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PORTFOLIO EFFICIENCY ANALYSIS OF JAPFA AND INDOFOOD CBP USING THE EFFICIENT FRONTIER APPROACH: IMPLICATIONS FOR FOOD SECTOR POLICY

Poppy Yuliani*, Bagus Pamungkas, Nicko Albart
Universitas Paramadina, Indonesia
Email: poppy.yuliani@students.paramadina.ac.id, bagus.pamungkas@students.paramadina.ac.id, nicko.albart@paramadina.ac.id

Abstract. The Indonesian capital market, particularly the food sector, is undergoing significant changes due to strategic government policies such as the free lunch program, which directly influence market dynamics and investor behavior. This study addresses the problem of how investors can optimize portfolio efficiency between two dominant food sector stocks, JAPFA and Indofood CBP (ICBP), under regulatory uncertainty. The primary objective is to identify an optimal portfolio allocation that balances risk and return using the Efficient Frontier approach developed by Markowitz (1952). Employing a quantitative descriptive method, daily stock price data from January to December 2024 were analyzed to simulate portfolio weights, expected returns, and risks. Results reveal a very low correlation (0.085) between JAPFA and ICBP, indicating strong diversification benefits that minimize portfolio risk without sacrificing returns. An optimal portfolio allocation around 30% JAPFA and 70% ICBP is recommended to maximize investment efficiency. The study's findings have important implications for investors, portfolio managers, and policymakers by demonstrating how diversification in the food sector can hedge against market volatility driven by government interventions. This research enriches the literature on portfolio management by integrating policy-driven market conditions. Future research should explore multi-asset portfolios, incorporate macroeconomic factors, and apply advanced optimization techniques such as artificial intelligence to better navigate complex and evolving market environments.

Keywords: Efficient Portfolio, Efficient Frontier, JAPFA, Indofood CBP, Risk, Return, Free Lunch

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INTRODUCTION

Investing in the capital market fundamentally involves a trade-off between risk and return, which is a key consideration in investment decision-making. In the context of the Indonesian government's policy regarding the free lunch program plan, the food sector is the focus of investors' attention because of the potential direct impact on the performance of companies in the sector (Fajriyah & Barokah, 2021; Salsabiila & Hakim, 2022; Wahyuni & Gusnita, 2022; Xu & Wang, 2018). JAPFA (JPFA) and Indofood CBP (ICBP) are two major issuers in the food production industry that are expected to experience significant influence from the implementation of the policy.

Globally, portfolio diversification in the food sector is receiving increasing attention, especially in the face of uncertainty caused by government interventions such as food subsidies, social assistance programs, or commodity price regulations (Barkhagen et al., 2023; Huynh & Dang, 2021; Koumou, 2020; Liu, 2019; Sisay, 2023). Several international studies show that the food sector, as a defensive sector, tends to have different risk characteristics than other sectors and is able to maintain portfolio stability in the event of economic shocks or policy changes (Calvo J.; Pedrycz W.; Yager R. R., 2016; Chen H., 2023). Therefore, understanding portfolio efficiency in this sector is crucial in the context of strategic investment decision-making, both at the national and global levels.

This study aims to analyze the efficiency of the portfolio consisting of JPFA and ICBP shares using the Efficient Frontier approach as developed by Markowitz (1952). This approach allows the identification of the optimal combination of risk and return through simulation of asset allocation weights, thus providing an idea of the most efficient portfolio in the face of market uncertainty due to public policy interventions.

The Efficient Frontier method is used to evaluate how diversification between the two stocks can minimize portfolio risk without sacrificing the rate of return on investment. Thus, this research not only makes an empirical contribution to the modern portfolio management literature but also offers practical implications for institutional and individual investors in formulating asset allocation strategies in the food sector amid national and international regulatory dynamics.

Several previous studies have used the Markowitz approach to assess portfolio efficiency across a range of sectors, including the consumer sector and Islamic stocks. However, most of these studies have not explicitly examined the impact of government policies on individual or combined food sector stocks. In addition, the general approach used is often based on sectoral indices without deepening the responses of each major issuer. The results of the research are expected to enrich understanding of the impact of government policies on optimal portfolio structure and support more rational and adaptive investment decision-making in the Indonesian capital market.

