VALUE AT RISK OF TELECOMMUNICATION INDUSTRY IN MALAYSIA USING VARIANCE-COVARIANCE METHOD

Shahirulliza S. Ambia[1*], **Syazwan A. Rahim**[2] **and Zulhusni A. Aziz**,[3]

Pusat Pengajian Sains Matematik, Kolej Pengajian Pengkomputeran, Informatik and Media Universiti Teknologi Mara (UiTM), 40450 Shah Alam, Selangor.

[1*]shahi091@uitm.edu.my, [2]syazwanmuhammad2700@gmail.com, [3]husnizul76@gmail.com

(indicates the corresponding author)*

ABSTRACT

An investor wants to diversify their holdings and build the finest portfolio they can while taking the fewest risks. The portfolio may operate in accordance with the selected level of risk for the investors or help them accomplish their objectives. Investors must consider the level of risk that each asset presents when deciding which assets to include in their portfolios, as they cannot predict how much the value of their investments will increase or decrease in the future, which can cause anxiety in the market. The Value at Risk (VaR) is determined in this study using the Variance-Covariance technique for both single and multiple assets. Four businesses in the telecoms sector's stock prices were obtained from the Bursa Malaysia. A suggestion for the ideal portfolio can then be made once the VaR for both single and multiple assets have been calculated, compared, and based on each potential investor's preferred degree of risk. According to the study, a large number of assets have a VaR that is noticeably larger than a single asset does. As a result, if the stock price of one company falls, the same will happen to the stock price of the other company, and vice versa. The study suggests that investors who are risk averse choose Celcom since it has the lowest VaR of any company. If they intend to invest in a portfolio of multiple assets, the VaR for 99% confidence interval is advised for them since it has the lowest VaR. Risk-takers are encouraged to select Telekom Malaysia for their single asset and 95% confidence interval portfolios when they have multiple assets because the VaR for the 95% confidence interval has the greatest VaR. Investors that are risk averse and entirely overlook risk when making investing decisions are said to be risk neutral.

.

Keywords*: Investment, Portfolio Optimization, Risk*

Received for review: 14-03-2023; Accepted: 09-04-2023; Published: 14-04-2023

1. Introduction

It has been determined that the telecommunications sector has a high potential to boost economic growth and create jobs. In addition to provide an immediate economic boost, investments in telecommunications infrastructure may pave the way for increased employment and growth prospects down the road. Significant fiscal stimulus expenditures in digital infrastructure are part of the fiscal stimulus programmes that national governments have put in place to lessen the effects of the crisis and accelerate economic recovery. In fact, study findings demonstrate that investments in the telecom sector have an impact that goes much beyond the

industry's boundaries, spurring the development of related sectors as well as the emergence of new ones.

People make choices on what to do with their money when they invest. Risk is the general term for any ambiguity surrounding the assets that may have the power to jeopardise their ability to generate revenue. Market risk, for instance, is the possibility that market forces will have an impact on whether the investment's value will increase or decrease. When corporate decisions about whether to join a new market or merge with other companies might have an impact on the value of investments, that is when the business risk may arise. Foreign investments come with potential political and monetary concerns for investors.

Investments in the telecommunications sector are unusual among stocks since occasionally, their stocks show traits of both income and growth stocks. The highest chances for share price rise for growth investors are offered by small wireless service providers. On the other hand, larger businesses that deal with equipment and services frequently serve as havens for cautious, income-oriented investors. The telecommunications industry offers excellent potential for value investors as well. Notwithstanding changes in the business cycle, demand for telecommunications services, a vital part of the global economy, continues to grow (Cronin, 1993).

There are other hazards. The term "liquidity risk" describes the ease or difficulty of liquidating an investment when necessary. The quantity of investments you have or do not have is a further risk factor. The danger, known as concentration risk, is typically larger the more money you put in one basket, such as buying one stock with all of your money (Kenton, 2022) The likelihood of a negative financial outcome, which is significant to investors, is simply known as risk. There are several important concepts to comprehend when it comes to investment risk.

Understanding risk and reward is the first step in learning more about investing. Typically, the potential return on an investment is inversely correlated with the level of risk attached to that investment or asset type (Chen, 2022). This relationship is justified by the idea that investors who are ready to make hazardous bets and possibly lose money should be compensated for their risk.

