data from 2018 to 2022. The research employs the Sharpe ratio and Modern Portfolio Theory for portfolio optimization, assessing risk-adjusted returns and the impact of different rebalancing strategies.

Referring to above research scope, therefore some limitation for this research :

- Historical data : The study relies on past data, limiting its predictive ability for future market conditions and subjecting it to potential inaccuracies and availability constraints.
- Assumption : Simplifying assumptions such as no transaction costs, constant risk-free rate, and exclusion of dividends and taxes might affect the real-world applicability of the findings.
- Model constraint : The use of the Sharpe ratio and Modern Portfolio Theory introduces inherent model limitations and assumptions, impacting the comprehensiveness of portfolio optimization.
- Specific Asset and Market Focus : The focus on selected Indonesian stocks and gold assets constrains the generalizability of the findings to other stocks, asset classes, or geographic markets.
- Economic and Geopolitical Factors : The research does not extensively consider the influence of significant economic and geopolitical events on the Indonesian stock market and gold prices.
- Rebalancing Frequency Limitation : The exploration of specific rebalancing frequencies might omit insights that additional frequencies could provide.

Chapter II Literature Review

This chapter will cover problem exploration, literature review reference from former studies and conceptual framework which will guide the data collection andanalysis in the forthcoming chapters. Portfolio optimization is a foundation in the field of finance and investment, and a wealth of literature has been dedicated to exploring its various facets. At the heart of portfolio optimization is the aim to allocate capital to different assets in a manner that maximizes return for a given level of risk, or minimizes risk for a given level of return.

II.1 Modern Portfolio Theory & Portfolio Optimization

The seminal work of Harry Markowitz (1952) introduced Modern Portfolio Theory (MPT), which has since served as the foundational framework for portfolio optimization. Markowitz posited that investors are concerned with both return and risk, and he introduced the concept of an efficient frontier – a set of optimal portfolios offering the highest expected return for a given level of risk. This theory emphasizes the importance of diversification and the correlation between asset returns, introducing the concepts of portfolio variance and covariance (Markowitz, H. 1952, "Portfolio Selection," The Journal of Finance).

II.2 Sharpe Ratio & Portfolio Allocation

William F. Sharpe introduced the Sharpe Ratio in 1966, which measures the performance of an asset or a portfolio adjusted for risk. The Sharpe Ratio has become a widely used metric for assessing the risk-adjusted return of an investment, aiding investors in making informed allocation decisions (Sharpe, W.F. 1966, "Mutual Fund Performance," Journal of Business).

II.3 Regional Focus : Indonesia Stock Exchange and Gold Investment

The pursuit of optimal portfolio allocation often finds a focal point in diverse and emerging markets, with Indonesia's stock exchange serving as a prime example. The Indonesia Stock Exchange (IDX) presents a vast array of investment opportunities, necessitating a comprehensive analysis of its unique market dynamics and risks

(Sukmana & Ibrahim, 2017). Additionally, the inclusion of gold as an asset class represents a conventional strategy for diversification, providing a hedge against inflation and currency fluctuations (Baur & McDermott, 2010). The inclusion of alternative investments, such as gold and real estate, in portfolio optimization has also been extensively studied. Bodie, Rosansky, and Kane (1995) examined the role of gold in a diversified portfolio, emphasizing its potential as a hedge against inflation and currency fluctuations (Bodie, Z., Rosansky, V.I., Kane, A. 1995, "Gold as a Portfolio Diversifier," Journal of Portfolio Management).

Gold has been recognized as a valuable diversification asset, particularly during market downturns. Baur & McDermott (2010) and Beckmann et al. (2015) conducted comprehensive studies on gold's role in portfolio diversification, revealing its potential as a non-correlated asset to stocks and its varying correlations across different timeframes.

II.4 Investment Strategies and Rebalancing

Rebalancing is an integral part of portfolio management, ensuring that the portfolio's asset allocation remains aligned with the investor's risk tolerance and investment goals. The literature presents varying perspectives on the frequency and threshold of rebalancing. Troughton (2008) delved into the balance between transaction costs and risk reduction, contributing valuable insights on optimal rebalancing strategies (Troughton, P. 2008, "Portfolio Rebalancing," Journal of Portfolio Management).

Bouchey et al. (2012) provided a comprehensive examination of different rebalancing strategies, weighing their impact on portfolio performance and risk-adjusted returns. Their research highlighted the significance of dynamic rebalancing and its influence on maintaining portfolio efficiency (Bouchey, P., et al. 2012, "Volatility Harvesting: Why Does Rebalancing Create Value?," Journal of Wealth Management).

II.5 Conceptual Framework

The conceptual framework of this study can be described as follows:

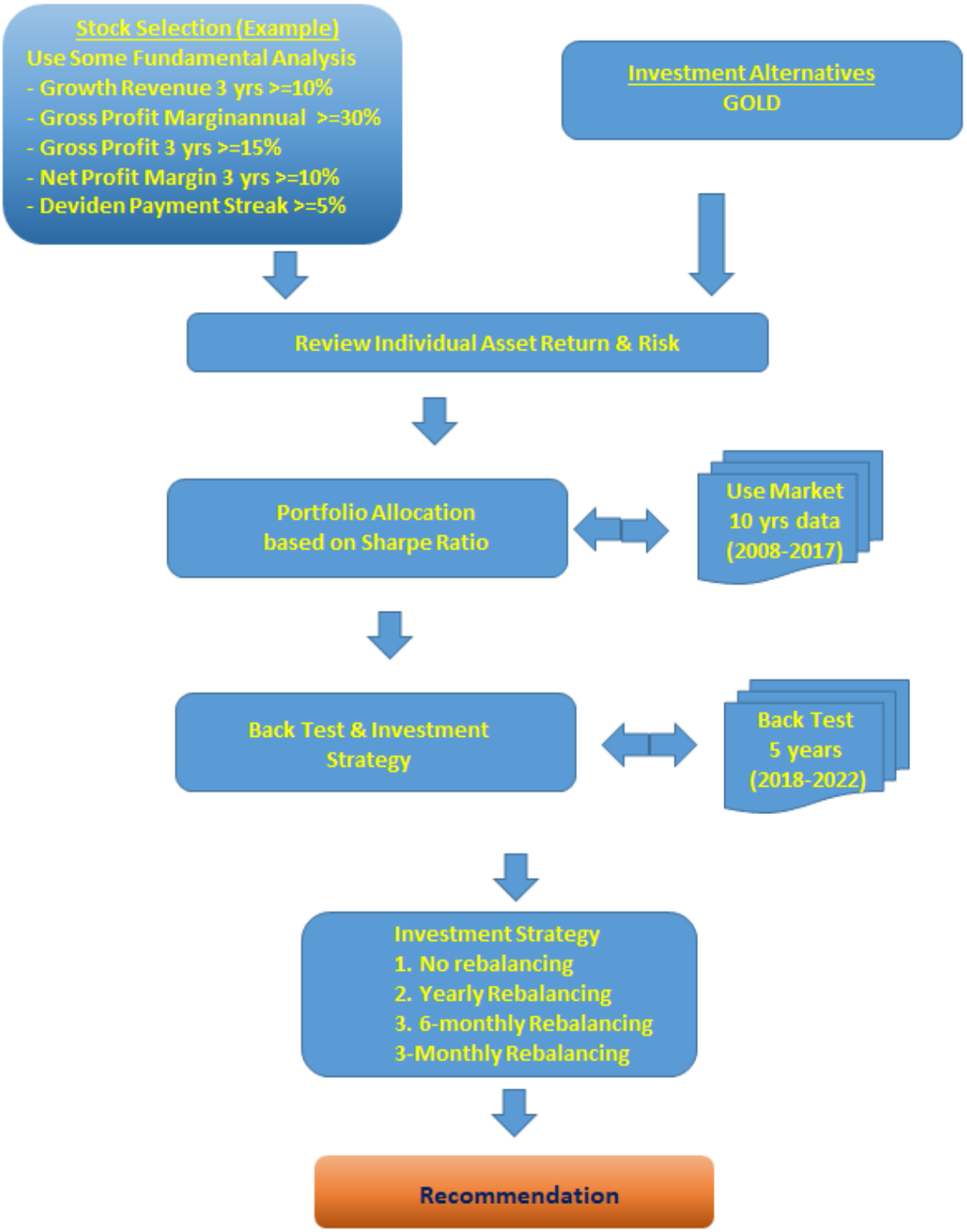

Figure 1 : Conceptual Framework

The main focus of this research is optimizing a portfolio by integrating the Sharpe ratio, leveraging a decade of historical data from 2008 to 2017. The assets under consideration include four companies chosen from the Indonesian Stock Exchange based on meticulous fundamental analysis, complemented by gold to enhance portfolio diversification. After determining the optimal allocation, it is back-tested in the context of the market, both

without rebalancing and using varied rebalancing frequencies: annually, semi-annually, and quarterly. The portfolio's performance is benchmarked against the prevailing Indonesia Stock Index. Insights derived from this comparative analysis form the foundation for the study's concluding recommendations.

Chapter III Research Methodology

In this section, researcher will explain regarding overall research methodology being used. It will begin with briefly how the data collected and its source, time period. Then, it followed by main methodology of research being used and continue with overall research design that briefly explained step-by-step of the research process, interconnection of data collected, how its analyzed and finally to conclude the research questions from previous chapter.

For the portfolio allocation, it is used Sharpe Ratio model. There are few of investment ratio could be used, such as Sharpe Ratio, Sartiono Ratio, Jensen and Treynor Ratio. **The Sharpe Ratio is used** due to its simplicity and effectiveness in conveying the risk-return tradeoff. It's a comprehensive measure that takes into account both the return and the risk associated with an investment. This ratio allows investors to compare the performance of different funds on a level playing field, regardless of their risk profiles. The Sharpe Ratio provides a clear, single measure to gauge whether higher returns are due to smart investment decisions or simply a result of taking on more risk.

III.1 Data Collection

For this study, we utilized secondary data, encompassing historical stock prices, dividends, and market indices. This data was sourced from Yahoo Finance, a reputable and publicly accessible financial database. Notably, we employed the adjusted closing price, which takes into account dividend adjustments.

The portfolio consist of Gold asset and some of selected group of companies listed on the Indonesia Stock Exchange (IDX) which derived based on some fundamental analysis, spanning a time frame from 2008 to 2022. The decade-long data from 2008 to 2017 serves the purpose of establishing portfolio allocation based on the return and risk associated with each asset.

In contrast, the data from 2018 to 2022, covering a five-year span, functions as a

comparative benchmark. During this latter phase, we evaluated the performance of the predefined portfolio allocations, contrasting strategies with and without rebalancing.

The Indonesia Stock Exchange (IDX), like other stock exchanges around the world, has been influenced by a variety of global and domestic economic events over the years. Several major economic events that could impacted to Indonesia Stock Exchange market are as follow:

- 2008-2009 Global Financial Crisis: Originating in the United States due to the subprime mortgage crisis, the Global Financial Crisis (GFC) had profound impacts on financial markets worldwide. Indonesian stocks also plummeted during this period, and foreign investors pulled out significant capital from emerging markets, including Indonesia.
- Political Stability and Economic Reforms (2014-2019): The election of Joko Widodo as President of Indonesia in 2014 brought in a wave of optimism. His administration initiated various economic reforms, infrastructure projects, and investment-friendly policies, providing a boost to investor confidence in the Indonesian economy and the IDX.
- COVID-19 Pandemic (2019-2021): The global pandemic resulted in an unprecedented shock to the world economy, causing severe recessions in many countries.

Gold, often considered a "safe-haven" asset, has been influenced by various global economic events, geopolitical tensions, and monetary policies. Investing in gold has been a popular strategy for many, primarily because of its historical role as a store of value and its potential to act as a hedge against economic uncertainties. Let's delve into the considerations and methodologies for investing in gold:

- Hedge Against Inflation: As the cost of goods and services increase (inflation), gold often retains its purchasing power, making it a popular hedge against inflation.
- Diversification: Gold usually has a low or negative correlation with stocks and bonds. This means its price doesn't necessarily move in tandem with stock or bond markets, making it a diversifying asset in a portfolio.

- Safe Haven: During times of geopolitical, financial, or economic crises, gold is often viewed as a "safe-haven" asset, with investors flocking to it in times of turbulence.
- Demand in Emerging Markets: As emerging market economies grow, the demand for gold in sectors like jewelry and technology can rise.

III.2 Indonesia Stock Selection : Fundamental Analysis

To begin, the research involves conducting a comprehensive fundamental analysis to choose stocks from the Indonesia stock Exchange. This method examines financial statements, evaluates company health and consider industry trends and type to ensure diversity. **Stockbit application** used to screen the stock based on several fundamental analysis criteria such as basic ratio, which normally used by investors:

a. Growth Revenue for 3 years > 10 %.

