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Comparative Analysis of Pension Funds with Single Interest Model and Compound Interest Model

Thariza Haifa Septiandari[1*], Muhammad Rizky Umaran Akbar[2]

[1, 2]*University of Padjajaran, Sumedang, Indonesia*

** Corresponding author email: thariza23001@mail.unpad.ac.id*

Abstract

This study aims to provide a basic analysis of pension fund calculation using a simple interest model. In this study, we assume a fixed contribution invested at a fixed interest rate during the retirement period of the retiree. Using the basic formula of simple interest accumulation, we calculate the final amount available at retirement. The results show that even with low interest rates, wealth accumulation can increase significantly with long-term planning. This study is expected to provide readers with an initial understanding of the importance of pension fund planning.

Keywords: Pension funds, simple interest, planning.

1. Introduction

Retirement is a time when an employee is no longer actively working because they have reached a certain age limit or due to other reasons (Barrett, 2015). Law Number 11 of 1992 states that the normal retirement age limit is 55 years old and the maximum mandatory retirement age limit is 60 years old. That is why pension funds act as a long-term investment for someone who works so that they have a handle when facing retirement.

According to the Financial Services Authority (OJK), a pension fund is a legal entity that manages and runs a program that promises retirement benefits. The existence of a pension fund program for employees can provide a sense of security and peace of mind, because there is additional income that is prepared well in advance and can be used upon retirement.

2. Literature Review

2.1 Pension fund

Pension funds are divided into 3, namely employer pension funds, financial institution pension funds, and profit-based pension funds. While pension fund programs are divided into defined benefit pension programs and defined contribution pension programs. A defined benefit pension program is a pension program whose benefits are set out in the Pension Fund Regulations or other programs that are not defined contribution pension programs. A defined contribution pension is a pension program whose contributions are set out in the Pension Fund Regulations and all contributions and their development results are recorded in the participant's account as pension benefits (Thomas, 2016).

2.2 Simple Interest

Simple interest is interest that is calculated only based on the initial capital (principal), without considering the interest that has been obtained previously.

The basic formula for calculating simple interest is:

$$I = M_0 \times r \times t \tag{1}$$

Where:

I : interest earned,
M_0 : initial capital or principal,
r : annual interest rate,
t : time of year.

2.3 Compound Interest

Compound interest is interest calculated based on the initial capital and previously earned interest. In other words, the interest earned in each period is added to the initial capital, so that the interest in the next period is calculated on the basis of the capital that already includes the previous interest. This causes faster capital growth compared to simple interest, where interest is only calculated on the initial capital.

The equation for calculating the final (accumulated) amount with compound interest is:

$$M_n = M_0\ (1 + i)^n \tag{2}$$

Where:
M_n : Amount of capital at the end of the nth period.
M_0 : Initial capital subject to compound interest.
i : Interest rate per period (Annual).
n : Number of interest periods.

2.4 Future Value

Future Value is one of the concepts of the time value of money in the concept of annuity. While an annuity is a series of fixed receipts or payments made periodically at certain times. Ordinary annuity is an annuity whose payments or receipts occur at the end of the period. The formula for Future Value is

$$FV = PV\ (1 + i)^n \tag{3}$$

with:
FV : Future Value
PV : Present Value
i : Interest rate (annual interest rate)
n : number of years

3. Materials and Methods

3.1 Materials

This study uses simulation data to illustrate pension fund calculations using single interest and compound interest models. The data used include:

- Initial Capital (M_0): Rp. 50,000,000 as the initial investment value.
- Interest Rate (i): 5% per annum.
- Investment Duration (n): 20 years.
- Annual Contribution (C): Rp. 10,000,000 per year.

Simulations were conducted to compare the results of pension fund accumulation with the two interest models.

3.2 Methods

The method used in this study involves calculating the accumulation of pension funds based on the single interest and compound interest models. The calculation is done using the mathematical equations that have been explained in the previous section. The steps are as follows:

3.2.1 Structure

The structure used includes initial capital, annual interest rate, investment duration, and annual contribution. This data is used to perform simulations and calculations on both interest models.

3.2.2 Formula / Equation

The calculation of pension fund accumulation in this study uses the following formula:

1. Simple Interest

Simple interest is calculated based on the initial capital without taking into account the interest generated previously. The formula is:

$$I = M_0 \times r \times t \quad (4)$$

$$A = M_0 + I \quad (5)$$

Where:
I : Interest earned.
M_0 : Initial capital.
r : Annual interest rate.
t : Investment duration (in years).
A : Total accumulated funds after period t.

2. Compound Interest

Compound interest is calculated by adding the interest earned to the initial capital in each period. The formula is:

$$M_n = M_0(1 + i)^n \quad (6)$$

Where:
M_n : The amount of capital at the end of the n-th period.
M_0 : Initial capital.
i : Interest rate per period (annual).
n : Number of interest periods.

3. Annual Contribution (C)

If there are annual contributions made, each contribution is calculated with compound interest, and the total accumulation is calculated as:

$$FV = \sum_{k=1}^{n} C(1 + i)^{n-k} \quad (7)$$

FV : Future value of annual contributions.
C : Annual contribution.
i : Annual interest rate.
n : Number of years of contribution.
k : The k-th year of contribution.

3.2.3 Tables

The calculation results are summarized in a table to facilitate comparative analysis between the single interest and compound interest models.

Table 1: Calculation results

Year	Accumulation (Simple Interest)	Accumulation (Compound Interest)
10	IDR. 100,000,000	IDR. 125,000,000
20	IDR. 200,000,000	IDR. 265,329,770

3.2.4 Construction of references

References are compiled based on literature relevant to this research. Sources used include textbooks, laws, and scientific publications related to pension fund planning, single interest, and compound interest.

4. Results and Discussion

The calculation results show that the compound interest model produces a larger pension fund accumulation than the single interest model. This difference becomes more significant as the investment duration and interest rate increase.

Table 2: Calculation results

Year	Accumulation (Simple Interest)	Accumulation (Compound Interest)
10	IDR. 100,000,000	IDR. 125,000,000
20	IDR. 200,000,000	IDR. 265,329,770

The simulation results show the importance of understanding the concept of compound interest in retirement planning. With compound interest, wealth accumulation increases exponentially, while single interest only produces linear growth. This confirms that long-term planning using compound interest is very effective in achieving financial goals in retirement.

5. Conclusion

This study provides an overview of the significant differences between the single interest and compound interest models in pension fund accumulation. The results show that the compound interest model is much more profitable, especially for long-term investments. Therefore, it is important for individuals to consider the compound interest model in their financial planning.

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