

Optimalization Stock Portfolio Shares-Lq45, With Linear Programming Method Approach Period 2003-2009

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Choosing stock as an investment alternative need to consider many factors, which are divided into fundamental and technical analysis. This study tried to combine both the analysis in a quantitative analysis aimed at selecting stocks, portfolio optimization and test the optimum back-testing simulation on the basis of the last 60 days of research data.

During January 2003 - November 2009 there were 10 stocks that always chosen to form LQ45 index, which means the 10 shares is always a good performance and liquid according to the considerations managers traded stock (now PT. Stock Exchange Jakarta) during the last 7 years. Based on the ratings Coefficient of Variance (CV), only 4 stocks from the first selection process 10 were selected to proceed to the stage portfolio optimization. All four stocks are coded SMCB (Cibinong Cement / Holcim), INDF (Indofood), AALI (Astra Agro Lestari) and UNTR (United Tractor). Method of Linear Programming Solver function is assisted by Ms Excel, where the objective function is the minimization of CV and some functionality limitations (constraints) generate several alternative optimum portfolio.

From several alternatives portfolio of Linear Programming, portfolio without limitation the maximum funds have the same composition portfolio with a maximum funding limit to Rp 100 million. Recommendations Linear Programming method is SMCB 63%, INDF AALI 18.31% and 18.69% can minimize the CV up to 5.66 in portfolio value of USD 58 million. This portfolio is only suitable for investors recommended the old players, while for the composition to investors following the stock lot SMCB ratio: 4-8:1 INDF = initial portfolio value of USD 3.8 to 11.6 million.

Field of Research : Stock Portfolio Shares – LQ45, Linear Programming

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1. Introduction

Every investment has risks and benefits of walking the same direction, if investors want big profits so they had to be ready to accept great risk, too. Investors consists of various levels of risk, the choice depending on the type of investors who will invest. Short-term investments generally have a higher risk than long-term investment because of fluctuations in the value of investment is very high. Investors are afraid to do short-term speculation because of the lack of information and high uncertainty. Current economic conditions uncertain, many things happen that can not be viewed as fundamental. Some phenomena that have affected the world economic conditions, namely: Mortgage subprime cases, decreased the fed funds rate, the increase in world oil prices. These phenomena led to confusion and doubt in the minds of investors. Instability of the world economy makes investors afraid to invest in instruments of money markets and capital markets that have high risk.

Investments that can provide benefits on deposit interest is an investment instrument in the form of shares. Benefits that can be provided from stock is the dividend and capital gains. Dividends are the result of investors over the long-term investments were doing, what needs to be done only hold the relevant shares for a long time (> 1 year). Investors who want to profit form of dividends has a smaller risk than the expected profit from capital gains. However, the results obtained from smaller dividends than capital gains other than that period of time to obtain these benefits is shorter if the investors expect capital gains. To get capital gains when it takes a relatively short time (could be 1 month, 1 week, 1 day even in 1 hour, after buying the stock), but to achieve the required depth analysis and research of information and (historical) on shares of the relevant. Based on the above background and the subject lifted the authors determine the title of this study titled "Optimizing the Portfolio Stocks LQ 45, with the Linear Programming Approach Method, Period 2003-2009"

Problem Definition

In view of a problem, then research the title elements are considered important for this paper. Given the title of the research has led to the shares listed on the LQ 45 in Indonesia Stock Exchange, then in this research can take several basic issues, namely :

1. How to choose stocks that meet the best criteria by BEI management and specific criteria for risk tolerance?
2. How to optimize the allocation of shares to form the theoretical optimum portfolio with some additional criteria?
3. How to evaluate and test statistic theoretical optimum portfolio performance with several indicators of investment?

2. Literature Review

Understanding Shares

Of securities traded in capital markets is often called the effect or securities, one of the stock. According Darmadji and Fakhruddin, (2001: 5), stocks can be defined inclusion or ownership marks a person or entity within a company or limited liability company. Being a stock is a piece of paper explaining that the owner of the paper is the owner of the company that issued the securities. The portion of ownership is determined by how much the inclusion embedded in the company.

JCI as an indicator of the stock in Indonesia

Composite Stock Price Index is the main indicator that describes the movement of stock prices in the capital market. Generally, all composite stock price index (composite) in various countries using a weighted average, including in Indonesia Stock Exchange. (Source: <http://coki002.wordpress.com/> JCI-as-market-indicators-in-Indonesia /, 2009)

Composite Stock Price Index (composite) has several functions or performance of a stock picture of them, namely:

- As an indicator of market trends.
- As an indicator of the level of profits.
- As Benchmark performance of a portfolio.
- Facilitate the formation of Portopolio with passive strategies.

