

# Optimally diversified portfolio

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## ABSTRACT

Investors can reduce risk by diversification or by forming a portfolio from its investment so that the possibility of the loss from one stock can be covered by gaining from other stock. One of the problems encountered in the formation of the portfolio is related to the size of the portfolio itself, is about how many stock in the portfolio that will minimize the level of risk. This research was conducted to determine the relationship between the size of the portfolio and risk level, both in total risk (variance) and unsystematic risk. By using Blue Chip stock in April 2012 as the sample period, the portfolio size range will be calculated for the level of risk, as result the number of stock in the portfolio that will produce the lowest level of risk. The result of this research showed that the greater the number of stocks in the portfolio will provide a level of lower unsystematic risk, meaning that the size of a large portfolio showed a good level of diversification. Optimally diversified portfolio consists of approximately 16 stocks, while over 16 stocks the level of unsystematic risk is decreased but not significant. This suggests that the size of the portfolio has a negative relationship with the level of unsystematic risk.

## ABSTRAK

Investor dapat mengurangi risiko dengan diversifikasi atau dengan membentuk portofolio investasi sehingga kemungkinan kerugian dari satu saham dapat ditutupi dengan memperoleh dari saham lainnya. Salah satu masalah yang dihadapi dalam pembentukan portofolio adalah terkait dengan ukuran dari portofolio itu sendiri, yaitu tentang berapa banyak saham dalam portofolio yang akan meminimalkan tingkat risiko. Penelitian ini bertujuan untuk mengetahui hubungan antara ukuran portofolio dan tingkat risiko, baik dalam risiko total (varians) dan risiko tidak sistematis. Dengan menggunakan saham Blue Chip pada April 2012 sebagai periode sampel, rentang ukuran portofolio akan dihitung untuk tingkat risiko, sebagai hasil jumlah saham dalam portofolio yang akan menghasilkan tingkat terendah risiko. Hasil penelitian ini menunjukkan bahwa semakin besar jumlah saham dalam portofolio akan memberikan tingkat risiko sistematis lebih rendah, yang berarti bahwa ukuran portofolio besar menunjukkan tingkat yang baik diversifikasi. Optimal portofolio yang terdiversifikasi terdiri atas sekitar 16 saham, sementara lebih dari 16 saham tingkat risiko tidak sistematis menurun tetapi tidak signifikan. Hal ini menunjukkan bahwa ukuran portofolio memiliki hubungan negatif dengan tingkat risiko tidak sistematis.

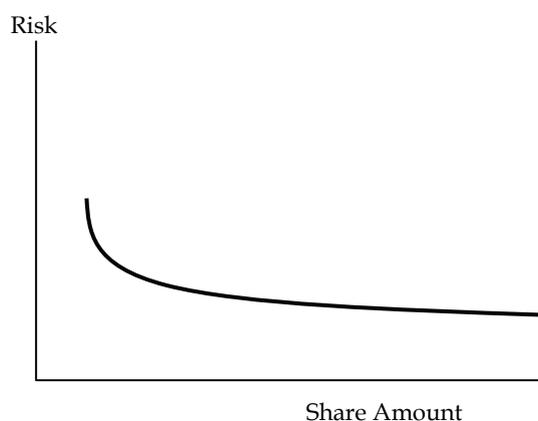
## 1. INTRODUCTION

Basically, there are three reasons why a person makes investments, such as: income, with the purpose of obtaining income; Appreciation, for the increasing of wealth and the ownership of an asset, and excitement, which is only a hobby realization. In the real world almost all investments contain elements of uncertainty or called as risk. In-

vestors cannot know with certainty the result to be obtained from its investments. In such circumstances, it is said that these investors face risks in its investments. What investors can do is that to estimate how the expected return from the investment, and how far the possibility of actual return will deviate from the expected return. As investors face a risky investment opportunities,

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**Figure 1**  
**Portfolio Risk Reduction through Increasing the Number of Stock**



Source: Tendelilin (2010).

investment options cannot rely solely on the expected rate of return. If investors expect to earn a high rate of return, then he should be willing to bear the higher level of risk.