In the context of investing, the reward is the potential for higher returns. The strongest long-term average yearly returns historically have come from stocks (just over 10% annually), followed by corporate bonds (approximately 6% annually), financial bonds (5.5%), and cash/cash equivalents like short-term Treasury bills (5.5%). (Cook, 2022). More gains come at the expense of greater risk; stocks are riskier as an asset class than corporate bonds, and corporate bonds are riskier than Treasury bonds or bank savings products (Cook, 2022).

Although supply is consistent, demand may vary from one source to another. Since telecom companies, like other utilities, are usually shielded from competition by government regulation, a corporation may benefit from regulatory protections for a number of years and produce reliable, substantial dividend yields (generated by high monthly revenue from its stable customer base). Uncertainty is then suddenly created by technical developments or mergers and acquisitions, allowing for loss—and recovery, with fresh growth (Cronin, 1993). Value investors may purchase a firm if it faces a downturn due to industry changes (such as the increasing relevance of wireless devices) and exhibits adaptation while maintaining good fundamentals. Averages and volatility are the best adjectives to use when describing an investment. Considering each investor's unique situation, objectives, and desires, it is difficult to foresee (and impossible to know) if historical averages over long periods will be in the investor's favour (Boyte-White, 2018).). There is no guarantee, even if you invest in a big, diverse portfolio of businesses.

Your investment return will be affected by the timing of both the purchase and selling of your investments. Although the saying "buy low, sell high" is well known, many investors actually act in the opposite manner (Carnevale, 2019). If you buy a stock or mutual fund when the market is booming and prices are high, you will lose more money than if you bought at a lower price if the price decreases for whatever reason. Your annualised total returns will be

lower than theirs and your recovery period will be longer as a result. The obvious industry is viewed as a sound defensive investment that also attracts to growth investors because of its constant growth, particularly during recessionary periods.

The persistent demand for voice and data services, along with a variety of subscription plans, assures a steady stream of income for large telecom businesses even in unpredictably tumultuous economic times. As a result, we advise starting your investment in the telecommunications sector.

2. Methodology

The historical closing prices of the daily stocks from Celcom, Maxis, Digi, and Telekom were gathered in the first step. Data collecting will took place during a four-month period from January through April. This information is being gathered so that we can estimate the risk and return on our investment. The return of the assets or the stocks for each company were calculated after the gathering of stock prices. The following formula, according to Offiong (2016), can be used to calculate the stock return's utilisation at time-i, R (i):

$$R_i = \ln\left|\frac{P_i}{P_{i-1}}\right| \tag{1}$$

where P_i denotes the price of the asset at time-i and P_{i-1}denotes the price of the asset at time i -1. When the profit from an investment exceeds the amount invested, this is referred to as a positive return. The following formula was used to compute the stocks' average return:

$$\overline{R} = \frac{1}{n}[R_1 + R_2 + \cdots + R_n] \tag{2}$$

$$\overline{R} = \frac{1}{n}\sum_{i=1}^{n} R_i$$

This calculation is used to determine if investments increase or decrease over a certain length of time. Calculating excess returns is required in order to find each asset's covariance. Assessing excess return involves comparing the expected return with the average rate of return

$$ER_i = R_i - \overline{R} \tag{3}$$

where,

ER_i = excess return at time i

R_i = return of the asset i

$\overline{R}$ = average return of the asset i

After determining the excess return, covariance can be defined by using formula below:

$$\text{Cov}\,(i,j) = \frac{1}{N-1}\sum_{i=1}^{N}(R_i - \overline{R}_i)(R_j - \overline{R}_j) \tag{4}$$

Whether a covariance is positive, negative, or independent depends on how it turns out. Positive covariance indicates that both assets, i and j, will move in the same direction if the covariance is greater than zero. The covariance will be negative, though, if it is smaller than 0. This indicates that the movements of the assets i and j are diametrically opposed. The data is uncorrelated if the covariance is 0, though.