The Efficient Frontier approach introduced by Markowitz (1952) allows investors to structure asset combinations with maximum returns at a certain level of risk. This approach is supported by various recent studies, including Chen H. (2023) in the journal Finance Research Letters which found that portfolios based on defensive sectors such as food and agriculture provide optimal returns during the post-COVID-19 pandemic government policy intervention period; Salo R. P.; Verma A. K. (2024) in the European Journal of Operational Research titled Fifty years of portfolio optimization discuss a historical and comprehensive review of how portfolio optimization theory and practice have evolved over the past five decades; Calvo J. et al. (2016) from the journal Annals of Operations Research titled Fuzzy Portfolio Selection with Non-Financial Goals: Exploring the Efficient Frontier discussed the development of a fuzzy-

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based multi-criteria portfolio model that combines financial and non-financial goals, such as social responsibility, within the framework of the Efficient Frontier. This model allows investors to evaluate the trade-offs between financial efficiency and social values; Rahmadani S.; Mulyono D. (2021) from the Benefit Journal who tested the efficiency of the portfolio of consumer sector stocks on the Indonesia Stock Exchange using the Markowitz method and concluded that the combination of major consumer stocks produces optimal returns in the midst of volatile market conditions; Yulianti (2021) in the Optimal Portfolio Performance Analysis of LQ-45 Stocks with the Markowitz Model which discusses the optimal Portfolio The Markowitz Model shows better performance than the Single Index Model, with ICBP as one of the constituent stocks and Huda S. et al. (2021) from the Journal of Derivatives: Journal of Mathematics and Mathematics Education which discusses the analysis of the formation of the optimal portfolio of JII30 stocks with the new - normal period single index model and concludes that the formation of the The optimal portfolio uses a single index model on JII30 shares.

However, most previous research has not explicitly examined market responses to prospective government programs such as free lunch. In addition, previous studies have tended to use a broad sectoral index approach without a deep focus on the individual performance of a particular issuer. This condition creates a research gap in the form of a lack of studies on the efficiency analysis of food sector stock portfolios related to the response to the free lunch program and the absence of specific research on the combination of JAPFA and ICBP stocks using the Efficient Frontier model in the context of the latest national policies.

By utilizing 2024 stock price data and a quantitative approach based on the Markowitz model, this study aims to make an academic and practical contribution in formulating an adaptive investment strategy for government policy dynamics in the food sector.

Investment decisions in Indonesia's food sector face uncertainties due to government policy interventions like the free lunch program. JAPFA and Indofood CBP (ICBP), as dominant players in this sector, are expected to be significantly influenced by these policies. However, investors lack clear insights on how to optimize portfolio allocation between these two stocks to balance risk and return amid such regulatory changes. This uncertainty complicates portfolio construction and risk management in a sector critical for national food security and economic stability.

The urgency of this research lies in the strategic importance of food sector stocks in Indonesia's capital market, especially as government policies like free lunch programs directly affect company performance and investor confidence. Understanding portfolio efficiency becomes vital for investors and financial institutions to navigate market volatility triggered by such policies, thereby protecting investments and stabilizing returns.

Additionally, food stocks represent defensive assets that traditionally perform reliably during economic shocks. With the Indonesian government poised to implement large-scale social assistance, timely research is necessary to provide adaptive investment strategies that mitigate risks and seize opportunities in this sector during periods of policy-driven market dynamics.

Markowitz's Efficient Frontier approach (1952) remains foundational in portfolio theory, emphasizing diversification to optimize risk-return profiles. Recent studies, such as Chen H. (2023) and Calvo et al. (2016), highlight the role of defensive sectors like food in providing portfolio stability post-pandemic and during policy interventions.

Prior research by Rahmadani S.; Mulyono D. (2021) and Yuliarni (2021) applied portfolio optimization methods to consumer and LQ-45 stocks in Indonesia, finding evidence for

optimal diversification benefits within these sectors. However, most studies focus broadly on sector indices rather than individual leading stocks, limiting actionable insights for specific asset allocations.

Furthermore, literature has yet to fully explore the impacts of government social programs on food sector portfolios, a gap that this study addresses by explicitly examining JAPFA and ICBP under the free lunch program context.

While portfolio optimization theory is well-established, there is a lack of research focusing on the effects of Indonesian government policies on specific food sector stocks, especially combining major issuers like JAPFA and ICBP. Existing studies often use aggregated sector indices, overlooking the differential responses of individual companies to regulatory shifts. This gap restricts investors' ability to tailor asset allocation strategies based on nuanced market conditions induced by policy changes, underscoring the need for focused portfolio efficiency analysis involving key stocks.