One of investment characteristic on security is the ease of forming an investment portfolio. That means investors can diversify their investment in the stock of investment opportunities. The portfolio itself can be interpreted as a combination of investment in various forms of asset/wealth to reduce risk by diversification. The principle of the portfolio is "do not put all your eggs in one basket", means that by diversifying the failure of one kind of investment does not bring the overall losses, but offset by gains from another. The principle also applies to investing in the capital market; it can be realized by forming an investment portfolio by diversifying its stocks in Capital Markets. Diversification is done by forming a portfolio of stocks that will be affected differently in certain circumstances, depending on the type of industry the company concerned (Tendelilin 2010).

The purpose of investing is to maximize the return, without ignoring the investment risk factors that must be faced. Return is one of the factors that motivate investors to invest and also a reward for the courage of investors to bear risk on its investments (Tendelilin 2010). In investing, especially in stock, has a higher level of risk than other investments. However, the high level of risk will be followed by high level of return also, or in other words "high risk high return". In the modern portfolio theory, risk types can be separated into two types, they are systematic risk and unsystematic risk. Systematic risk is the risk associated with changes in the market as a whole, or in other

words, systematic risk is risk that cannot be eliminated, while unsystematic risk is the risk that is not associated with the overall market, where the risk is more related to changes in conditions micro- enterprise issuers and types of risk can be eliminated. The total risk faced by an investor to invest is a combination of systematic risk and unsystematic risk. In relation to the reduction in the level of unsystematic risk in investing, an investor can do diversification. Diversification can be done by forming a portfolio by selecting a combination of a number of assets so that risk can be minimized without reducing the expected returns. Reducing the level of risk without reducing the rate of return is the purpose of investor (Isynuwardhana 2013).

In portfolio management, it is recognized the concept of risk reduction as a result of additional securities in the portfolio. This concept is a very important concept in understanding the risk of the portfolio. This concept states that if we are continually adding to the types of securities in our portfolio, the risk reduction benefits that we gain will be even greater to the point that the benefits of these reductions began to decrease. The benefit of portfolio risk reduction will reach its peak when the portfolio consists of many types of stocks, and after that the benefit of reducing the risk of the portfolio won't be felt anymore (Tendelilin 2010).

Risk reduction effect by increasing the number of stock is described in Figure 1. One of the problems faced by investors in the portfolio formation is related to the size of the portfolio itself. Investors need to know the number of stocks to be used in forming portfolio. This study will try to determine the size of the portfolio or the number of stock in

**Table 1**  
**List of Research Sample**

No.	Company	Code	Sector
1	PT. Astra Internasional Tbk	ASII	Manufacture
2	PT. Unilever Indonesia Tbk	UNVR	Manufacture
3	PT. Indofood Sukses Makmur Tbk	INDF	Manufacture
4	PT. Mayora Indah Tbk	MYOR	Manufacture
5	PT. Kalbe Farma Tbk	KLBF	Manufacture
6	PT. Semen Gresik Tbk	SMGR	cement
7	PT. Indocement Tunggul Prakasa Tbk	INTP	cement
8	PT. Astra Agro Lestari Tbk	AALI	Plantation
9	PT. London Sumatera Plantation Tbk	LSIP	Plantation
10	PT. Perusahaan Gas Negara Tbk	PGAS	Energy & Metal
11	PT. Bukit Asam Tbk	PTBA	Energy & Metal
12	PT. Indo Tambangraya Megah Tbk	ITMG	Energy & Metal
13	PT. Aneka Tambang Tbk	ANTM	Energy & Metal
14	PT. Vale Indonesia Tbk	INCO	Energy & Metal
15	PT. Telekomunikasi Indonesia Tbk	TLKM	Service
16	PT. United Tractor Tbk	UNTR	Service
17	PT. AKR Corporindo Tbk	AKRA	Service
18	PT. Hexindo Adi Prakasa Tbk	HEXA	Service

Source: www.sahamok.com

the portfolios that will produce the lowest level of risk, taking into account the variance and unsystematic risk of the portfolio.