Revenue is the income of a company. Income is the spearhead for the company to generate profits from its core business, or in other words, it's the topline. This is to avoid misleading of the revenue which could come from non-core business such as selling assets, exchange rate differences, savings, etc. If the revenue grows, the net profit will also increase (although sometimes it doesn't due to various expenses that must be borne). Why 10%? It's just a conservative figure regarding the growth of a company. For example, if this year's income is 100, hopefully next year it can be 110. If we want to write 20% or 30%, that's fine, but it seems a company would have difficulty maintaining an average revenue growth above that for at least 3 years.

b. Gross Profit Margin annual > 30%.

After looking at the revenue, we will examine the company's gross profit side. The gross profit margin is gross profit divided by revenue. To calculate gross profit, the method is to subtract the cost of goods sold (COGS) from the revenue. Why is the gross profit margin important? Because by using the gross profit margin ratio, it automatically calculates the cost of goods sold or COGS. If revenue increases and COGS decreases, then the gross profit goes up (good

efficiency). If revenue remains the same and COGS decreases, then the gross profit increases slightly (decent efficiency). If both revenue and COGS remain constant, then the profit remains stable. If revenue remains the same and COGS increases, then the profit decreases slightly. If revenue decreases and COGS increases, then special attention is needed.

c. Gross Profit Growth 3 years > 15%.

Another important point is the growth of gross profit over at least 3 years with an average increase of more than 15%. If there's a company that's able to increase its gross profit margin for 3 consecutive years, it means they are indeed capable of generating revenue and holding down their cost of goods sold.

d. Average Net Profit Margin 5 year > 10%.

The net profit margin is the current year's net profit divided by the total revenue. Why do we need to know the net profit margin or net income? Because if we only use gross profit, we won't know the net income after deducting expenses or other revenues. Sometimes there are standard expenses such as sales expenses or administrative expenses, but occasionally there are uncontrollable expenses such as exchange rate differences, etc. Therefore, to prevent profit or expenses that only appear once, we need to use an average net profit margin ratio for at least 5 years with a figure above 10%. A net income with an average of 10% is already good.

e. Average Dividend yield 5 year > 4%.

After selecting company based on revenue, COGS, net profit margin, but if they don't distribute dividends, what's the point of calling them a wonderful company? We need to target an average dividend yield of at least 4% over the past 5 years so that a large one-time dividend distribution can be eliminated. That ratio is too biased because it's affected by price, and we know prices move every second.

III.3 Research Methodology

Once we defined the best four stock that derived from Fundamental analysis, including gold asset to diversify the portfolio, then next is to understand each

asset and portfolio risk and return.

a. Return

The yearly return of each individual stock can be calculated using the formula:

Return = (Ending price - Beginning Price) / (Beginning Price)

- Note: to avoid misleading of estimating return, then geometric return calculation was used.

The expected return of a portfolio is the weighted average of the expected returns of the individual assets.

$$R_p = w_1R_1 + w_2R_2 + ... + w_nR_n$$

Where:

- R_p is the expected portfolio return
- w_i is the weight of asset i in the portfolio
- R_i is the expected return of asset i

b. Variance

Variance measures the dispersion of a set of data points around their mean. In the context of investments, variance gives an idea of the volatility or risk associated with an asset's returns.

$$\sigma^2 = \frac{\sum(R_t - \bar{R})^2}{N}$$

Where:

- R_t is the return at time t
- $\bar{R}$ is the average return over the period
- N is the number of observations

For a two-asset portfolio, the variance is:

$$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\text{Cov}(1,2)$$

For portfolios with more assets, the formula expands but follows the same principle, taking into account the weights, variances, and covariances.

c. Covariance

Covariance indicates the directional relationship between the returns on two

assets. A positive covariance means that the returns of the two assets tend to move together, while a negative covariance means they move inversely.

$$\text{Cov}(X,Y) = \frac{\sum(X_t - \bar{X})(Y_t - \bar{Y})}{N}$$

Where:

- X_t and Y_t are the returns on asset X and Y at time t, respectively
- $\bar{X}$ and $\bar{Y}$ are the average returns on assets X and Y, respectively
- N is the number of observations

d. Variance-Covariance Matrix

When dealing with portfolios with multiple assets, it's helpful to organize the variances and covariances into a matrix known as the variance-covariance matrix. In this matrix:

- The diagonal entries are the variances of the assets.
- The off-diagonal entries are the covariance between the assets.

e. Risks

Take the square root of the variance to get the standard deviation, which represent the assets risks or volatility.

$$\sigma = \sqrt{\sigma^2}$$

A higher standard deviation indicates higher volatility and, typically, higher potential risk and reward. Conversely, a lower standard deviation implies more consistent returns and lower volatility.

f. Sharpe Ratio

Once the portfolio return and standard deviation (square root of variance) is defined, then Sharpe ratio can be estimated.

$$\text{Sharpe Ratio} = \frac{R_p - R_f}{\sigma_p}$$

Where:

- R_p = Expected portfolio return
- R_f = Risk-free rate
- σ_p = Standard deviation (volatility) of the portfolio's return

The Sharpe ratio provides a measure of the risk-adjusted performance of an

investment. A higher Sharpe ratio indicates that the investment provides a higher return for a given level of risk.

Important Note :

- Determination of Optimal Weights: By maximizing the Sharpe ratio, the optimal allocation or weight for each asset in the portfolio can be deduced, aiming to obtain the maximum possible return for a given risk level.
- All above calculation will be done in excel sheet utilizing actual market data from 2008-2017.

III.4 Back Testing

Once we defined portfolio allocation that maximized Sharpe ratio utilizing market data from 2008-2017, then the next steps is to define investment strategy based on "No-balancing and Re-balancing strategy" and compared to actual Indonesian stock index from 2018-2022.

- Non-Rebalancing Strategy: on this case, the portfolio is set with the initial optimal weights and remains untouched throughout the chosen back-testing period.
- Rebalancing Strategy: The portfolio is regularly readjusted at predetermined intervals: yearly, semi-annually, and quarterly. These adjustments aim to realign the portfolio with the optimal weights as determined by the Sharpe ratio.

Chapter IV Findings: Business Solution

This chapter will show analysis and result summary of research methodology from data collection, screening the stock based on some fundamental analysis, expected return on each assets, risks and portfolio allocation based on Sharpe ratio.

This chapter will also show the investment strategy summary based on no-rebalancing and re-balancing strategy and review the result of return compared with Indonesian stock index.

IV.1 Stock Screening and Data Collection

Table 1 displays a summary of the stock screening results obtained through the Stockbit application, utilizing various fundamental analysis ratios.