LQ 45 Index Definitions

LQ 45 Index is a market capitalization value of the 45 most liquid stocks and has a large capitalization value that is an indicator of liquidation. LQ 45 Index, using the 45 stocks selected based on trading liquidity and adjusted every six months (each beginning in February and August). Thus there are stocks in the index will always be changing.

Stocks in the index must meet the LQ 45 through the selection criteria and the main as follows:

1. Sign in ranking of the total 60 major transactions in the regular market shares (the average value of transactions during the last 12 months).
2. Ranking based on market capitalization (the average market capitalization during the last 12 months)
3. JSE has been recorded in at least 3 months
4. The company's financial condition and prospects for growth, the frequency and the number of trading days regular market transactions.

Shares that was included in the LQ and 45 continue to be monitored every six months will be reviewed (early February, and August). If there are shares that have not signed the criteria it will be replaced with another stock that

meets the requirements. The selection of shares - the stock must be reasonable LQ 45, therefore, has JSE advisory committee consisting of experts in the BAPEPAM, Universities, and Professional in the field of capital markets.

3. Methodology and Research Design

Type and Source of Data

Types of data used in this study are secondary data, derived from the Indonesian Stock Exchange site as the manager of the stock market in Indonesia.

Sampling Method

Sampling is based on research objectives, namely to do the selection, portfolio optimization and evaluation of simulation, then including purposive sampling.

Calculation Method and Data Analysis

Some of the methods used to analyze the data and calculations are:

1. Adjusted Risk Ranking.
2. Linear Programing.
3. Two-sample test methods Analysis of Variance (ANOVA).

Data Presentation

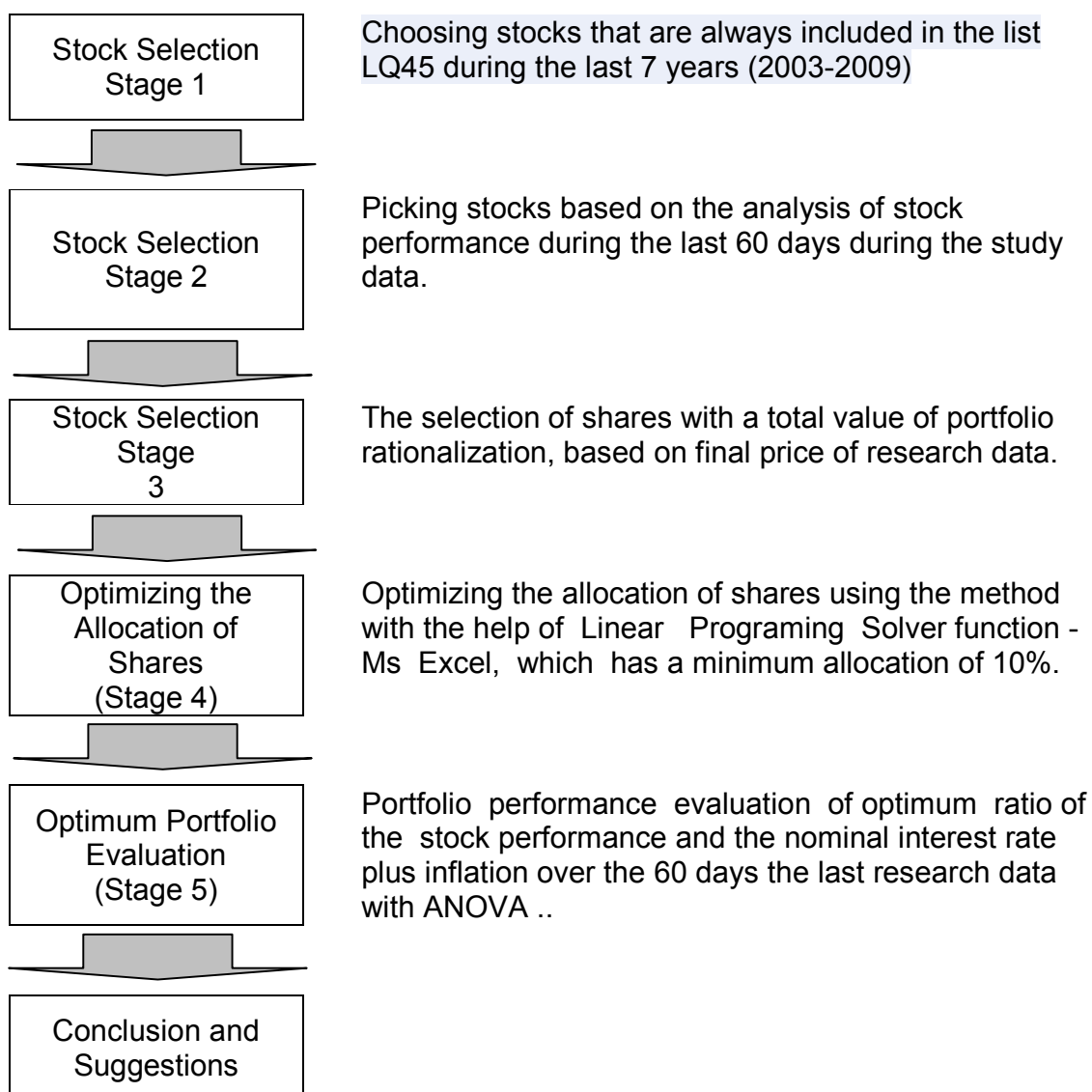
The results of data analysis and calculations will be presented in the form of tables, graphs, charts or drawings as illustrations that clarify the exposure analysis research.