## 2. THEORETICAL FRAMEWORK AND HYPOTHESIS

In the previous researches, they have been conducted to determine the number of stock that will provide the lowest risk level. However, the results obtained indicate the size of the number of different stocks. Research conducted by Evans and Archer (1968) classified as the first research and used as a reference for further researches. Evans and Archer (1968) revealed that in order to achieve a diversified portfolio then the number of stock required is 10-15 stocks. Blume and Crockett (1974) conducted a study and found that almost all individual investors in the United States have a portfolio consisting of less than 10 stocks and only 11% of investors who have a portfolio above 10 stocks. This shows that investor using Evans and Archer research in deciding the size of portfolio.

The continuing researches showed that the number of stock required to form a diversified portfolio is growing, from 10-15 stocks in the 1950s into hundreds in the 2000s (Benjelloun 2010). Statman (1987) stated that in order to establish a diversified portfolio, the size of 30 stocks are needed in a

portfolio. Sanyal and Sen (1998) stated that it takes 75 stocks to reduce unsystematic risk. Campbell et al. (2001) and Benjelloun (2010) gave a similar result which takes about 40 to 50 stocks to produce a diversified portfolio.

The researches about the size of portfolio are still limited done in the Indonesian capital market. As far as I know, there is only one study relating to this topic, it was Tendelilin (1998) who conducted research in Indonesia and Philippine capital market. The study resulted in recommendations to minimize the risk of a portfolio that required at least 14 stocks for Philippine capital market and 15 stocks to Indonesian capital market.

## 3. RESEARCH METHOD

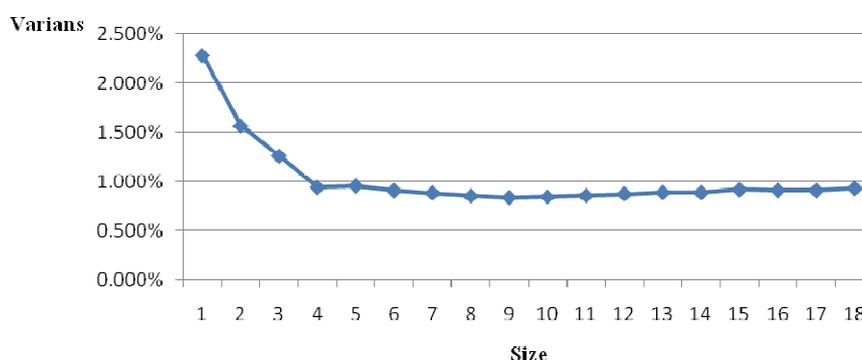
This research used a descriptive method with a quantitative approach, which is making a description, image or painting in a systematic way, factual and accurate information on the facts, properties and relationships of investigated phenomena (Nazir 2003).

The populations of this research are stocks listed on the Indonesia Stock Exchange, the sample in this study are the stocks that categorized as the Blue Chip in period of April 2012. The sampling techniques were using purposive sampling. According Sugiyono (2009) purposive sampling is a

**Table 2**  
**Size and Variance of Portfolio**

Portfolio Size	Portfolio Variance
1	2.282%
2	1.567%
3	1.260%
4	0.941%
5	0.956%
6	0.909%
7	0.884%
8	0.853%
9	0.838%
10	0.844%
11	0.857%
12	0.874%
13	0.889%
14	0.887%
15	0.917%
16	0.911%
17	0.909%
18	0.931%

**Figure 2**  
**Size and Variance of Portfolio**



sampling technique with particular consideration. Criteria for sample selection in this research were based on the determination of blue chip indicators, such as:

1. Large market capitalization; stocks of blue chip companies need to have a large market capitalization (trillion), thus it is more difficult to manipulate market prices
2. The percentage of public ownership is outstanding enough (high liquidity levels); although it has large capitalization, remains to be seen what percentage of shares owned by the public. If public ownership is small, then the stock price will also be easily manipulated so that became illiquid.
3. Older companies has been in stock exchange for

a long time (minimum 5 years); the duration of company in stock exchange is important to know the activity (track record) such shares during the period

4. Company performance and stability performance for 5 years; should always be a company that makes a profit, and this ensures that the company every year is always able to pay dividends to its shareholders.