The variance for single asset can be calculated using the formula below:

$$\sigma_i^2 = \frac{1}{N-1}\sum_{i=1}^{N}(R_i - \overline{R})^2 \tag{5}$$

Based on derivation and explanation about asset allocation weightage in literature review section, the portfolio weight can be calculated by constructing the matrix linear equation:

$$W = \begin{pmatrix} 2\sigma_A^2 & 2\sigma_{AB} & 2\sigma_{AC} & 2\sigma_{AD} & 1 \\ 2\sigma_{AB} & 2\sigma_B^2 & 2\sigma_{BC} & 2\sigma_{BD} & 1 \\ 2\sigma_{AC} & 2\sigma_{BC} & 2\sigma_C^2 & 2\sigma_{CD} & 1 \\ 2\sigma_{AD} & 2\sigma_{BD} & 2\sigma_{CD} & 2\sigma_D^2 & 1 \\ 1 & 1 & 1 & 1 & 0 \end{pmatrix} \begin{pmatrix} w_A \\ w_B \\ w_C \\ w_D \\ \lambda \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$$

where,

W = Variance Covariance Matrix

Then the matrix rearranged in following solution system:

$$\begin{pmatrix} w_A \\ w_B \\ w_C \\ w_D \\ \lambda \end{pmatrix} = \begin{pmatrix} 2\sigma_A^2 & 2\sigma_{AB} & 2\sigma_{AC} & 2\sigma_{AD} & 1 \\ 2\sigma_{AB} & 2\sigma_B^2 & 2\sigma_{BC} & 2\sigma_{BD} & 1 \\ 2\sigma_{AC} & 2\sigma_{BC} & 2\sigma_C^2 & 2\sigma_{CD} & 1 \\ 2\sigma_{AD} & 2\sigma_{BD} & 2\sigma_{CD} & 2\sigma_D^2 & 1 \\ 1 & 1 & 1 & 1 & 0 \end{pmatrix}^{-1} \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$$

After then, the functions in Microsoft Excel were used to solve the matrix. The formula to calculate the linear equation in matrix form is MMULT AND MINVERSE functions. The inverse matrix of a given matrix is returned by the Excel MINVERSE function. The matrix product of two matrices is returned by the Excel MMULT function. MMULT produces a matrix with the same number of rows and columns as matrix 1 and matrix 2, respectively. The variance and covariance matrix are shown in matrix 1. The outcome will be a matrix with each asset's weighted value.

$$\sigma_p^2 = w_A^2\sigma_A^2 + w_B^2\sigma_B^2 + w_C^2\sigma_C^2 + w_D^2\sigma_D^2 + 2w_Aw_B\sigma_{AB} + 2w_Aw_C\sigma_{AC} + 2w_Aw_D\sigma_{AD} + 2w_Bw_C\sigma_{BC} + 2w_Bw_D\sigma_{BD} + 2w_Cw_D\sigma_{CD} \tag{6}$$

where,

σ_p^2= Variance of the portfolio

σ_i^2 = Variance of asset i

σ_j^2 = Variance of asset j

w_i = Weight of asset i

w_j = Weight of asset j

Calculate the standard deviation for single asset by using this formula:

$$\sigma_i = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(R_i - \bar{R})^2} \tag{7}$$

Next, calculate the standard deviation of portfolio P with the following formula:

$$\sigma_p = \sqrt{w_A^2\sigma_A^2 + w_B^2\sigma_B^2 + w_C^2\sigma_C^2 + w_D^2\sigma_D^2 + 2w_Aw_B\sigma_{AB} + 2w_Aw_C\sigma_{AC} + 2w_Aw_D\sigma_{AD} + 2w_Bw_C\sigma_B \; 2w_Bw_D\sigma_{BD} + 2w_Cw_D\sigma_{CD}} \tag{8}$$

where,

σ_p = Standard deviation of the portfolio

σ_i^2 = Variance of asset i

σ_j^2 = Variance of asset j

w_i = Weight of asset i

w_j = Weight of asset j

The matrix was then solved using the functions in Microsoft Excel after that. MMULT AND MINVERSE functions are the formula to calculate the linear equation in matrix form. The Excel MINVERSE function returns the specified matrix's inverse matrix. The Excel MMULT function returns the matrix product of two matrices. The matrix created by MMULT has exactly the same number of rows and columns as matrixes 1 and 2, respectively. Matrix 1 displays the variance and covariance matrix. The result will be a matrix containing the weighted value of each asset.

$$\mathrm{VaR} = V_0.\alpha.\sigma \tag{9}$$

V_0 = Initial value of the asset

α = The number of standard deviations below the mean corresponding to the (1-Z) quantile of the standard normal distribution / Z- Score