4. Discussion of Findings

Testing Data

There are several stages in the preparation of optimum portfolio that is the main objective in this study. Generally consists of 3 parts: tock Selection, Optimization and Evaluation of Portfolio Allocation Portfolio. Here are the details and criteria for each stage of this research will be used:

Exhibit 1: Stage Research



Picture 1. Frame work Research

Stock Selection Stage 1

The first stage of the selection of shares, refer to the list of stocks selected in the list of stocks that make up the index LQ.45. Index LQ.45 launched since February 1997. Handbook Based Stock Price Index Indonesia Stock Exchange (2008), the stocks selected in the list with the criteria LQ.45 index level of liquidity and market capitalization. List of the 45 stocks reevaluated every 6 months, ie every February and August. LQ45 index. Shares that are always selected on the basis of LQ45 data for the last 7 years is as follows.

Table 1. List of 10 Stocks That Always Chosen in LQ45 Period from 2003 to 2009

Code	Company	Sector / Subsector	capitalization*
AALI	Astra Agro Lestari	Agriculture	PU
ANTM	Aneka Tambang	Mining	PU
ASII	Astra Internasional	Automotive	PU
BBCA	Bank Central Asia	Banking	PU
INDF	Indofood	Consumptiongoods	PU
ISAT	Indosat	telecommunications	PU
MEDC	Medco Energi Int'l Semen Cibinong /	Energy	PU
SMCB	Holcim	Basic industries	PP
TLKM	Telkom Indonesia	telecommunications	PU
UNTR	United Tractors	heavy equipment	PU

*Bursa Efek - November 2009

PU = Papan Utama (*Main Board*)

PP = Papan Pengembang (*Development Board*)

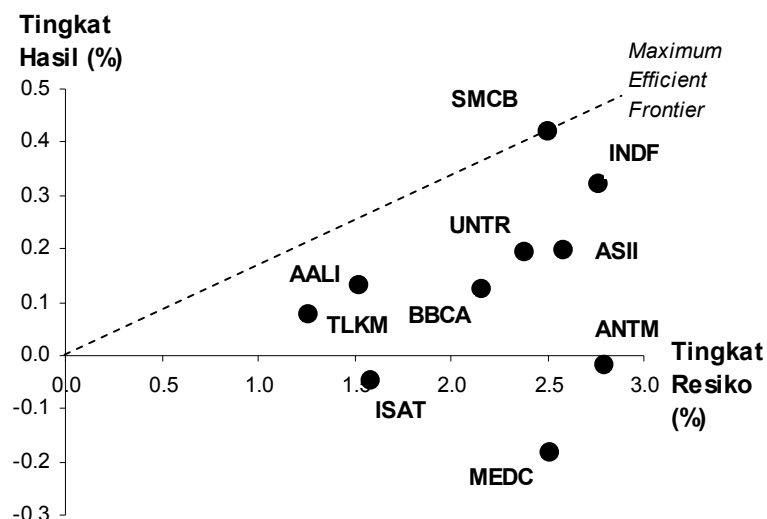
* Stock Exchange - November 2009

PU = Main Board (Main Board)

PP = Development Board (Development Board)

Stock Selection Stage 2

Recent data obtained during the preparation of this study is 24 November 2009, the last day by 60 working days from the date the stock begins August 27, 2009. Stock performance parameters used in the second stage is the average level of results (\bar{R}_i) and the level of risk (σ_i):



