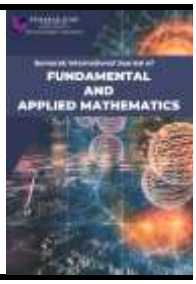
Semarak International Journal of
Fundamental and Applied Mathematics

Journal homepage:
https://semarakilmu.com.my/journals/index.php/sijfam/index
ISSN: 3030-5527



Examining the Sufficiency of Private Pension Funds in Malaysia Using Monte Carlo Simulation

Norhana Abd. Rahim[1,*], Yumn Suhaylah Yusoff[1]

[1] Faculty of Science and Technology, Universiti Sains Islam Malaysia, Bandar Baru Nilai, 71800 Nilai, Negeri Sembilan, Malaysia

ARTICLE INFO

Article history:
Received 15 January 2024
Received in revised form 10 February 2024
Accepted 9 March 2024
Available online 30 March 2024

ABSTRACT

Retirees must make wise plans to have enough savings in order to continue living at the same level after retirement. Retirement planning is essential for ensuring enough retirement funds, which give Malaysians elderlies with a source of income to maintain their standard of living and keep them out of poverty. Uncertainties in dividend rates, interest rates, and inflation have made it difficult for Malaysia's private pension system, notably the Employee Provident Fund (EPF) scheme, to stay financially viable and capable of offering pensioners adequate protection. Thus, this study takes into consideration these important factors in analyzing the sufficiency of the private pension fund in Malaysia for different income groups namely top 20% of income earners (T20), middle 40% income earners (M40) and bottom 40% income earners (B40). Several scenarios are prepared according to Malaysian's norm to examine the sufficiency of pension fund for each income group. The differences among the scenarios are income groups, retirement age and number of pension fund withdrawals. Then, the Monte Carlo simulation is run to calculate the accumulated value of the pension fund. Following that, the estimated monthly pension amount and the income replacement ratio are calculated to measure pension sufficiency. The results show that the income replacement ratio on average is significantly lower for all income groups as compared to the World Bank standard which stated that the income replacement ratio should not be below 70%. The results also show similar ratio with the current income replacement ratio recorded in Malaysia currently. When the number of withdrawals is taken into consideration, the income replacement ratios on average also show a decreasing pattern for all income groups. These findings indicate that the income replacement ratio in Malaysia is below the ideal rate and the pension amount is not sufficient to maintain the standard of living and purchasing power of retirees. Therefore, the government should take some action regarding this problem focusing on the B40 income group on how to increase their pension fund for better quality of life during retirement and avoid poverty.

Keywords:
Pension Sufficiency; Income Groups; Simulation; Uncertainty; Inflation

[*] *Corresponding author.*
E-mail address: norhana@usim.edu.my

https://doi.org/10.37934/sijfam.1.13848

1. Introduction

1.1 Overview of Malaysian Pension Fund

A pension fund is defined as a scheme which provides retirement income for employees when they retire at the end of their career. Contributions from employers, employees, or both have accumulated into this fund. There are two types of pension fund currently available worldwide which are defined benefit plan and defined contribution plan. A defined benefit (DB) plan is a type of retirement plan that offers guaranteed retirement benefits for employees. In Malaysia, this pension plan is the primary source of retirement income for public sector employees provided by the government. On the other hand, a defined contribution (DC) is a retirement plan that involves the contribution from employer and employees with a fixed percentage of contribution rate [1]. Because there is no income supplied after retirement under the defined contribution (DC) plan, pensioners must accumulate retirement savings. As a result, pensioners must assume a significant risk that their retirement income will underperform in the future, making it insufficient [2]. Therefore, a proper retirement planning is vital to provide appropriate retirement savings that serve as a source of income for elderly Malaysians to continue living and avoid poverty [3].

This study focusing on the defined contribution (DC) plan for private sector workers in Malaysia. The Employees Provident Fund (EPF) is the most vital pension scheme at providing financial protection for retired private-sector workers in Malaysia. In this scheme, the employee and employer contribute a specific percentage of their monthly salary into the employee's EPF account. The percentage ranges from around 20% to 23% from the year 2000 to 2022. The retirees under this scheme will receive benefits based on the total amount contributed and investment earnings upon mandatory retirement at age 60 [4]. Typically, the EPF invests member funds into stocks, shares, and other investments to generate profits and pay dividends to members. Members will benefit if the fund is invested in a strong economic environment, but when the market return on investment performance is poor, it will result in a shortfall of retirement savings.

