Available online at https://ejournal.corespub.com/index.php/ijmsc/index

International Journal of Mathematics, Statistics, and Computing

e-ISSN 3025-0803

Vol. 2, No. 1, pp. 32-36, 2024

Application of the Compound Interest Model in Analyzing Long-Term Investments on Nvdia Company Stock

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Abstract

Long-term investment is a strategic decision that requires careful planning and in-depth analysis. One approach to analyze the potential returns from long-term investments is through the application of the compound interest model. This model considers the accumulation of interest on both the principal amount and the previously earned interest, providing a more realistic picture of investment growth over time.This research aims to explore how the application of the compound interest model can enhance the analysis of long-term investments. The analysis of these variables provides a comprehensive picture of the dynamics of investment growth and opens up opportunities for more informed investment decision-making. This research emphasizes the importance of a thorough understanding of the key variables in the compound interest model to enhance the accuracy of investment decisions.The findings of this research are expected to offer practical guidance for investors and financial practitioners in managing their portfolios more intelligently and measurably. These findings make a significant contribution to the development of more effective long-term investment strategies, thereby enhancing portfolio performance and overall investment outcomes.

Keywords: Analyzing Long-Term, Investment, Stock

1. Introduction

The rapid economic growth and complex dynamics of the financial markets demand a profound understanding of investment analysis models that can provide accurate and detailed insights into the movement of stock prices (Peter, 1996). One such model that is the focus of attention in this research is the Compound Interest Model. According Siegel (2021), this model has proven effective in analyzing long-term investments, especially when applied to the opening and closing prices of various stocks in the financial market.

This study aims to delve deeper into the concept of the Compound Interest Model and apply it in the context of long-term investment analysis. The primary focus of this research lies in the literature review of the Compound Interest Model, with a specific emphasis on its application to analyze the movement of opening and closing stock prices. The case study conducted in this research is of a simulated nature, utilizing stock data collected from leading company in the development and graphics processing unit.

2. Literature Review

The compound interest model is a financial mathematical concept that is important in analyzing long-term investments (Broverman, 2010). According Knoll (1996), compound interest refers to interest calculated on the principal amount and previous interest, and can provide increasingly greater benefits to the recipient if done in the long term. In this context, the concept of calculating interest based on previous principal and interest creates the potential for exponential profits over time

This concept is commonly used in various banking and investment products, and when applied in investment products, can produce high profits for investors (Blümke, 2009). Investors who understand and apply this model can experience the benefits of investment consistency, sustainable asset growth, and wise reinvestment policies.

In the face of rapid economic growth and complex financial market dynamics, the theoretical foundation of the Compound Interest Model forms a critical basis (Nee, 1992). The literature review involves the works of financial theorists such as Fisher (1930) and Irving Fisher (1896), who provide a mathematical basis for understanding the concept of interest and its application in the context of long-term investment analysis.

3. Materials and Methods

3.1 Materials

The main source of long-term investment data that we utilize in this study comes from Yahoo! Finance, a financial platform known for its credibility in providing up-to-date information on various financial instruments. We accessed information on globally traded stocks, including the stocks that are the main focus of this research. Our data involves monthly stock prices, including opening and closing prices, for the most recent six-month period. These prices form the basic framework for the compound interest model analysis, allowing us to model long-term investment growth by considering the compound interest generated by changes in stock prices over time. In addition, we also utilize historical interest rate data and relevant company financial information, provided by Yahoo! Finance, to deepen our understanding of the factors affecting long-term investments. By using these data sources, we aim to provide a more in-depth and accurate analysis of investment performance over a longer period of time. In this research, we used historical data of nvdia company stocks.

3.2 Methods

3.2.1. Structure

This research focuses on a literature review of the compound interest model, with an emphasis on applying the concept to analyze the opening and closing prices of several stocks. The case study is conducted by simulating stock data collected from a leading company in the graphics processing unit (GPU) development and technology industry, Nvidia. The research phase includes the following steps:

a. Identification and collection of historical data of Nvidia stocks.
b. Determination of relevant and necessary variables for analysis, including factors that affect stock prices.
c. Use of a compound interest model to assess the future value of the investment, focusing on the opening and closing prices of the stock.