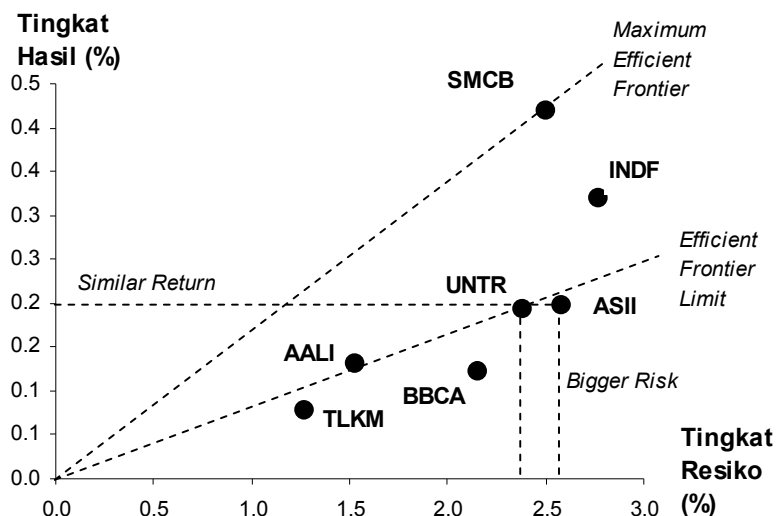
Picture 2. Mapping of Performance 10 Share During Last 60 Days.

Table 2. Rank of Performance 7 Share During Last 60 Day.

Saham	\bar{R}_i	σ_i	CV	Peringkat
SMCB	0.42%	2.50%	5.96	1
INDF	0.32%	2.77%	8.67	2
AALI	0.13%	1.53%	11.59	3
UNTR	0.19%	2.39%	12.43	4
ASII	0.20%	2.59%	13.17	5
TLKM	0.08%	1.27%	16.45	6
BBCA	0.12%	2.16%	17.59	7

In accordance with the theory of Elton & Grubber (2002), shares SMCB ranked first for having the line efficiency with the greatest angle, followed by shares INDF, AALI, UNTR, ASII, last TLKM and BBCA. In a deeper analysis, following some adjustments considered necessary in the selection of shares:

- a. Shares ASII no better performance than UNTR, because the ratio of marginal average increase level of results and relatively low risk level. Investors CVASII, relatively the same alias, which will see that CVUNTR tend to select stocks with the corner of Efficient Frontier line is bigger, namely UNTR shares.
- b. The impact of a continuation of the above points is the line of Efficient Frontier UNTR shares into shares of the lower limit for the election of the next stage. With the same analogy, investors will tend to choose stocks that have averaged a higher level of risk at a lower, so the stock ASII, BBCA and TLKM not selected in this adjustment.



Picture 3. Stock Selection Based Adjustment Performance Last 60 Days

Stock Selection Phase 3

Initial survey based on the minimum value of opening balance and recommendations of the analysis and market participants of some securities firms, in general, can be classified as follows:

Min. Opening Balance	Recommended for Investors
< Rp 5 millions	beginners
Rp 5 - 25 millions	Beginners and old players
> Rp 25 millions	Old players

Based on the latest research data rates to 4 stocks selected to optimize the allocation of between Rp 1640 - Rp 33,350 per share. Shares worth USD 1640 a fractional change in price USD 10, while the USD 33,350 is USD 50. Some assumptions determining the minimum number of shares (lots), namely:

- Sell Commission = 0.03% of the purchase transaction, minimum Rp 15.000
- Selling Commission = 0.05% of transactions, a minimum of Rp 15.000
- Taxes have not taken into account. For example SMCB Shares at IDR 1280 per piece (August 27, 2009) have reached USD 1290 (the fraction USD 10) to

obtain the minimum gains. When investors buy 1 lot of these shares, the commission charged for: USD 15,000 (min) \diamond Commission Sell = $1 \times 500 \times \text{USD } \$ 1280 \times 0.03\% = \text{USD } 192.00$ USD 15,000 (min) \diamond Commission Sell = $1 \times 500 \times \text{USD } \$ 1290 \times 0.05\% = \text{USD } 322.50$ Total Commission = USD 30,000 (minimum) Gain = $(\text{USD } 1290 - \text{USD } \$ 1280) \times 1 \times 500 = \text{USD } \$ 5000$ Net Cash Flow = Rp 5,000 - Rp 30,000 = USD -25,000