1.2 Factors Affecting Pension Fund Inadequacy

One of the greatest challenges confronting EPF members today is insufficient pension funds. The issue of insufficient funds in the Employees Provident Fund (EPF) is at a serious level. According to Daniph [4], the EPF Head Strategy Management Department, Balqais Yusoff stated that only 22% of the 6.7 million EPF active contributors aged 54 years have savings of RM196,800 or more to cover retirees' living expenses during retirement years. Thus, this small percentage indicates that the majority of EPF members will suffer from inadequacy problems. Moreover, the Ministry of Finance also mentioned that 6.3 million members under the age of 55, or 48%, have less than RM10,000 in their accounts as of Sept 30, 2023 [5]. With less than RM10,000 in their accounts, EPF's members are expected to have pension amount of less than RM42 each month for a period of 20 years [6].

According to Department of Statistics Malaysia [7], the estimated life expectancy for both genders in 2021 who reach the age of 60 years old expected to live until the age of 78.9 for males and females over 81.8 years old, respectively. The increase in life expectancy will lead to an increasing number of Malaysia's elderly population and hence contributed to inadequate savings due to a shorter saving period and more extended spending.

Apart from that, the EPF pension systems also confront with risks of uncertainty due to the unstable economic condition in our country. Among the risks involved with the inadequacy of retirement income are inflation and returns on investment. Abdul Rauf *et al.,* [8] found that inflation rate, dividend rate and interest rate have significant relationship on pension benefits of private

workers in Malaysia. Many studies have investigated the effect of inflation on pension benefits and found that there is a significant relationship between them [1,9,10]. Inflation rate in Malaysia is expected to increase between average 2.5% and 4% as shown in Figure 1 [11]. Additionally, EPF is facing an exceedingly substantial risk to ensure that they will keep their return high by investing in only approved investments such as Malaysia Government Securities (MGS), followed by corporate loans and bonds, equities, money market instruments, and real estates. Due to market fluctuations, these investment activities always present a big challenge for the EPF to provide competitive returns to its members. Therefore, this study undertakes to analyze the sufficiency of the private pension fund in Malaysia by taking into consideration the factors affecting insufficiency of the pension fund.