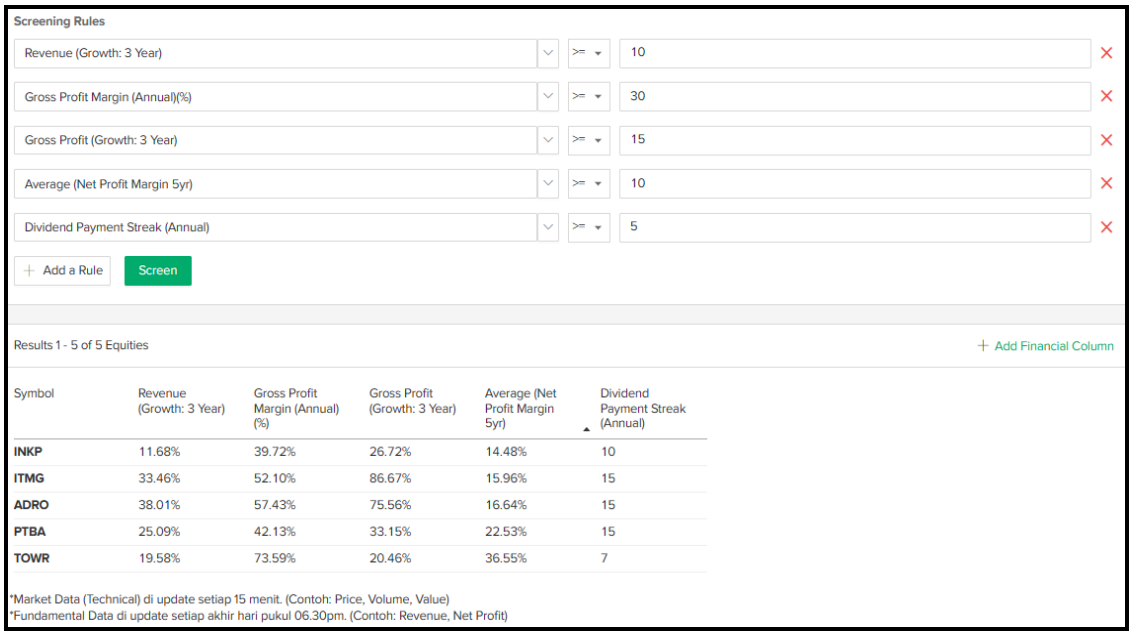

Table 1 : Stock Screening using Stockbit

To screen stocks, several fundamental analysis ratios were employed, including a three-year revenue growth of more than 10%, an annual gross profit margin exceeding 30%, a three-year gross profit growth surpassing 15%, and a five-year average net profit margin greater than 5%.

Based on these criteria, five stocks were screened, out of which four were selected. Additionally, Gold assets were incorporated into the portfolio.

Company	Sector
INKP	Industry (paper packaging)
ITMG	Coal Mining
PTBA	Coal Mining
TOWR	Telecomunicaiotn tower
GOLD	

Table 2 : Portfolio Summary

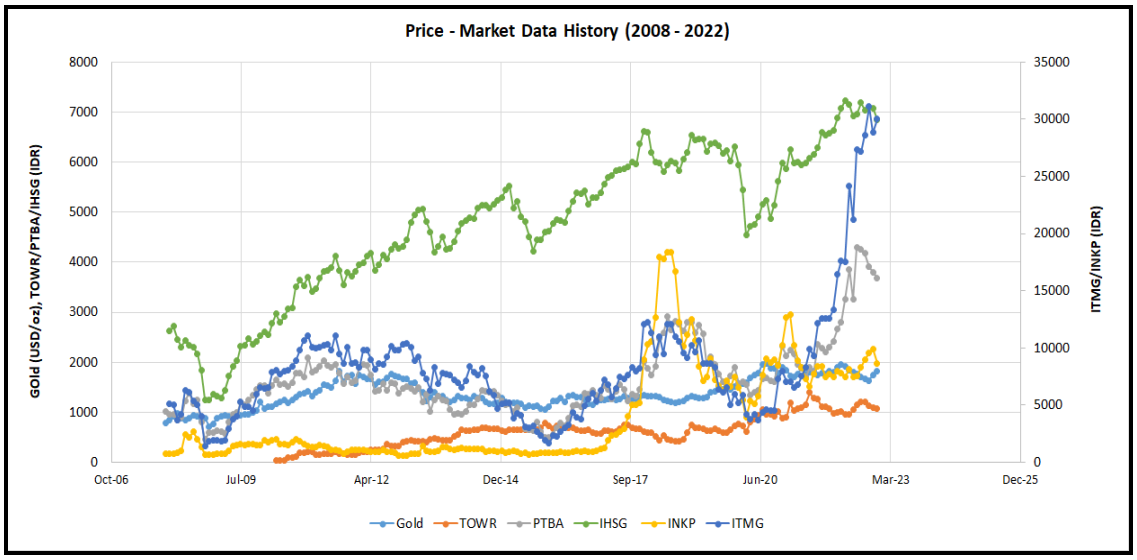

Figure 2: Data Collection for Selected Portfolio.

IV.2 Asset and Portfolio Allocation

Drawing on historical data from 2008 to 2017, Figure-3 displays the return and risk for each asset, while Table-3 presents the annual average asset return, risk, and Sharpe ratio in comparison to IHSG.

Gold assets have the lowest annual return and risk, with a 6% per annum return accompanied by 20% risk. INKP boasts the highest return at 26% per annum, paired with a risk of 73%. In comparison, the IHSG's average return stands at 19% per annum with a 21% risk.