Table 3. Minimum Number of Shares Purchase Shares In Stock-Portfolio

Stock code	Price fraction	Purchase price*	Min. Lot	purchase transaction value
SMCB	10	1.280	6	3.840.000
INDF	25	2.650	3	3.975.000
UNTR	100	13.750	1	6.875.000
AALI	100	21.650	1	10.825.000
Total				25.515.000

*If starts from beginning research data (August 27th 2009)

Optimalisasi Portfolio (Tahap 4)

The criteria which used to optimize portopfolio is with using size measure of CV limited partner, the variables which used in equation of Linear programming shaal be as follows:

$$\begin{array}{lll}
 S_1 = \text{Amount Lot SMCB} & w_1 = \text{proportion SMCB} & \\
 S_2 = \text{Amount Lot INDF} & w_2 = \text{proportion INDF} & \\
 S_3 = \text{Amount Lot UNTR} & w_3 = \text{proportion UNTR} & \\
 S_4 = \text{Amount Lot AALI} & w_4 = \text{proportion AALI} & \\
 \rho_{12} = 0,48 & \bar{R}_1 = 0,42\% & \sigma_1 = 2,50\% \\
 \rho_{13} = 0,37 & \bar{R}_2 = 0,32\% & \sigma_2 = 2,77\% \\
 \rho_{14} = 0,47 & \bar{R}_3 = 0,19\% & \sigma_3 = 2,39\% \\
 \rho_{23} = 0,21 & \bar{R}_4 = 0,13\% & \sigma_4 = 1,53\% \\
 \rho_{24} = 0,46 & & \\
 \rho_{34} = 0,43 & &
 \end{array}$$

Portfolio rate of return equation:

$$R_{Port} = \sum_n^1 w_i R_i = w_1 R_1 + w_2 R_2 + w_3 R_3 + w_4 R_4$$

Portfolio risk level equation:

$$\sigma_{Port} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + w_3^2\sigma_3^2 + w_4^2\sigma_4^2 + 2w_1w_2\sigma_1\sigma_2\rho_{12} + 2w_1w_3\sigma_1\sigma_3\rho_{13} + 2w_1w_4\sigma_1\sigma_4\rho_{14} + 2w_2w_3\sigma_2\sigma_3\rho_{23} + 2w_3w_4\sigma_3\sigma_4\rho_{34}}$$

Total porpori all shares in the portfolio:

$$w_1 + w_2 + w_3 + w_4 = 1$$

The total value of portfolio:

$$(1280.S_1 + 2650.S_2 + 13750.S_3 + 21650.S_4).500 \leq 100 \text{ juta}$$

Portfolio optimization steps will be done in two versions, namely:

- Version 1: let the linear programming to find the solution to the allocation percentage of each stock that produces the minimum CV without a lot of attention to the minimum value or maximum value of the portfolio.
- Version 2: let the linear programming to find the solution to the number of lots in the form of an integer and can be worth zero - with a maximum funding level.

Optimizing Portfolio Version 1

Purpose Function : minimization $CV = \frac{\sigma_{Port}}{R_{Port}}$

Restriction Function :

$$w_1 + w_2 + w_3 + w_4 = 1$$

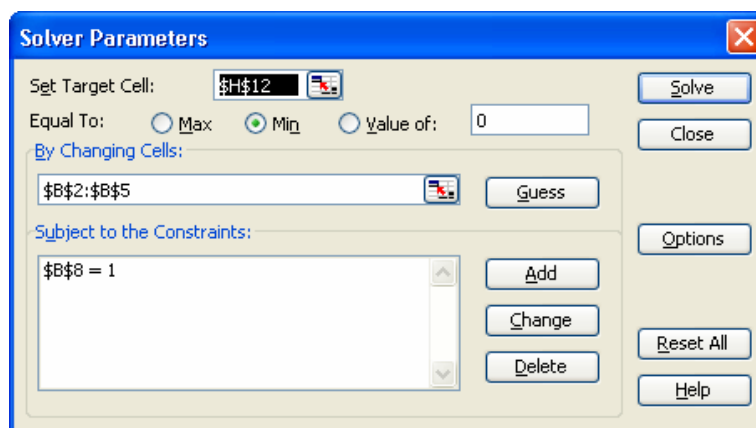
$$w_1 \geq 0$$

$$w_2 \geq 0$$

$$w_3 \geq 0$$

$$w_4 \geq 0$$

Linear Programing calculation results on portfolio optimization step 2 with the display version of Ms Excel worksheet is as follows:



Picture 4. Optimizing Portfolio Version 1, In the Function Solver

	A	B	C	D	E	F	G	H	I
1									
2		Stock	W_i	R_i	σ_i	WR_i	(W_iT_i)²		2W_iW_jT_iT_jR_{ij}
3		SMCB	62.97%	0.42%	2.50%	0.26%	2.48E-04	SMCB-INDF	7.68E-05
4		INDF	18.36%	0.32%	2.77%	0.06%	2.59E-05	SMCB-AALI	3.33E-05
5		AALI	18.67%	0.13%	1.53%	0.02%	8.16E-06	SMCB-UNTR	0.00E+00
6		UNTR	0.00%	0.19%	2.39%	0.00%	0.00E+00	INDF-AALI	5.99E-06
7								INDF-UNTR	0.00E+00
8								AALI-UNTR	0.00E+00
9		Total	100.00%			0.35%	2.82E-04		1.16E-04
10									
11								Port Risk =	1.99%
12								Port Return =	0.35%
13								CV =	5.69
14									

Picture 5. Optimizing Portfolio Version 1, In view Ms Excel

Optimizing Portfolio Version 2

Purpose function : minimization $CV = \frac{\sigma_{Port}}{R_{Port}}$

Restriction Function :

$$w_1 + w_2 + w_3 + w_4 = 1$$

$$S_1 \geq 0$$

$$S_2 \geq 0$$

$$S_3 \geq 0$$

$$S_4 \geq 0$$

$$S_1 = \text{int}$$

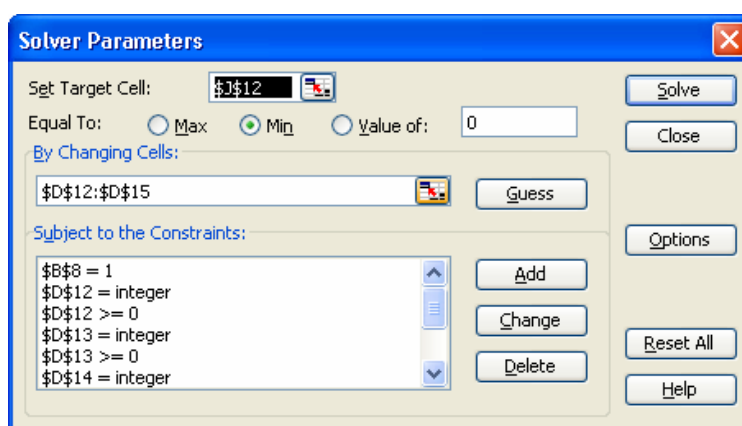
$$S_2 = \text{int}$$

$$S_3 = \text{int}$$

$$S_4 = \text{int}$$

$$(1280.S_1 + 2650.S_2 + 13750.S_3 + 21650.S_4).500 \leq \text{Dana Maksimum}$$

Description: The maximum Fund will be changed several times to determine the portfolio that can qualify a maximum of funds provided by investors.



Picture 6. Optimizing Portfolio Version 2, In the Function Solver

	A	B	C	D	E	F	G	H	I
1									
2		Stock	W_i	R_i	σ_i	W_iR_i	(W_iT_i)²		2W_iW_jT_iT_jR_{ij}
3		SMCB	63.00%	0.42%	2.50%	0.26%	2.48E-04	SMCB-INDF	7.67E-05
4		INDF	18.31%	0.32%	2.77%	0.06%	2.57E-05	SMCB-AALI	3.33E-05
5		AALI	18.69%	0.13%	1.53%	0.02%	8.18E-06	SMCB-UNTR	0.00E+00
6		UNTR	0.00%	0.19%	2.39%	0.00%	0.00E+00	INDF-AALI	5.98E-06
7								INDF-UNTR	0.00E+00
8								AALI-UNTR	0.00E+00
9		Total	100.00%			0.35%	2.82E-04		1.16E-04
10									
11		Stock	Price	Lot	Value	Allocation		Port Risk =	1.99%
12		SMCB	1,280	57	36,480,000	63.00%		Port Return =	0.35%
13		INDF	2,650	8	10,600,000	18.31%		CV =	5.69
14		AALI	21,650	1	10,825,000	18.69%			
15		UNTR	13,750	0	-	0.00%			
16		Total			57,905,000	100.00%			
17									
18					Max Fund = 100,000,000				

Picture 7. Optimizing Portfolio Version 2, In view Ms Excel

The picture above shows the calculation result in step Linear Programming portfolio optimization version 2 with a maximum budget of Rp 100 million - have relatively similar results with version 1. For a deeper analysis, the calculation is repeated several times with different maximum funds up to Rp 5 million.