This study uniquely integrates the Efficient Frontier method to analyze portfolio efficiency specifically for JAPFA and Indofood CBP stocks within the current regulatory framework shaped by the Indonesian government's free lunch program. By simulating portfolio weights and evaluating risk-return trade-offs with up-to-date 2024 market data, the research provides novel empirical evidence on diversification benefits and investment strategies tailored to government intervention scenarios. This sector- and policy-specific focus adds practical value for investors and policymakers in Indonesia's capital market.

The primary objective is to analyze and identify the optimal portfolio composition between JAPFA and Indofood CBP stocks using the Efficient Frontier approach, aiming to minimize risk without sacrificing expected returns. The study intends to offer practical recommendations for investors and portfolio managers navigating market uncertainties linked to government food policies.

The findings provide crucial guidance for institutional and retail investors by demonstrating how diversification between JAPFA and ICBP can effectively reduce portfolio risk. Policymakers can also use the insights to understand how capital market actors respond to policy interventions, facilitating better-designed regulations. Academically, the research enriches portfolio management literature by linking classical theory with contemporary market conditions influenced by public policy, thereby fostering more adaptive investment decision-making frameworks.

MATERIALS AND METHODS

This research is included in the category of quantitative descriptive research with a case study approach. The quantitative descriptive research aims to provide a systematic, factual, and accurate picture of the characteristics of the JAPFA and Indofood CBP (ICBP) stock portfolios during the observation period. This study is not intended to test a specific hypothesis, but rather to describe the efficiency conditions of the portfolio based on the Efficient Frontier approach developed by Markowitz.

The quantitative approach is used because the analysis is carried out with numerical data in the form of daily returns of stocks and statistical calculations such as expected return values, standard deviations, and correlations between stocks. The data used is secondary data in the form of the daily closing prices of JAPFA and ICBP shares obtained from the Indonesia Stock Exchange and other stock market data provider sites during the period January to December 2024.

The selection of JAPFA and ICBP as the research objects is based on strategic justification:

both are dominant players in Indonesia's food sector, have large market capitalization, and are highly sensitive to government policies, especially those related to national-scale food programs. JAPFA is engaged in the production of animal protein and animal feed, while ICBP focuses on processed food and daily consumer needs. These two companies have the potential to respond differently to the "free lunch" policy, so the combination of the two could represent relevant risk and return dynamics for investors in the sector.

In processing the data, the researcher calculates the daily return, as well as calculates the average return, standard deviation, and correlation between stocks. Next, a combination of portfolio weights from the two stocks was simulated to produce portfolio points on the Efficient Frontier curve. This analysis aims to determine the optimal combination that provides maximum returns at a given level of risk.

The results of the analysis show that the correlation between JAPFA and ICBP stock returns is very low, which is 0.085. This is in line with Markowitz's diversification theory, which states that a combination of assets with low correlation results in less portfolio risk than a single investment. By combining two assets that are not strongly correlated, investors can obtain a more efficient portfolio, i.e. one that provides maximum return at a certain level of risk or minimal risk at a certain level of return.

Furthermore, this research has important policy implications, especially in the context of government intervention in the food sector. These findings suggest that investors can respond to strategic policies, such as free lunch programs, by allocating investments wisely among the major issuers that are directly affected. Diversification between stocks in the food sector can be an effective strategy to manage risks arising from market fluctuations triggered by public policies. Therefore, this approach is not only relevant for retail investors, but also for financial institutions and portfolio managers in formulating policy-based investment strategies.

RESULTS AND DISCUSSION

1. Daily Return Calculation

Daily returns are calculated based on changes in stock prices from the previous day to the current day using the following equation:

$$Rt = \frac{Pt - Pt\_1}{Pt\_1}$$

where Rt is the return at time t, Pt is the stock price at time t, and Pt1 is the stock price at the previous time._

2. Calculation of Expected Return and Standard Deviation

Based on daily return data, the expected return value (E(R)) is calculated as the average return and the standard deviation (σ) as a measure of the volatility of each stock, as presented in the following table:

Table 1. Calculation of Expected Return and Standard Deviation

Stock	Expected Return	Standard Deviation
JPFA	0,24%	2,32%
ICBP	0,04%	1,68%

3. Correlation Analysis

The correlation coefficient between JPFA and ICBP returns of 0.085 indicates a very low relationship between the two assets.