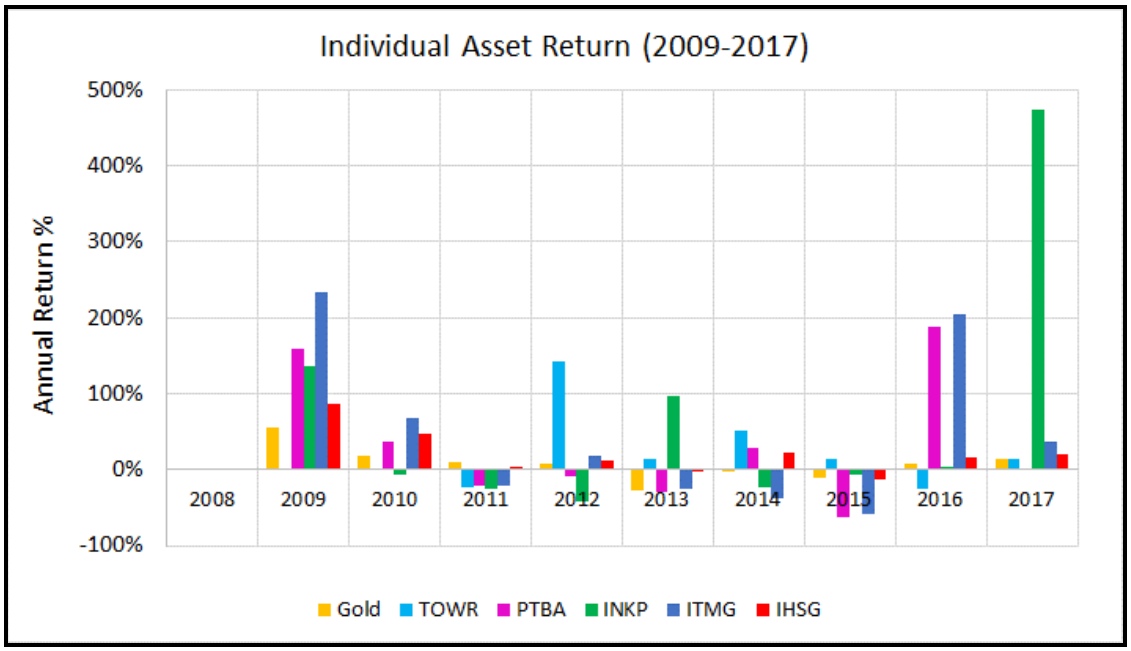

Figure 3 : Individual Asset Return from 2008-2017.

	Gold	TOWR	PTBA	INKP	ITMG	IHSG
An-Return (Geomean)	6%	18%	11%	26%	17%	19%
Annualized Risk	20%	70%	46%	73%	53%	21%
Annual Risk free	5.30%	5.30%	5.30%	5.30%	5.30%	5.30%
Sharpe Ratio	0.03	0.2	0.1	0.3	0.2	0.7

Table 3 : Individual Asset Average Annual Risk & Return (2008-2017)

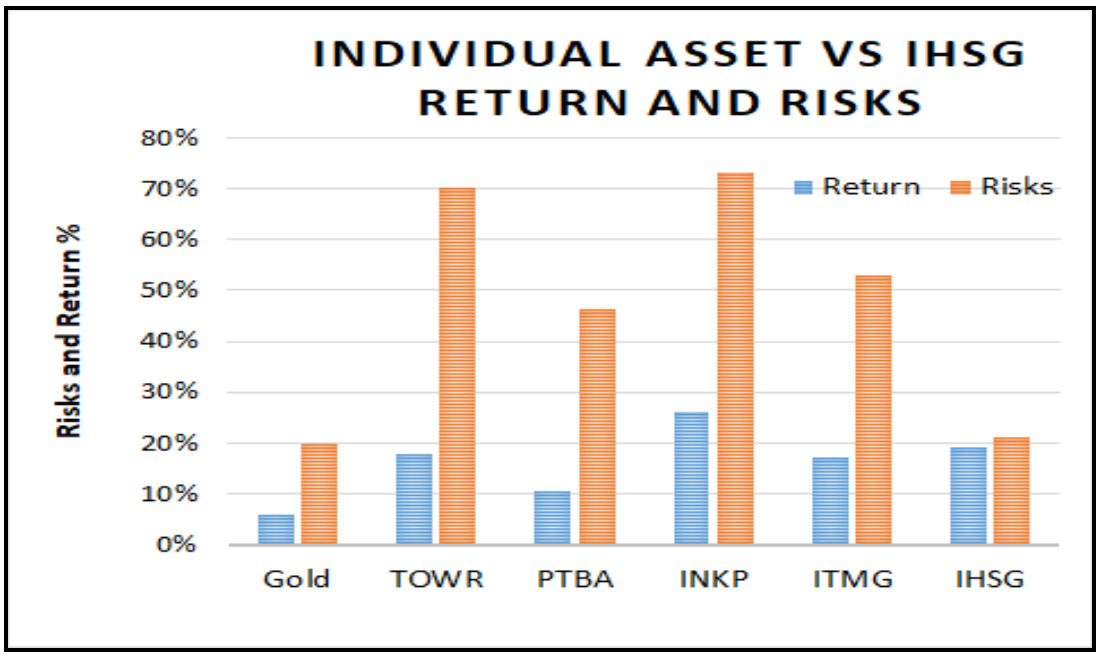

Figure 4 : Individual Asset Annual Average Risk and Return

IV.3 Portfolio Optimization with Maximizing Sharpe Ratio

To optimize portfolio allocation, the Variance and Covariance Matrix for each asset was estimated, as displayed in Table-4. Initial asset weights were approximated based on the assumption that each asset should have a minimum weight equal to or exceeding 5% but not surpassing 50%. These weights were then iteratively adjusted to maximize the Sharpe ratio, as detailed in Chapter III.

HariSulistyana : This asset weight is iterated to maximize portfolio Sharpe Ratio

Variance-Covariance Matrix	Portfolio	Gold	TOWR	PTBA	INKP	ITMG
	Weight	16.5%	22.9%	5.0%	30.4%	25.2%
Gold	16%	0.0032	-0.0005	0.0004	-0.0007	0.0003
TOWR	23%	-0.0005	0.0410	-0.0009	-0.0023	0.0007
PTBA	5%	0.0004	-0.0009	0.0179	0.0076	0.0141
INKP	30%	-0.0007	-0.0023	0.0076	0.0446	0.0051
ITMG	25%	0.0003	0.0007	0.0141	0.0051	0.0233
Contribution to Variance		0.00005	0.00200	0.00033	0.00443	0.00211
	Min W	5%	5%	5%	5%	5%
	Max W	50%	50%	50%	50%	50%

	For Calc
Sum of Weight	100%
Risk Free Rate	5.30%
Portfolio Return	18%
Risks	9.4%
Sharpe Ratio	1.33