Table 4. Optimizing Portfolio Version 2, The Various Funds Rate Maximum

Port	Dana Maks. (Juta)	Proporsi Alokasi (%)				Port Risk	Port Return	CV
		SMCB	INDF	AALI	UNTR			
1	100	63.00	18.31	18.69	-	1.98%	0.35%	5.66
2	50	61.57	16.27	22.16	-	1.95%	0.34%	5.74
3	40	56.21	16.62	27.16	-	1.87%	0.32%	5.84
4	30	78.37	21.63	-	-	2.31%	0.40%	5.78
5	20	77.17	22.83	-	-	2.30%	0.40%	5.75
6	10	68.49	31.51	-	-	2.26%	0.39%	5.79
7	5	65.89	34.11	-	-	2.26%	0.39%	5.79

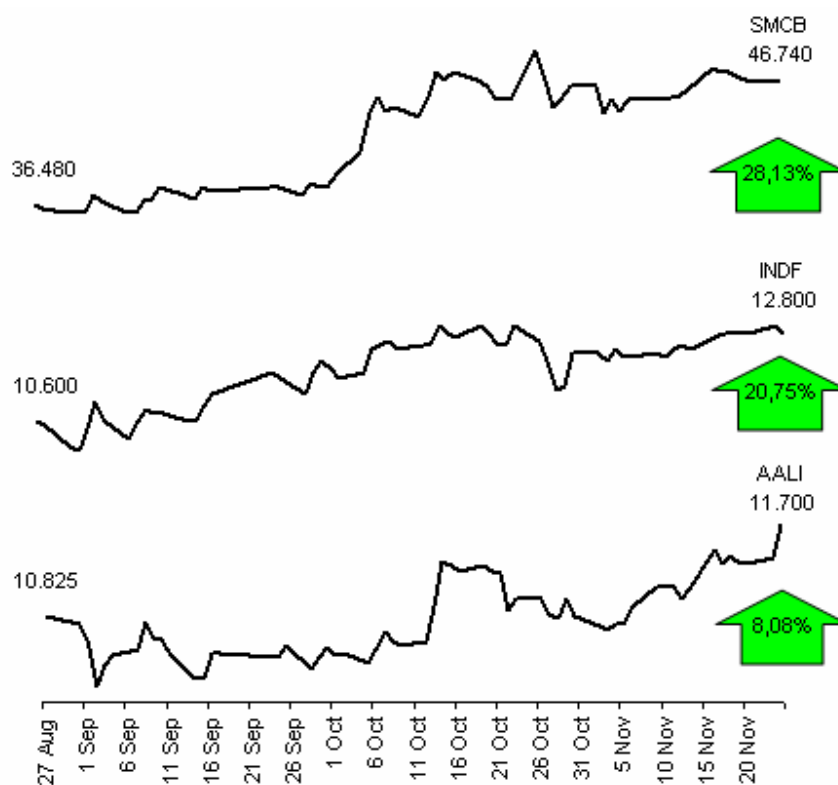
The table above shows that the optimum portfolio allocation SMCB achieved with 61.57%, INDF AALI 16.27% and 22.16% at the minimum CV of 5.66 (Porfolio-1). None of the above alternatives portfolio allocated to stocks UNTR, where the rank-one CV is in stock at the lowest order - Linnear Programming "reject" the reason this stock is inefficient. CVmin any portfolio with a composition of relatively equal allocation with optimization step without considering the maximum funds. Linear Programming method can not find the optimum portfolio at the maximum funding level of USD 70 to 100 million, the second closest solution is to fund a maximum of USD 60 million that actually produce the lowest CV, with a portfolio value of USD \$ 57,905,000 consisting of 57 lots SMCB, INDF Lot 8 , AALI 1 lot.

Table 5. Composition (Lot) Optimum Portfolio Version 2, In The Maximum Fund

Port	Dana Maks. (Juta)	Alokasi dalam Lot				Total Portfolio
		SMCB	INDF	AALI	UNTR	
1	100	57	8	1	-	57,905,000
2	50	47	6	1	-	48,855,000
3	40	35	5	1	-	39,850,000
4	30	30	4	-	-	24,500,000
5	20	14	2	-	-	11,610,000
6	10	9	2	-	-	8,410,000
7	5	4	1	-	-	3,885,000

Simulation Porfolio Evaluation (Phase 5)

In this phase, the research chose the best portfolio (CV Min = 5.66) to be evaluated by back-testing simulation and Anova statistical test. Back-testing simulations will be conducted during the last 60 days of research data, from August 27 until 24 November 2009. The movement of the optimum value of the initial portfolio of USD 57,905,000 will be simulated with JCI stock index with initial value of 2356.064.