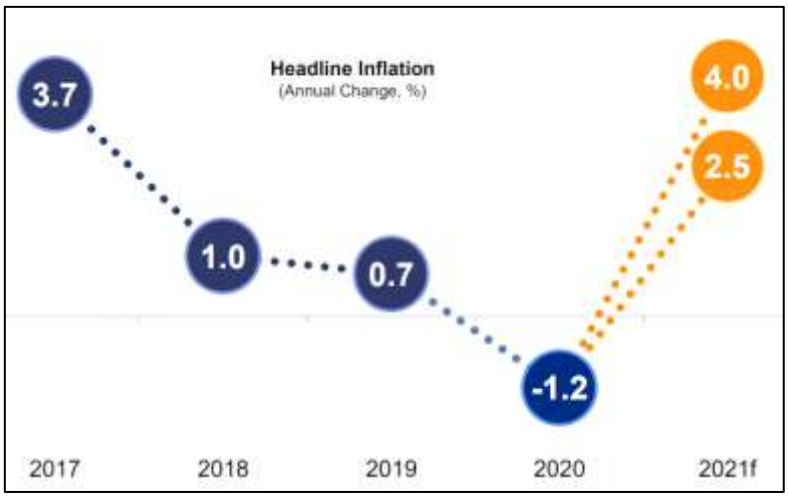


Fig. 1. Malaysian inflation

1.3 Income Replacement Ratio

The income replacement ratio is defined as an individual net pension entitlement divided by net pre-retirement salary [1-3]. The income replacement ratio is commonly used to measure the sufficiency of pension amount. Jackie [12] stated that the higher income replacement ratio would ensure that the pensioners would maintain the normal life after retirement. The minimum world standard net replacement ratio is set at 70% by the World Bank Standards [13]. However, many studies suggested varieties of net replacement ratios. Palmer [14] suggested income replacement ratios range from 65% to 85% depending on the income level. While Duncan *et al.,* [15] suggested replacement ratios range from 70% to 90%. Another study projects the best replacement ratios from respondents in United States and found that the best income replacement ratio is at 70% [16]. Other studies also suggested that income replacement ratio should vary according to income group [17-19]. For high-income groups, Purcel [17] recommended an income replacement ratio of 65%, whereas for low-income groups, it should be 90%. In the meantime, an income replacement ratio of 95% for low-income groups and 45% for high-income groups was proposed by Binswanger and Binswanger and Schunk [18]. Currently, the income replacement ratio for public pensioners in Malaysia is recorded at 50% [17]. Moreover, Khalid [20] also reported that a pensioner from private sector in Malaysia only receives RM693 per month until age 75 which is less than the poverty line of RM900 per month. This indicates that pensioners in Malaysia are financially poor after retirement.

The issue of pension insufficiency in Malaysia has been widely discussed in many studies and among related industrial practitioners. Insufficient pension funds, especially for private workers in Malaysia, were caused by issues with rising life expectancy, inflation fluctuation, and return on investment uncertainty. This insufficiency issue has significant impact on pensioners to maintain their

pre-retirement living standard and avoid poverty. In addition, longer life expectancy necessitates higher costs for medical expenses. Motivated by the mentioned significant problems, this study attempts to examine the adequacy of Malaysia's private pension fund by taking into account the most important elements influencing the fund's inadequacy.

2. Methodology

2.1 Scenarios and Assumptions

Several scenarios are created to run Monte Carlo simulation. These scenarios are created according to the number of possible withdrawals of the pension fund during the working years. The numbers of possible withdrawals are none, one withdrawal and two withdrawals. The first withdrawal is assumed at age 30 for purchasing first home. The second withdrawal is assumed at age 50 for either investment or pre-retirement purposes. Then, each category of withdrawal is categorized into three different income groups in Malaysia namely B40, M40 and T20. These scenarios are considered to reflects the different scenarios that might be occurred in Malaysia. After the scenarios have been created, the Monte Carlo simulation is run to calculate the accumulated value, estimated monthly pension amount and income replacement ratio which taking into consideration the uncertainties in inflation rates, dividend rates and annuity rates.

Several variables are assumed to be fixed such as age starts working, retirement age, contribution rate and salary increment. Age starts working is assumed to be 24 years old and the retirement age is assumed to be 60 years old for normal case, 55 for pessimistic case and 65 for optimistic case. The salary increment is fixed at 3% per annum while the contribution rate is fixed at 11% for employee and 13% for employer. The pensioners are assumed to live until age 75 based on average life expectancy in Malaysia.

2.2 Accumulated Value

The accumulated value of the pension fund is calculated using the real rate of interest. The real rate of interest is adjusted for inflation as follows:

$$i' = \frac{1+d}{1+j} - 1 \tag{1}$$

where i' is the real rate of interest, d is the dividend rate and j is the inflation rate. Following that, the accumulated value (AV) is calculated as follows:

$$AV = \sum_{j=0}^{r-e-1} S \times c \times (1+k)^j \times (1+i')^{r-e-j+1} \tag{2}$$

where S is the monthly salary, c is the employee and employer contribution, k is salary increment, r is the retirement age and e is employment age.

2.3 Estimated Monthly Pension Amount

The monthly pension amount is estimated before we can proceed to calculate the income replacement ratio. The annuity due formula is used to estimate the monthly pension amount as follows:

$$AV = P\ddot{a}_{\overline{n}|} = P\left(\frac{1-v^n}{i}\right) \quad (3)$$

where P is the estimated monthly pension amount, n is the retirement period and i is the annuity rate.

2.4 Income Replacement Ratio

The income replacement ratio serves as a proxy for measuring the sufficiency of the retirement fund. The income replacement ratio is determined as follows:

$$\text{Replacement ratio, } RR = \frac{\text{Estimated monthly pension,} P}{\text{Last drawn salary,} LS} \quad (4)$$

It is an appropriate measure for sufficiency since it is a requirement by the World Bank standard. The World Bank standard sets the minimum income replacement ratio of 70% to maintain the standard of living among retirees [1].