Through this approach, this research aims to provide a more in-depth understanding of Nvidia's stock price dynamics and future investment potential.

3.2.2. Formula / Equation

The compound interest model, developed by Albert Einstein and Johann Carl Friedrich Gauss in the 18th century, is used to calculate the growth of investment or debt by considering the effect of reinvested interest on principal. Important assumptions in this model include the consistency of the interest rate, periodic reinvestment of income, frequency of interest compounding, and a fixed principal throughout the period. This model provides a more accurate picture of the growth in value of an investment or debt in the long run, by taking into account the effects of interest generated by principal and reinvested interest.

3.2.2.1. Mathematical Representation

In determining the value of investments in the long term, we can use the compound interest model. According Schulmerich (2010), the compound interest model is mathematically defined as follows:

$$FV = PV\left(1+\frac{r}{n}\right)^{nt} \qquad (1)$$

where

FV : future value of the investment
PV : the present value or initial value of the investment (Present Value).
r : the annual interest rate (in decimal form)
n : the number of times that interest is compounded per year
t : the number of years the money is invested or borrowed

3.2.2.2. Variables that Determine the Future Value of Investment

a. P as principal amount, denoting the initial investment

Assuming that PV (present value) is the last closing price of the time period you are observing, you can think of PV as the last closing price.

b. r as the annual interest rate
To get r (annualized interest rate), you can use the following formula:
Monthly Returns:

$$Return = \frac{Closing\ price\ today - closing\ price\ yesterday}{Initial\ closing\ price} \times 100 \tag{2}$$

$$Cumulative\ Returns = \left(1 + \frac{Month\ 1\ Returns}{100}\right) \times \ldots \times \left(1 + \frac{Month\ 6\ Returns}{100}\right) - 1 \tag{3}$$

Annual interest rate:

$$r = (Cumulative\ Returns + 1)^{\frac{1}{Total\ Period}} - 1 \tag{4}$$

c. n as the number of times that interest is compounded per year
For monthly data, assume that compounding is done every year. So, set

$$n = 1 \tag{5}$$

d. t as the number of years the money is invested or borrowed
Time period can be calculated as the number of observation periods:

$$t = current\ stock\ data\ date - buying\ time\ date \tag{6}$$

4. Results and Discussion

The Table 1 below reflects the results of calculating investment growth using the compound interest model with different initial investment values in each period. In each row of the Table 2, the Present Value (PV) value is the starting point of the calculation, with varying interest rates (r) and the assumption that interest is accumulated annually (compounded annually, $n = 1$). The investment periods range from the first to the sixth.

Table 1: Historical Data of NVDIA Company Stocks

Date	Closing Price
31/05/2023	IDR 5,972,261
01/07/2023	IDR 7,249,604
01/08/2023	IDR 7,256,431
01/09/2023	IDR 6,327,130
01/10/2023	IDR 6,748,411
01/11/2023	IDR 7,656,920
01/12/2023	IDR 7,769,261

Table 2: Calculation Results with Compound Interest Model

Present Value (PV)	Annual Interest Rate (r)	Compound per Year (n)	period (t)	Future Value (FV)
IDR 7,249,604	0.21	1.00	1	IDR 8,800,144.23
IDR 7,256,431	0.10	1.00	2	IDR 8,816,726.34
IDR 6,327,130	0.02	1.00	3	IDR 6,703,085.15
IDR 6,748,411	0.03	1.00	4	IDR 7,625,428.80
IDR 7,656,920	0.05	1.00	5	IDR 9,816,788.63
IDR 7,769,261	0.04	1.00	6	IDR 10,106,962.25

This Table 2 provides an overview of how the value of an investment can evolve over time with different interest rate variations and investment periods. Using this data, we can analyze investment growth trends, evaluate the impact of investment decisions on each period, and gain deeper insights in the context of Financial Mathematics.