Picture 8. Back-Testing Simulation and Components Portfolio Portfolio During the last 60 days (in thousands of Rupiah)

The biggest contribution came from stock SMCB growing 28.13%, while the combined contribution of shares INDF and AALI SMCB almost equal shares $\approx (20.75\% + 8.08\% = 28.83\%)$ INDF stock movement and had several times SMCB opposite direction but the overall portfolio value showed an increasing trend slowly. Comparison of simulated back-testing portfolio and JCI shows that the average portfolio rate of return over 60 days (0.37% per day, cumulative = 23.03%) to reach 4 times more than the stock index (0.09% per day, cumulative = 4.92%), while fluctuations in portfolio (2.06%) was almost 2-fold fluctuations in JCI (1.10%).



Picture 9. Comparison of Simulation Portfolio Back-Testing and JCI During the last 60 days

First Hypothesis Test

H0: The average portfolio rate of return is lower or equal to the level of market return ($\mu_1 \leq \mu_2$)

H1: The average portfolio rate of return higher than the market rate of return ($\mu_1 > \mu_2$)

$$\bar{X}_1 = 0,37\% \quad s_1 = 2,06\% \quad n_1 = 59$$

$$\bar{X}_2 = 0,09\% \quad s_2 = 1,10\% \quad n_2 = 59$$

$$\alpha = 5\%$$

$$Z_{Uji} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{0,37\% - 0,09\%}{\sqrt{\frac{(2,04\%)^2}{59} + \frac{(1,10\%)^2}{59}}} = 0,904$$

$$Z_{Tabel} = Z_{0,01} = 1,64 \quad (\text{Right side test})$$

Conclusion Statistics:

H0 not rejected because $Z_{Uji} < Z_{Tabel}$ so that the research hypothesis (H1) is rejected, then the average profit level of the optimum portfolio of lower or equal to the level of stock returns.

Second Hypothesis Test

H0: Variance (risk level) portfolio is lower or equal to the variance of stock ($\sigma_{1,1}^2 \leq \sigma_{1,2}^2$)

H1: The variance portfolio is higher than the stock variance ($\sigma_{1,1}^2 > \sigma_{1,2}^2$)

$$s_1 = 2,06\% \quad n_1 = 59$$

$$s_2 = 1,10\% \quad n_2 = 59$$

$$F_{Uji} = \frac{s_1^2}{s_2^2} = \frac{(2,06\%)^2}{(1,10\%)^2} = 3,513$$

$$F_{Tabel} = 1,53$$

Statistical conclusions

H0 not accepted because $Z_{Uji} > Z_{Tabel}$ that research hypothesis (H1) is not rejected, then the variance (risk level) optimum portfolio is greater than the stock varies.

5. Conclusion

Several conclusions can be presented in this study are:

1. During the period January 2003 - November 2009 there were 10 stock index is always chosen to form LQ45. Based on ranking criteria Coefficient of variance (CV), only 4 stocks are selected to proceed to the portfolio optimization process, the SMCB (Cibinong Cement / Holcim), INDF (Indofood), AALI (Astra Agro Lestari) and UNTR (United Tractor).
2. The results of portfolio optimization with Linear Programming method showed that the portfolio by minimizing the objective function CV portfolio, both with maximum funding limits or do not produce a similar composition, ie 63.00% SMCB, INDF AALI 18.31% and 18.69% (UNTR not selected), with a minimum CV of 5.66.
3. The total value of the optimum portfolio resulting from the method of Linear Programming is Rp 57,905,000, is more suitable for investors long player, while the novice investor with a stock ratio (lot) of stock INDF SMCB is 4-7: 1, in the range of portfolio value of USD 3.8 to 11.6 million. All of the recommended portfolio has been able to cover the cost of trading commissions.
4. Simulation back-testing the last 60 days the research data shows that the profit rate for the portfolio 0.37% per day, 4 times the market rate of return of only 0.09% per day, with the largest contribution from SMCB shares. The level of risk (variance) portfolio optimally reached 2.06%, reaching 2 times the level of market risk which only reached 1.10%.
5. Statistical test showed that the level of portfolio return is lower or equal to the = 5%), whereas the level of risk (variance) □ level of stock returns (portfolio is greater than the level of market risk.

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