3. Results

3.1 Income Replacement Ratios for Normal Scenario

The results of the income replacement ratios with and without inflation adjustments for various scenarios are displayed in Table 1. After the simulation is run, the probability of getting desired income replacement ratio that set by the World Bank standard at 70% is also presented in Table 1. The compulsory retirement age (60) is assumed for the normal scenario. The results shown in Table 1 are estimated for three different income groups namely B40, M40 and T20. The results also estimated for three different scenarios. The first scenario is assumed when no withdrawal is made during employment duration (N0). Then, the first withdrawal is assumed at age 30 for purchasing first home (N1). The second withdrawal is assumed at age 50 for investment or pre-retirement purposes (N2).

Table 1
Probability of income replacement ratio (RR), RR with and without inflation adjustment for normal case

Income group		No inflation adjusted scenarios (%)			Inflation adjusted scenarios (%)		
		N0	N1	N2	N0	N1	N2
B40	RR	65.88	36.71	33.53	43.21	26.90	23.18
	Probability	49.06	39.26	38.32	29.08	0.66	0.66
M40	RR	67.93	37.63	33.61	44.62	27.42	23.60
	Probability	49.38	38.90	38.24	29.84	0.58	0.56
T20	RR	66.51	35.27	31.38	45.09	27.56	23.65
	Probability	49.02	38.40	37.34	29.76	0.56	0.54

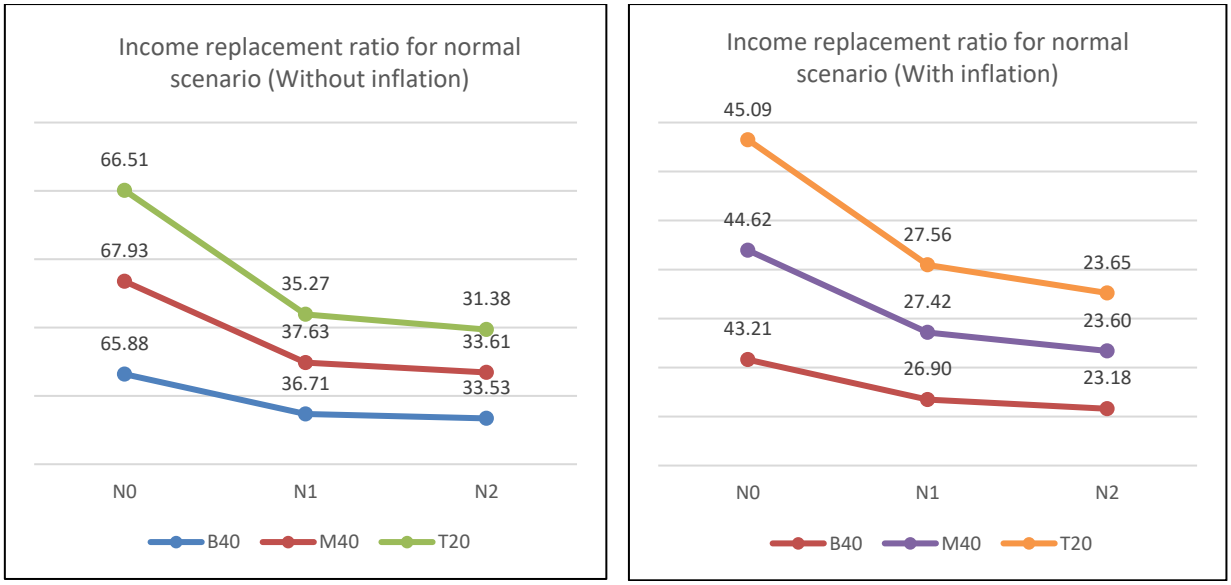
For no inflation adjusted scenarios, the replacement ratios are 65.88%, 67.93% and 66.51% for B40, M40 and T20 respectively. The results indicate that replacement ratios are greater for all income levels if no withdrawals (N0) are made during the employment years than if one (N1) or two withdrawals (N2) are made as in Figure 2(a). However, the ratios drastically decline if one or two withdrawals are made throughout the working year. This withdrawal issue in EPF also has been highlighted in several previous studies [21-22]. If a single withdrawal is made, the replacement rates for B40, M40, and T20 are 36.71%, 37.63%, and 35.27%, respectively. In the event that two withdrawals are made, the replacement rates for B40, M40, and T20 are 33.53%, 33.61%, and 31.38%, respectively. But the difference between one and two withdrawals is not significant.