Based on these criteria, the samples in this study are shown in Table 1.

The steps of data processing in this research follow the research conducted by Irala & Patil (2007).

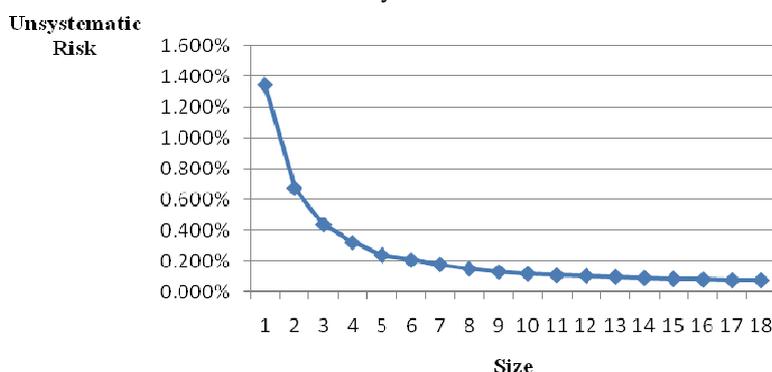
Step 1:

Calculate the monthly returns and market shares

**Table 3**  
**Size and Unsystematic Risk**

Portfolio size	Unsystematic risk
1	1.341%
2	0.670%
3	0.435%
4	0.319%
5	0.236%
6	0.205%
7	0.176%
8	0.149%
9	0.130%
10	0.117%
11	0.107%
12	0.103%
13	0.097%
14	0.089%
15	0.084%
16	0.078%
17	0.075%
18	0.074%

**Figure 3**  
**Size and Unsystematic Risk**



(ISHG) from January 2008 to June 2012.

$$R_i = \frac{(P_t - P_{t-1})}{P_{t-1}} \quad (1)$$

Step 2:

Making a regression of stock returns and the market return to obtain the equation:

$$\bar{R}_i = \alpha_i + \beta_i \bar{R}_m \quad (2)$$

Step 3:

Calculate the estimated/expected return for each period:

$$ER_{it} = \alpha_i + \beta_i R_{mt} \quad (3)$$

Step 4:

Calculate residual returns/abnormal return for each period:

$$\varepsilon_{it} = R_{it} - ER_{it} \quad (4)$$

Step 5:

Calculate the return residual variance of each stock,  $\sigma_{\varepsilon_i}^2$ , and the variance of the market,  $\sigma_m^2$

Step 6:

At this stage, there will be set up consisting of various combinations portfolio of 1 to 18 stocks. The assumptions used for the proportion of each stock are equally weighted. This research took a random combination of stock with a total of 1741 iterations that are performed.

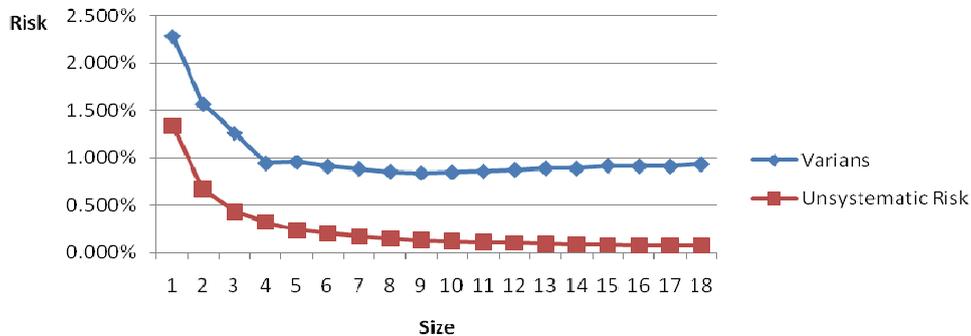
Step 7:

Calculate the portfolio unsystematic risk (Sharpe 1963):