HariSulistyana : Set as Max Value

Table 4 : Variance and Covariance Matrix

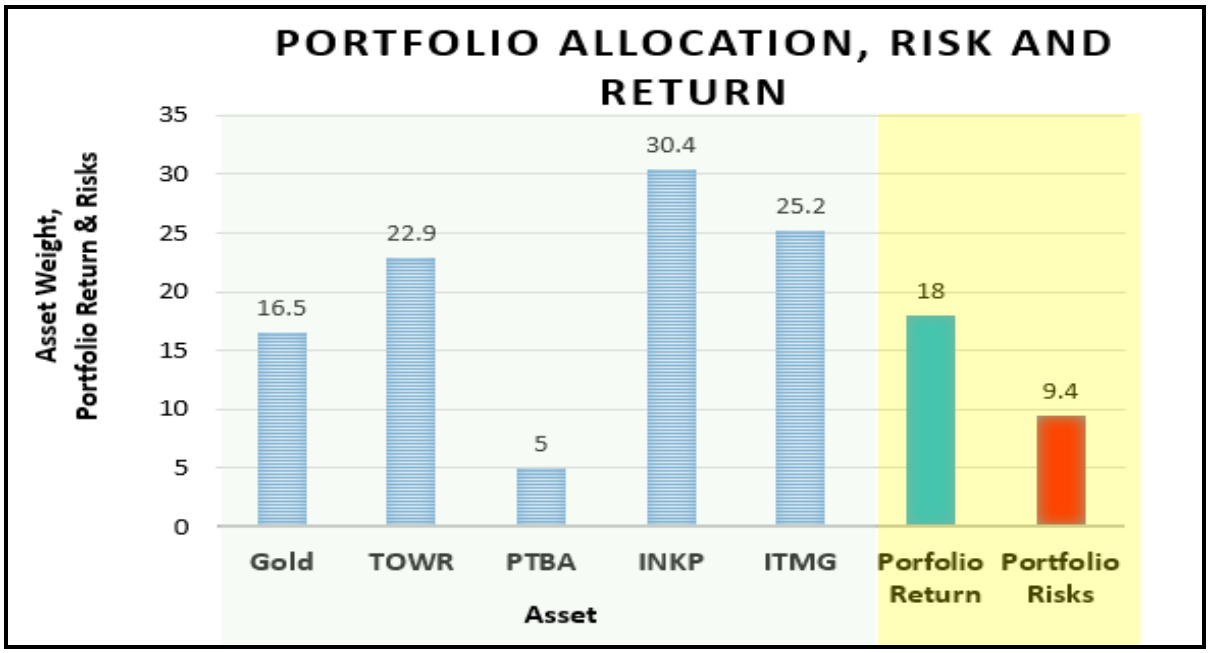

Figure 5: Portfolio Allocation, Return and Risk Summary

In summary, the portfolio's returns, determined by asset allocation using the Sharpe ratio, mirror those of the IHSG, albeit with significantly reduced risk.

IV.4 Investment Strategy

After determining the portfolio allocation using the Sharpe ratio, our next step is to back-test this allocation across various investment strategies in comparison with the IHSG from 2018 to 2022. The investment strategies comprise

a. **No rebalancing**. The portfolio allocation remains unchanged throughout the back-testing period.
b. **Yearly rebalancing**. The portfolio is adjusted annually to align with the initial asset allocation.
c. **Semi-Annual rebalancing**. The portfolio is adjusted every six months to mirror the initial asset allocation.
d. **Quarterly re-balancing**. The portfolio is adjusted every three months to match the initial asset allocation.

For return estimation on each strategy, we start with an investment of IDR 1,000 Million at the close of 2017, allocating to assets as per the optimized portfolio weight. To simplify calculations, we've assumed no transaction fees. The returns from each strategy are subsequently compared with the IHSG index.