The income replacement ratios (RR) adjusted for inflation show a larger percentage in the case of no withdrawal (N0) throughout the working years than in the scenario with one withdrawal (N1) and two withdrawals (N2) for all income groups as in Figure 2(b). The income replacement ratios (RR) are 43.21%, 44.62% and 45.09% for B40, M40 and T20 respectively. If an employee is assumed to withdraw the fund at age 30 for purchasing their first home, the income replacement ratio (RR) recorded at 26.9% for B40, 27.42% for M40 and 27.56% for T20. Next, if an employee assumed to withdraw again at age 50 for investment or pre-retirement purposes, the income replacement ratio (RR) is the lowest at 23.18% for B40 and 23.60% for M40 and 23.65% for T20. There is only a small decrease in the income replacement ratio (RR) as compared to one withdrawal. All these findings are significantly lower than the minimum ratio set by the World Bank standard. Thus, it indicates that the pension fund is insufficient as stated by the World Bank standard that the income replacement ratio should exceed 70% to maintain the standard of living [12]. This finding contrasts with research by Kamal *et al.*, [23], which demonstrated that pensioners in Malaysia have sufficient retirement wealth for all income levels using a replacement rate of 70%. Moreover, Saidi *et al.,* [13] also showed that the replacement ratio for employee provident fund (EPF) in Malaysia is less than 70%.

According to results in Table 1, the probabilities of getting 70% or more in income replacement ratio without accounting for inflation are 49.06%, 49.38% and 49.02% for B40, M40 and T20 respectively, if no withdrawal is made during working years. These findings indicate that there is high probability to get income replacement ratio exceed the World Bank standard if no withdrawal is made during the working years for EPF's contributor in Malaysia.

If there is one withdrawal (N1) during employment at age 30 for purchasing first home, the probabilities for exceeding minimum standard of 70% are 39.26% (B40), 38.90% (M40) and 38.40% (T20). If there are two withdrawals (N2) during the employment years, with the second withdrawal is at age 50 for investment or pre-retirement purposes, the probabilities of getting the income replacement ratio exceed the standard are 38.32% for B40, 38.24% for M40 and 37.34% for T20. These findings also show a decreasing pattern in probabilities of getting the income replacement ratio exceeding 70% from B40 to T20. Moreover, the probabilities also decrease as the number of withdrawals increases.

If without withdrawal and after accounting for inflation scenario is considered, the probabilities of exceeding the minimum standard of 70% are 29.08%, 29.84% and 29.76% for B40, M40 and T20 respectively. Then, the probabilities significantly decrease for one and two withdrawal scenarios. All the probabilities of getting the income replacement ratio exceeding the standard are significantly low which indicates that the pension fund is insufficient. Therefore, these findings proved that the pension amount for private retirees in Malaysia is significantly insufficient which is contrary to what suggested by the Department of Statistics Malaysia that the average consumption per month for population aging 65 years and above is about 75% of the average consumption per month for population aging 25 – 64 years [7].



(a) (b)

Fig. 2. Income replacement ratio for normal scenario (a) without inflation and (b) with inflation

3.2 Income Replacement Ratio for Pessimistic Scenario

Table 2 shows the findings of the income replacement ratios for different scenarios, both with and without inflation adjustments. These findings take the early retirement age of 55 into account which is regarded as a pessimistic scenario. Table 2 also shows the probability of obtaining an income replacement ratio higher than the required minimum of 70%.