**Table 4**  
Variance and Unsystematic Risk

Portfolio Size	Variance	Unsystematic Risk
1	2.282%	1.341%
2	1.567%	0.670%
3	1.260%	0.435%
4	0.941%	0.319%
5	0.956%	0.236%
6	0.909%	0.205%
7	0.884%	0.176%
8	0.853%	0.149%
9	0.838%	0.130%
10	0.844%	0.117%
11	0.857%	0.107%
12	0.874%	0.103%
13	0.889%	0.097%
14	0.887%	0.089%
15	0.917%	0.084%
16	0.911%	0.078%
17	0.909%	0.075%
18	0.931%	0.074%

**Figure 4**  
Variance and Unsystematic Risk



$$\sigma_{ep}^2 = \sum_{i=1}^n W_i^2 \sigma_{ai}^2 \tag{5}$$

Step 8:  
Calculate the  $\beta_p^2$  portfolio:

$$\beta_p^2 = \sum_{i=1}^n W_i^2 \beta_i^2 \tag{6}$$

Step 9:  
Calculate the total risk of portfolio (Sharpe 1963):

$$\sigma_p^2 = \beta_p^2 \sigma_m^2 + \sigma_{sp}^2 \tag{7}$$

**4. DATA ANALYSIS AND DISCUSSION**  
**Size and Variance of Portfolio**

In Table 2 and Figure 2, it can be seen clearly the relationship between the size of portfolio with the level of portfolio variance. Variance can be inter-

preted as the total risk of portfolio, which is a combination of systematic and unsystematic risk. Total risk level fluctuated on any additional number of stocks; this may happen due to the greater number of stock that will make a fluctuated systematic risk portfolio. The level of the smallest variance is obtained when the size of portfolio consists of 9 stocks.

**Size and Unsystematic Risk**

In principle, the portfolio was formed with the aim to reduce the risks that are unsystematic, diversified portfolio is the portfolio with the lowest level of unsystematic risk. Table 3 and Figure 3 show the results of unsystematic risk calculations for each portfolio size. Unsystematic

risk level has a tendency to decrease with increasing the number of stock. However, when the portfolio size of stocks above the 16, then decreased levels of unsystematic risk is getting smaller, so it can be said that a diversified portfolio is the portfolio size by 16 stocks. Figure 3 shows this relationship in the form of graphs, which is seen when the number of stocks above 16, then decrease the level of risk is not significant.

#### Variance and Unsystematic Risk

Variance level and unsystematic risk of portfolio showed no consistent change when the size of portfolio increases. Variance or total risk of portfolio tends to fluctuate on each additional number of stocks, while unsystematic risk decreased when the number of stock increases. Table 4 shows the results of the calculations, while Figure 4 shows the relationship in graphical form.

#### Discussion

The results showed that a portfolio consists of 16 stocks can be regarded as a diversified portfolio, although there was a tendency that stock replenishment will further lower the level of unsystematic risk, but the decline for the stock number above 16 is not significant. This is not in line with the variance or risk from the total portfolio. The variance, which is a combination of systematic risk and unsystematic risk, showed a fluctuating rate for each additional number of stocks. These results indicate that increasing the number of stock does not have too much effect on the level of total risk.

The analysis of variance or total risk of the portfolio shows that investing in stocks, are still having systematic risk, that is the risk associated with changes in the market as a whole, or can be said as the risks that arise due to all the assets in the market will receive the effects of changes value of interest rate, inflation, etc. This risk cannot be eliminated so that the total risk which is a combination of systematic and unsystematic risk has fluctuated relative to the level of increase in the number of stocks.

The results of this study also indicate that there is a negative relationship between the sizes of portfolio with the level of risk; the greater the size of the portfolio will generate a lower level of risk. In the Indonesian stock market, the best size of the portfolio is consisting of 16 stocks; each additional share above this amount will have no effect on the level of portfolio risk.

#### 5. CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

Portfolio is one strategy that can be done by investors to reduce the high levels of risk in investing stocks. But often the problem is related to the number of stock held in a portfolio. The results of this research indicate that for Indonesian market, an investor should have a portfolio consisting of 16 stocks. This is because in a portfolio consisting of 16 stocks, the level unsystematic risk can be eliminated.

This research still has limitations, such as the relatively small size sample, so it is expected that the further research could use a larger sample. For investors, they should also pay attention to the systematic risk due to the formation of the portfolio will only eliminate the unsystematic risk only.

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