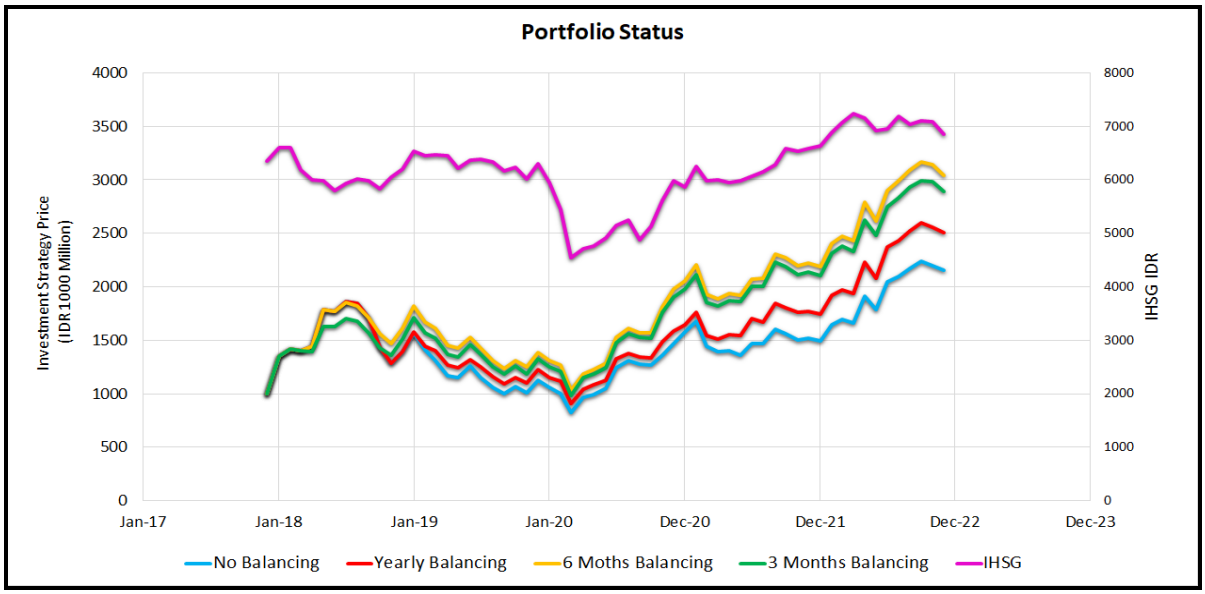

Figure 6 : Portfolio Status at Each Investment Strategy

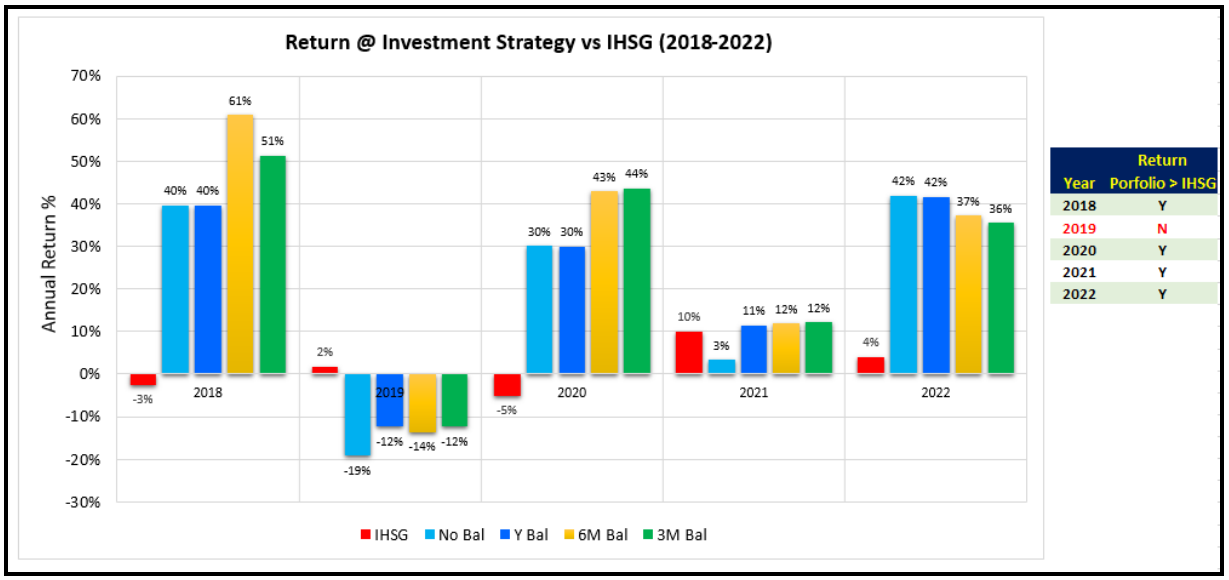

Figure 7 :Portfolio Return at Each Investment Strategy vs IHSG

As depicted in Figure-7, when comparing the portfolio return to the IHSG Index, the portfolio outperformed the IHSG in four out of five years. The only year it lagged behind was in 2019. This underperformance was primarily attributed to coal mining stocks, specifically PTBA and ITMG. In 2019, fears arose regarding a slowdown in coal demand, particularly from major importers like China. Such concerns can lead to reduced coal prices, consequently affecting the profitability and stock performance of coal producers.

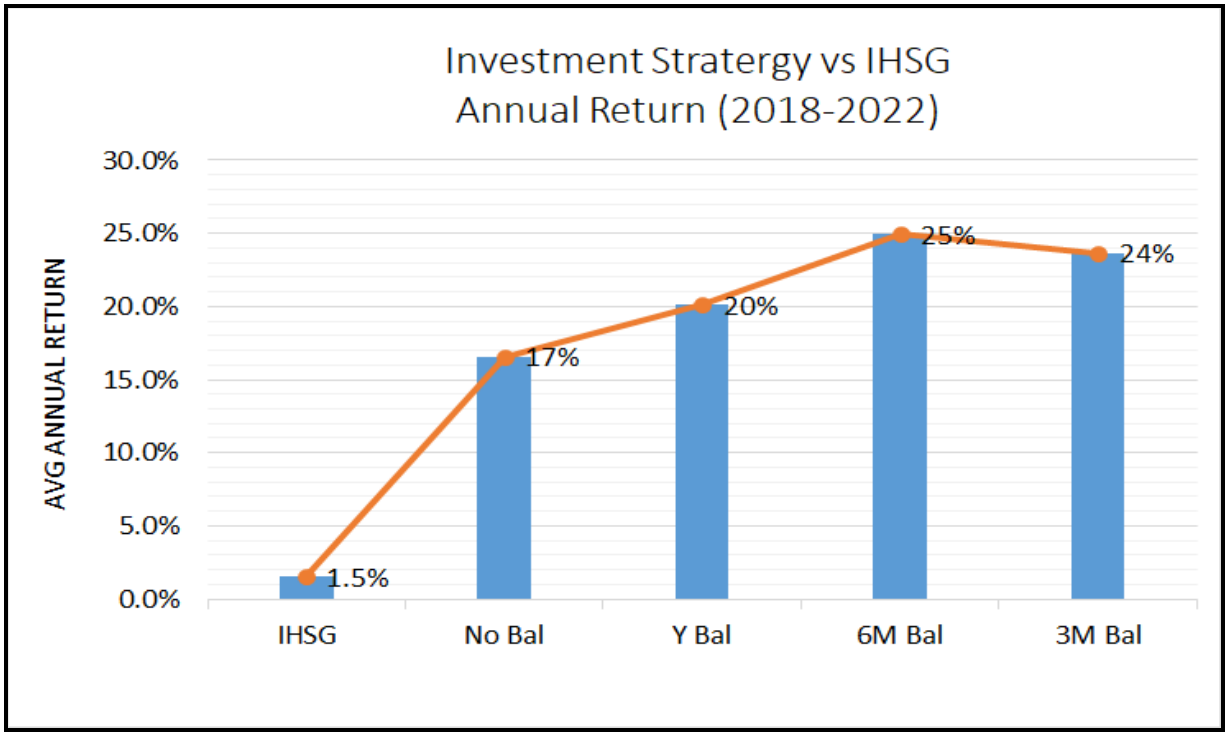

Figure 8 : Average Annual Portfolio Return at Each Investment Strategy vs IHSG

Chapter V Conclusion and Recommendation

V.1 Conclusion

Drawing from analyses in previous chapters and returning to the core research questions of this final project, we arrive at the following conclusions:

1. **How does portfolio optimization using the Sharpe ratio on selected Indonesian stocks and gold assets influence investment returns and risk?**

   - Based on our research analysis comparing the risk and return of individual assets versus the combined portfolio, the returns align closely with the Indonesian Index. However, the portfolio's risk is considerably lower than that of individual assets or the index itself.

2. **How does gold impacted the portfolio return and risk?**

   - The primary purpose of incorporating gold into the portfolio is to diversify assets and mitigate risks. Figure-9 offers a comparative view of returns and risks for portfolios with and without gold. Evidently, the inclusion of gold lowers the risk from 15% to 9.4% while only marginally decreasing returns (from 20% to 18%).