σ = Standard deviation of the asset daily return

For the 95% confidence level, Z = 0.95 (1 – Z) is the quartile (1-0.95) = 0.05 = 5% normal distribution the corresponding value of α is 1.645. Now, estimate the VaR portfolio with multiple assets (10)

$$\mathrm{VaR} = \alpha.\sigma_p$$

where the parameter α links the quantile of the normal distribution and the standard deviation: α = 1.645 for P = 95%. The VaR was calculated for both single and multiple assets, and the two were compared to see which one was more desirable to investors. The comparison was followed by the selection of the optimum investment based on the preferred level of risk for the investors. After calculating the VaR for both single and multiple assets, a comparison between the two was done to determine which one is more appealing to investors. Following the comparison in previous step, the ideal investment was selected based on the investors' preferred level of risk.

3. Results and Discussion

The four firms chosen for the study, Celcom, Digi, Telekom Malaysia, and Maxis were analysed based on their descriptive findings.

Daily VaR for Single Asset				
	Celcom	Digi	Telekom Malaysia	Maxis
Daily VaR for 95% Confidence Interval	0.779432459	0.8718412	1.496359587	0.937337079
Daily VaR for 99% Confidence Interval	1.103998559	1.23488753	2.119463731	1.327656775

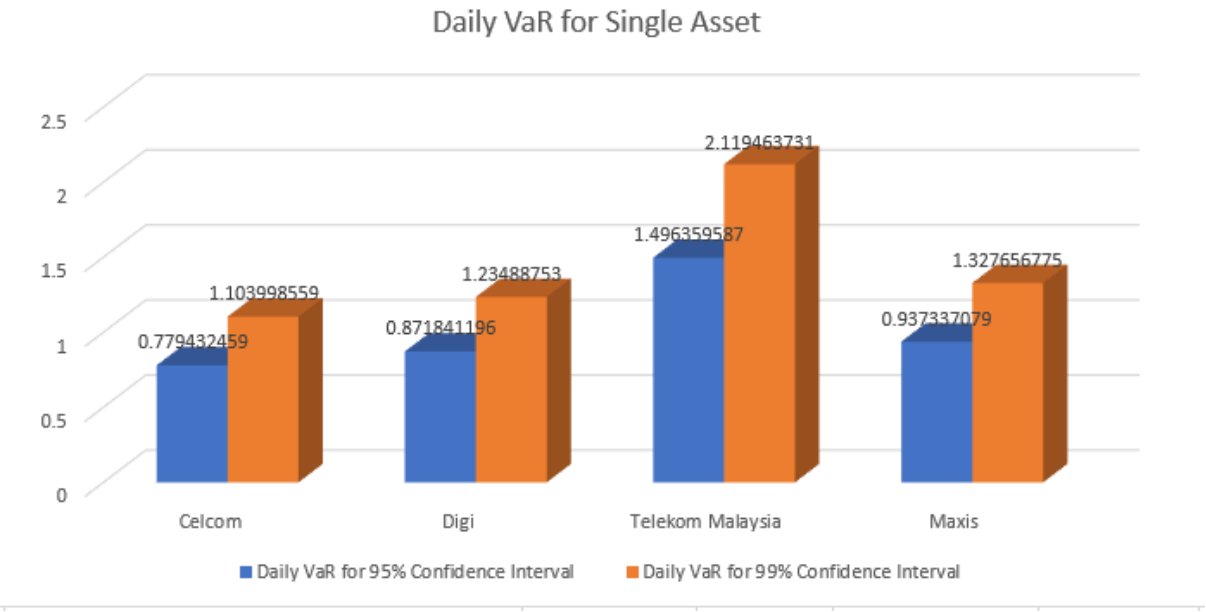

Figure 1: Daily VaR for Single Asset with 95% and 99% Confidence Interval From January 2022 – April 2022