4. Portfolio Weight Simulation

The simulation was carried out by combining portfolio weights ranging from full allocation in JPFA (100%) to full allocation in ICBP (100%), in order to evaluate various combinations of asset allocation in the portfolio.

5. Calculation of Expected Return and Portfolio Risk

Expected return of the portfolio (E(Rp)) is calculated based on the weight of each asset in the portfolio as follows:

$E(Rp)=w1\cdot E(R1)+w2\cdot E(R2)$

The risk or standard deviation of the portfolio (σp) is obtained through the formula:

$$\sigma p = \sqrt{w\frac{2}{1}\cdot\sigma\frac{2}{1}+w\frac{2}{2}\cdot\sigma\frac{2}{2}+2w1w2\cdot\rho\cdot\sigma1\sigma2}$$

Where:

- W1: the proportion of the investment weight on the 1st asset, provided that the total weight amount is equal to one or one hundred percent;
- E(R1): expected return of the 1st asset;
- σ_1: standard deviation of the 1st asset;

ρ: the correlation coefficient between the two assets.

Table 2. Portfolio Risk

1	2	3	4	5	6	7	8	9	10	11	12 = 9+11	13 = sqrt12
Wjpfa	Wicbp	Wjpfa^2	Wicbp^2	Σjpfa	σicbp	σjpfa^2	σicbp^2	9=(3*7)+(4*8)	ρa.b	11=2(1*2*10*5*6)	σjpfa.cbp^2	σjpfa.cbp
1	0	1	0	0,0232	0,0168	0,0005364	0,0002813	0,000536424	0,085026	0,0000000000	0,00053642	2,32%
0,9	0,1	0,81	0,01	0,0232	0,0168	0,0005364	0,0002813	0,000437317	0,085026	0,0000059456	0,00044326	2,11%
0,8	0,2	0,64	0,04	0,0232	0,0168	0,0005364	0,0002813	0,000354565	0,085026	0,0000105700	0,00036514	1,91%
0,7	0,3	0,49	0,09	0,0232	0,0168	0,0005364	0,0002813	0,000288169	0,085026	0,0000138732	0,00030204	1,74%
0,6	0,4	0,36	0,16	0,0232	0,0168	0,0005364	0,0002813	0,000238128	0,085026	0,0000158551	0,00025398	1,59%
0,5	0,5	0,25	0,25	0,0232	0,0168	0,0005364	0,0002813	0,000204443	0,085026	0,0000165157	0,00022096	1,49%
0,4	0,6	0,16	0,36	0,0232	0,0168	0,0005364	0,0002813	0,000187112	0,085026	0,0000158551	0,00020297	1,42%
0,3	0,7	0,09	0,49	0,0232	0,0168	0,0005364	0,0002813	0,000186138	0,085026	0,0000138732	0,00020001	1,41%
0,2	0,8	0,04	0,64	0,0232	0,0168	0,0005364	0,0002813	0,000201518	0,085026	0,0000105700	0,00021209	1,46%
0,1	0,9	0,01	0,81	0,0232	0,0168	0,0005364	0,0002813	0,000233255	0,085026	0,0000059456	0,0002392	1,55%
0	1	0	1	0,0232	0,0168	0,0005364	0,0002813	0,000281346	0,085026	0	0,00028135	1,68%

Information:

Columns 1-4: Portfolio Weights and Squares

- **Column 1 (Wjpfa):** Shows the weight (proportion) of Wjpfa assets in the portfolio. The value ranges from 0 (no Wjpfa assets) to 1 (Wjpfa assets only).
- **Column 2 (Wicbp):** Shows the weight of Wicbp's assets in the portfolio. The value also ranges from 0 to 1, and is always a complement to column 1 (Wjpfa + Wicbp = 1).
- **Column 3 (Wjpfa^2):** The square of the weight of the Wjpfa asset. It is used in the calculation of portfolio variance.

- **Column 4 (Wicbp^2):** The square of the weight of the Wicbp asset. It is also used in the calculation of portfolio variance.

Columns 5-8: Variance and Covariance

- **Column 5 (σjpfa):** The variance (or standard deviation squared) of the Wjpfa asset. It measures the volatility or risk of the asset.
- **Column 6 (σicbp):** Wicbp asset variance.
- **Column 7 (σjpfa^2):** The square of the standard deviation of the Wjpfa asset.
- **Column 8 (σicbp^2):** The square of the standard deviation of the Wicbp asset.