The calculation results in the table provide significant insight into the dynamics of investment growth by applying the compound interest model. The analysis is carried out taking into account the change in the initial value of the investment (PV), the variation in the interest rate (r), as well as the difference in the compound per year (n) over a certain investment period.

a. Initial Investment (PV)
Each period starts with a different initial investment, ranging from IDR 6,327,130 to IDR 7,769,261. This initial investment is the basis for calculating growth over the investment period.

b. Annual Interest Rate (r)
The annual interest rate varies from 0.02 to 0.21. A high interest rate may increase investment growth, while a low interest rate may slow down growth.

c. Interest Rate and Time
A comparison between a higher interest rate in the first period and a lower interest rate in the second period provides an understanding of how time can enhance or dampen the impact of interest rates on investment growth.

d. Compound Frequency per Year (n)
In each case, the compound frequency per year is set as 1, which means the interest is compounded or calculated once per year.

e. Investment Period (t)
Each row represents a different investment period, ranging from 1 to 6. Investment returns are calculated at the end of each period.

f. Future Value (FV)
Future Value shows the value of the investment at the end of each period. The results obtained range from IDR 6,703,085.15 to IDR 10,106,962.25. Future Value reflects the investment growth that occurs after the application of the compound interest model, as shown on the Figure 1.

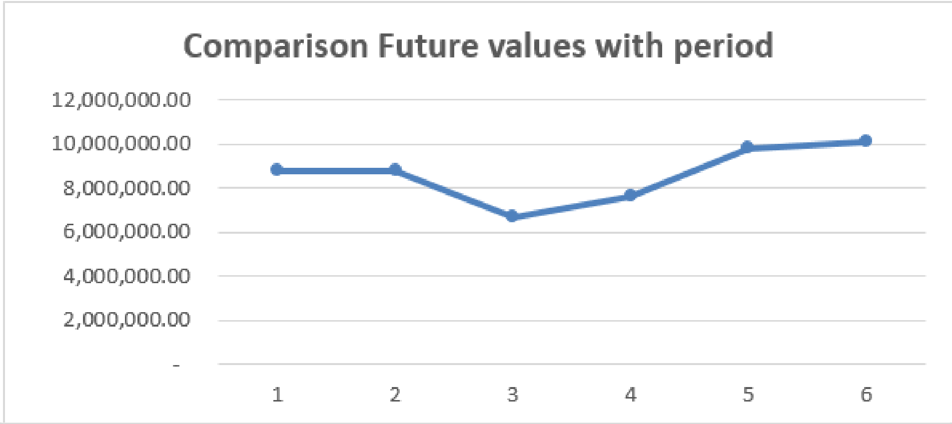

Figure 1: Comparison graph of future values with period

5. Conclusion

Considering the calculation results in the above table that reflect the application of the compound interest model in analyzing long-term investments, the following conclusions can be drawn:

a. Variation in Initial Investment
Diverse initial investments in each period provide insight into the diversity of fund allocation and reinforce the importance of early decisions in designing investment portfolios.

b. Impact of Annual Interest Rate (r)
Different annual interest rates give an idea of their direct effect on investment growth. High interest rates lead to greater profit potential, while low interest rates may restrain growth.

c. Compound Frequency per Year (n)
Setting the compound frequency per year as 1 indicates that the interest is calculated once per year. This frequency option can be customized according to the financial strategy and investment goals.

d. Investment Period (t)
Analysis over various investment periods (1 to 6) provides an understanding of the development of investments over time. This can serve as a guide for making long-term investment decisions.

e. Future Value (FV)
The Future Value at the end of each period reflects the investment returns.The range of FV values obtained (IDR 6,703,085.15 to IDR 10,106,962.25) illustrates the variation in potential final investment returns.

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