Figure 1 displays the daily VaR for a single asset for Malaysia's four largest telecommunications companies. A higher VaR suggests a larger danger, whereas a lower VaR indicates a reduced risk. Celcom has the lowest VaR for both 95% and 99% confidence intervals, according to the aforementioned statistic. For 99% confidence intervals, the VaR is 1.103998559, indicating that there is a 99% likelihood that the investment loss would not be

greater than 1.103998559 the following day. For 95% confidence intervals, the VaR is 0.779432459, meaning that there is a 95% chance over the following day the loss in the investment will not exceed 0.779432459. Next, by having around the same VaR, Digi and Maxis are equivalent to one another. There is a 95% possibility that the investment will lose money the following day and not lose more than 0.871841196 for Digi and not lose more than 0.937337079 for Maxis, according to the VaR for 95% confidence intervals for Digi and Maxis, respectively. The following day's loss will most likely not surpass 1.23488753 for Digi and 1.32765775 for Maxis, according to the 99% confidence intervals for both businesses, which are 1.23488753 and 1.32765775, respectively. In contrast, Telekom Malaysia has the highest VaR, with 95% and 99% confidence intervals of 1.496359587 and 2.119463731, respectively. These figures indicate that with a probability of 95% and 99% the loss the following day would not surpass 1.496359587 and 2.119463731 respectively. The VaR shows the level of risks for investors to invest in their interest companies.

Daily VaR for Multiple Asset	
	Assets
Daily VaR for 95% Confidence Interval	0.158196318
Daily VaR for 99% Confidence Interval	0.22407138

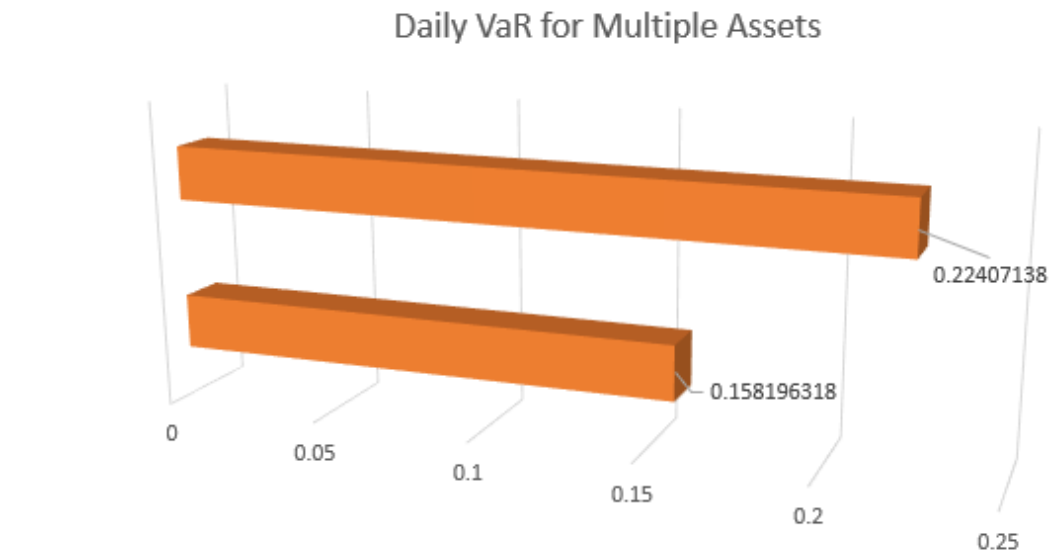

Figure 2: Daily VaR for Multiple Assets with 95% and 99% Confidence Interval From January 2022 – April 2022

Figure 2 above displays the daily VaR for a portfolio made up of the four major Malaysian telecoms businesses. The above graphic shows that the daily VaR in 99% confidence intervals is higher than the daily VaR in 95% confidence intervals. With 95% confidence intervals, the VaR is 0.158196318, and for 99% confidence intervals, it is 0.22407138.

According to this, the worst losses that could occur the following day are 0.158196318 and 0.22407138, respectively, with 95% and 99% likelihood.

Table 1: VaR for Single and Multiple Assets With 95% and 99% Confidence Interval

Telecommunication Companies	VaR for Single Asset With 95% Confidence Interval	VaR for Single Asset With 99% Confidence Interval	VaR for Multiple Assets With 99% Confidence Interval	VaR for Multiple Assets With 95% Confidence Interval
CELCOM	0.7794	1.1040	0.2241	0.1582
DIGI	0.8718	1.2349		
TELEKOM MALAYSIA	1.4964	2.1195		
MAXIS	0.9373	1.3277		

The value at risk for single and multiple assets is display in Table 1 above with 95% and 99% confidence intervals**.** It can be shown that value at risk for a single asset are much higher than the value at risk for multiple assets using both confidence intervals. The rationale for this outcome is because the portfolio of multiple assets is made up of businesses operating in the same industry. As a result, the assets' positive covariance indicates that they are advancing in the same direction. The price of the stock of the other asset will increase if the price of the stock of the first asset does, and vice versa. Therefore, investors who want to diversify their investments are advised to choose assets from several industries to reduce investment risk.