Columns 9-13: Portfolio Risk Calculation

- **Column 9 (9 = (3 * 7) + (4 * 8)):** This is the calculation of the variance of the portfolio. This formula combines the variance of each asset (columns 7 and 8) and the covariance between them.
- **Column 10 (pa.b):** this is the constant or adjustment factor used in subsequent calculations. The correlation between the two stocks is 0.085.
- **Column 11 (11 = 2 * (1 * 2 * 10 * 5 * 6)):** This formula is part of the portfolio risk calculation
- **Column 12 (12 = 9 + 11):** Sum of portfolio variance (column 9) and other risk components (column 11). This may be a more comprehensive measure of portfolio risk.
- **Column 13 (13 = sqrt12):** The square root of column 12. This most likely represents the **standard deviation of the portfolio**, which is a common measure of the portfolio's risk. The results are expressed in percent.

From the calculation results, it is known that the average daily return of JAPFA shares is 0.24% and ICBP is 0.04%, with standard deviations of 2.32% and 1.68%, respectively. The correlation between the two stocks is 0.085 which indicates a very low relationship. Weight simulations show that portfolio risk can be suppressed to the lowest level at a combination of about 30% JAPFA and 70% ICBP. Thus, diversification of stocks with low correlation can result in a more efficient portfolio. The Efficient Frontier curve that is formed illustrates that a combination of stocks provides optimal returns at a certain level of risk.

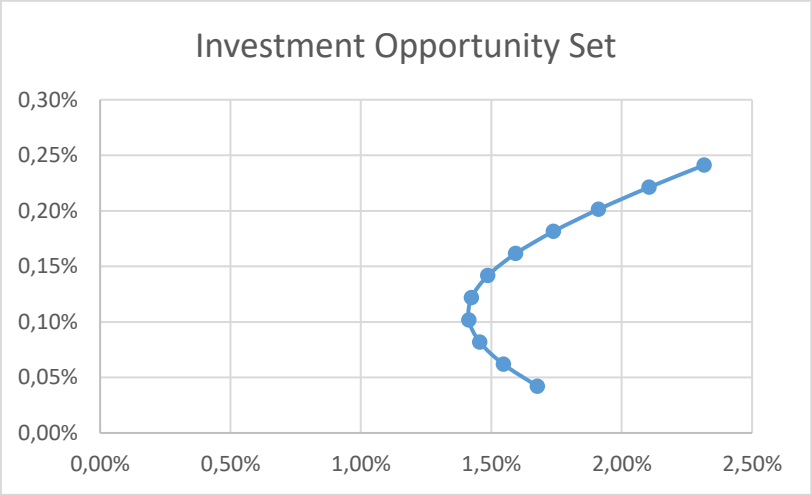

Figure 1. Efficient Frontier Curve

Information:

- The horizontal axis (X) indicates **portfolio risk**, often measured by standard deviation (σp).
- The vertical axis (Y) indicates **the expected return** or expected return of the portfolio.

Curve interpretation shows that the dots on the curve represent different combinations of assets in the portfolio. The bottom left shows and the risk is low but the return is also low and the upper right part is high risk but the potential return is also high. Conservative investors choose a

point near the left side (low risk) and aggressive investors choose a right point (higher risk for the potential for big profits).

CONCLUSIONS

In the context of the Indonesian capital market's dynamics, particularly amid strategic policies like the free lunch program, the application of the Efficient Frontier method is highly relevant as these policies directly impact the food sector, necessitating investment decisions grounded in comprehensive data analysis and responsive to regulatory changes. This study demonstrates that combining JAPFA and ICBP stocks forms an efficient portfolio, supported by a low correlation rate of 0.085, which aligns with Markowitz's modern portfolio theory emphasizing risk diversification. Diversifying between these two food sector stocks effectively reduces portfolio risk without compromising returns, making it a suitable strategy to navigate market uncertainties stemming from government interventions. As one of the first studies to analyze government policy impacts on food sector stocks through the Efficient Frontier approach, this research contributes novel insights to the portfolio efficiency literature, offering practical implications for academics, investors, and policymakers in crafting data-driven asset allocation strategies. The findings reinforce the importance of modern portfolio theory as a decision-making tool in the food sector and enrich understanding of risk management amid complex capital market challenges. For future research, it is recommended to explore the effects of similar policies across other sectors and incorporate macroeconomic variables such as inflation, interest rates, and consumer demand trends. Additionally, developing more advanced models like multi-asset portfolios or artificial intelligence-based optimization could provide robust solutions for rapidly evolving market conditions.

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