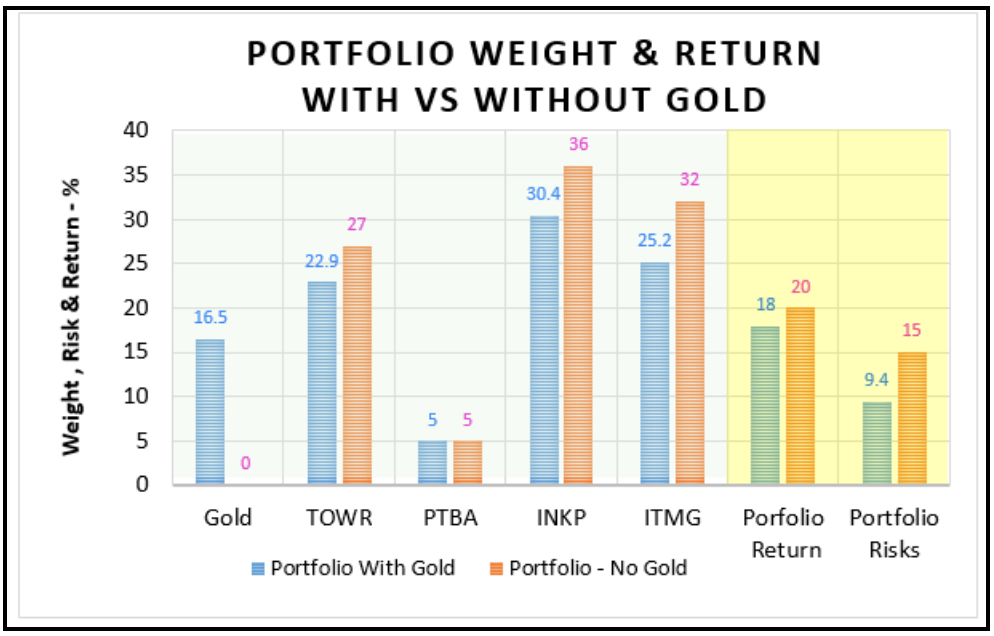

Figure 9 : Portfolio Weight & Return : Gold vs No Gold

3. **Which rebalancing strategy : no rebalancing, yearly rebalancing, six-monthly rebalancing or three-monthly rebalancing – yields the most profitable outcomes?**

   - **Six-monthly rebalancing**. This strategy yielded the most profitable return. It's essential to highlight that these returns were calculated assuming no transaction fees.

     It's pertinent to mention that investment strategies will differ based on specific circumstances. Their effectiveness may vary if there are changes in asset combinations or underlying assumptions, such as the time period for defining portfolio allocations. Consequently, back-testing and re-estimation of the portfolio allocation are imperative to determine the optimal investment approach.

     Furthermore, the portfolio's overall allocation managed to surpass the returns from the Indonesian index IHSG in four out of five years. The lone year where the portfolio return lagged behind the index was 2019, attributable to global fluctuations in coal demand and prices.

4. **How does market volatility in the Indonesian stock market affect the performance of the portfolio under different rebalancing strategies?**

   - Based on the research, the performance of the portfolio is indeed influenced by the volatility inherent in the Indonesian stock market. Nonetheless, the data suggests that the portfolio's performance consistently outpaces the index, often with markedly reduced risk levels.

   - Figure-10 illustrates the monthly return comparison of each investment strategy versus the IHSG. The findings demonstrate that while the portfolio's volatility mirrors that of the IHSG, it generally surpasses the index. The notable exception was in 2019, where portfolio returns fell below the index due to global coal demand dynamics.

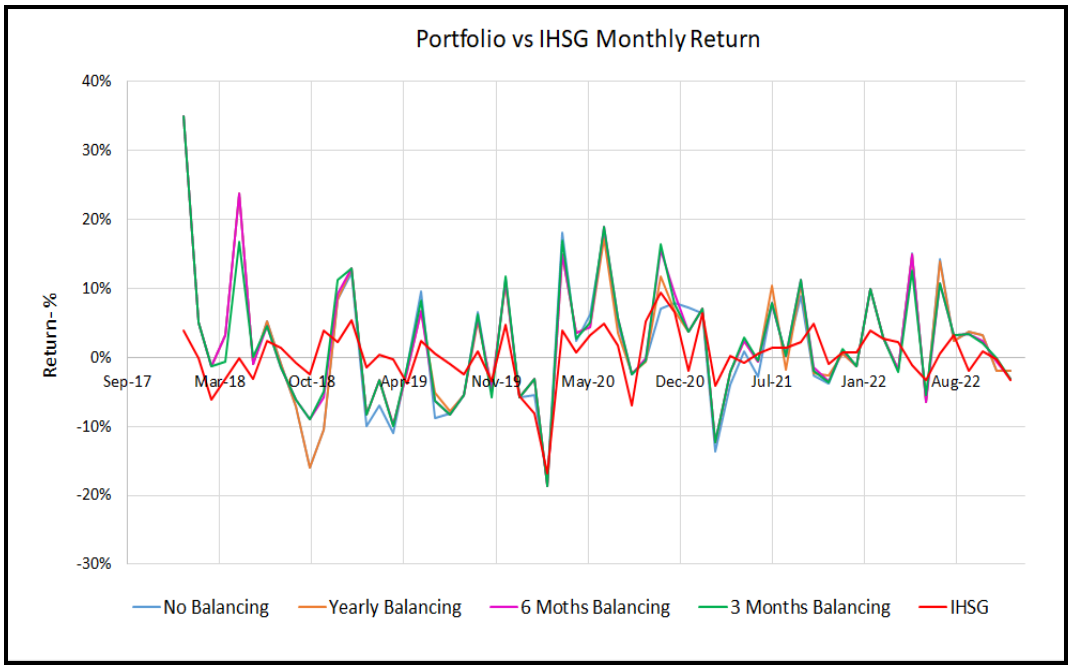

Figure 10 : Portfolio (each Investment Strategy) Return vs IHSG

V.2 Recommendation

1. **Sharpe Ratio Efficacy**: The Sharpe ratio method, a portfolio management strategy, outperformed the Indonesian Exchange Index when assessed with historical data from 2018-2022.
2. **Optimal Rebalancing Strategy**: The semi-annual rebalancing emerged as the most effective investment strategy for the scenarios presented in this research.
3. **Methodology Caveats**: Before adopting the Sharpe ratio and the associated investment strategies, investors must be knowing of the assumptions and limitations highlighted in this research evaluation. It's vital to note that this analysis is retrospective; it doesn't furnish forecasts for precise future returns, and past performance doesn't necessarily predict future results.
4. **Additional Considerations:** Another key limitation to bear in mind is that the research didn't factor in transaction fees during portfolio rebalancing. As such, the actual investment strategy performance might differ from the conclusions presented here.

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APPENDICES

Appendix A : Individual Asset Price (2008-2022)

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Appendix B Monthly Return Individual Asset

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Appendix C – Annual Return & Risks of Individual Asset

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Appendix D Investment Strategy – No rebalancing

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Appendix E Investment Strategy – Yearly Rebalancing

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Appendix F Investment Strategy – 6-Monthly Rebalancing

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Appendix G Investment Strategy – 3-Monthly Rebalancing

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