4. Conclusion and Recommendation

Each company's VaR fluctuates depending on the outcome. The danger increases as VaR increases. This implies that investors who are prepared to make hazardous bets and perhaps lose money have to be compensated for their risk, and vice versa. Low risk investments are those that come with a built-in safety margin over their rivals. Thus, the risk is smaller the lower the VaR. Regarding the risk they will encounter and the returns they will receive, investors frequently hold diverse points of view. Risk preferences pertain to how people view risks. Investors view risk from several angles. They can be divided into three groups: risk-averse, risk-neutral, and risk-takers. It is advised that risk averse investors choose Celcom if they want to invest in a single asset because they are those who are hesitant to take risks and desire to minimise them. The VaR for 95% confidence interval is advised for them if they decide to invest in a portfolio of many assets because it has a low reading of VaR. In the meantime, it is suggested that risk-loving investors who are eager to take more risks in order to earn higher returns select Telekom Malaysia if they wish to invest in a single asset and 99% confidence interval in a portfolio of multiple assets because the VaR for 99% confidence interval has a higher VaR. No decision can be made for risk neutral investors in this study, since these investors are not interested in knowing the risk associated with any investment. We advise those conducting the subsequent research to increase the precision and accuracy of value at risk estimates by using historical data collected over a longer time period—from four months to half-yearly or annually. As a result, the outcome will be more consistent and cover a wider range, which will make it easier for future investors to choose the firms in which to invest and determine how much money should be allocated to each portfolio based on its weight. They can use a number of techniques, such as the Historical Method and the Monte Carlo Simulation Method, to calculate the VaR. By taking into account additional sectors or industries for the investment portfolio, future researchers can expand on this study. Using finance, information

technology, and automobiles as examples. These industries can be combined to build a portfolio with a range of assets.

Acknowledgement

The authors thanks to Pusat Pengajian Sains Matematik, Kolej Pengajian Pengkomputeran, Informatik and Media for supporting this research.

References

Cronin, F. J., Parker, E. B., Colleran, E. K., & Gold, M. A. (1993). Telecommunications infrastructure investment and economic development. Telecommunications policy, 17(6), 415-430.

Ghazali, P. L., Riaman, R., & Ulfatmi, R. (2020, February). Calculation of Value-at-Risk Variance-Covariance with the Approach of Simple Cash Portfolio, Factor Models and Cash Flow. In Operations Research: International Conference Series (Vol. 1, No. 1, pp. 19-24).

Gupta, P., Mehlawat, M. K., Inuiguchi, M., & Chandra, S. (2014). Portfolio optimization with interval coefficients. *In Fuzzy Portfolio Optimization* (pp. 33-59). Springer, Berlin, Heidelberg.

Jismy. M. J (2018) A study on the Information seeking and Investment Behaviour of Equity Investors

Markowitz, H. M. (1999). The early history of portfolio theory: 1600–1960. *Financial analysts journal*, 55(4), 5-16.

Markowitz, H. M. (1999). The early history of portfolio theory: 1600–1960. *Financial analysts journal*, 55(4), 5-16.

Redhead, K. 1997. Financial Derivatives: An Introduction to Future, Forwards, Options and Swaps. Prentice Hall Europe.

Srivastava, M. (2010). Analysis of Variance and Covariance.

Sukono, (2019, November). ARIMA-GARCH Model for Estimation of Value-at-Risk and Expected shortfall of Some Stocks in Indonesian Capital Market. In Proceedings of the International Conference on Industrial Engineering and Operations Management Riyadh, Saudi Arabia (pp. 327-334).

Susanti, D., Sukono, S., & Verrany, M. J. (2020, February). Value-at-Risk Estimation Method Based on Normal Distribution, Logistics Distribution and Historical Simulation. *In Operations Research: International Conference Series* (Vol. 1, No. 1, pp. 13-18).

Cook, W. (2022). Has the technological investment been worth it? Assessing the aggregate efficiency of non-homogeneous bank holding companies in the digital age. *Technological Forecasting and Social Change*, 178, 121576.