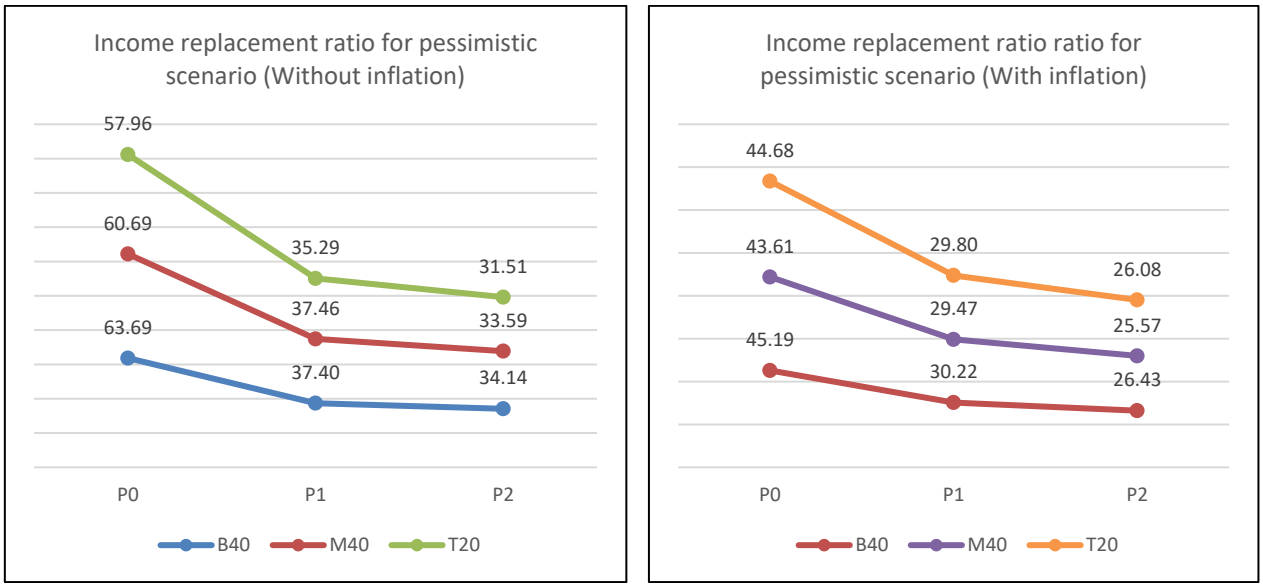
Table 2
Probability of income replacement ratio (RR), RR with and without inflation adjustment for pessimistic case

Income group		No inflation adjusted scenarios (%)			Inflation adjusted scenarios (%)		
		P0	P1	P2	P0	P1	P2
B40	RR	63.69	37.40	34.14	45.19	30.22	26.43
	Probability	47.70	37.22	36.38	25.80	0.56	0.56
M40	RR	60.69	37.46	33.59	43.61	29.47	25.57
	Probability	45.94	36.40	35.42	27.10	0.64	0.62
T20	RR	57.96	35.29	31.51	44.68	29.80	26.08
	Probability	45.26	35.84	34.88	27.74	0.42	0.42

The first scenario is assumed when no withdrawal is made during employment duration (P0), the private worker retires early at age 55 and is not accounted for inflation. The results show that the replacement ratios are 63.69%, 60.69% and 57.26% for B40, M40 and T20 respectively. When one or two withdrawals are taken during the employment period, the replacement ratios drop significantly as in Figure 3(a). If one withdrawal is made where the first withdrawal is assumed at age 30 for purchasing first home (P1), the replacement ratios are 37.40% for B40, 37.46% for M40 and 35.29% for T20. While if two withdrawals are taken where the second withdrawal is assumed at age 50 for investment or pre-retirement purposes (P2), the replacement rates are 34.14%, 33.59% and 31.51% for B40, M40 and T20 respectively. If inflation is taken into account for each scenario, a similar trend is seen in the results presented in Table 2 and Figure 3(b).

According to results in Table 2, the probabilities of getting 70% or more in income replacement ratio without accounting for inflation are 47.70%, 45.94% and 45.26% for B40, M40 and T20 respectively, if no withdrawal is made during working years. These results also suggest that if no

withdrawal is taken by Malaysian EPF contributors during their working years, there is a significant likelihood that their income replacement ratio will surpass the World Bank requirement. If there is one withdrawal (P1) during employment, the probabilities for exceeding minimum standard of 70% are 37.22%, 36.40% and 35.84% for B40, M40 and T20 respectively. If there are two withdrawals (P2), the probabilities of getting the income replacement ratio exceeding the standard are 36.38% for B40, 35.42% for M40 and 34.88% for T20. The likelihood of achieving a replacement ratio greater than 70% decreases when inflation is taken into account in each scenario, as opposed to not accounting for inflation. Therefore, these findings confirmed that the pension amount is not sufficient to sustain the same standard of life throughout retirement.



(a) (b)

Fig. 3. Income replacement ratio for pessimistic scenario (a) without inflation and (b) with inflation

3.3 Income Replacement Ratio for Optimistic Case

The results of the income replacement ratios for various scenarios, both with and without inflation adjustments, are displayed in Table 3. These results consider a late retirement age of 65, which is seen to be an optimistic situation. The likelihood of achieving an income replacement ratio over the necessary minimum of 70% is also displayed in Table 3.

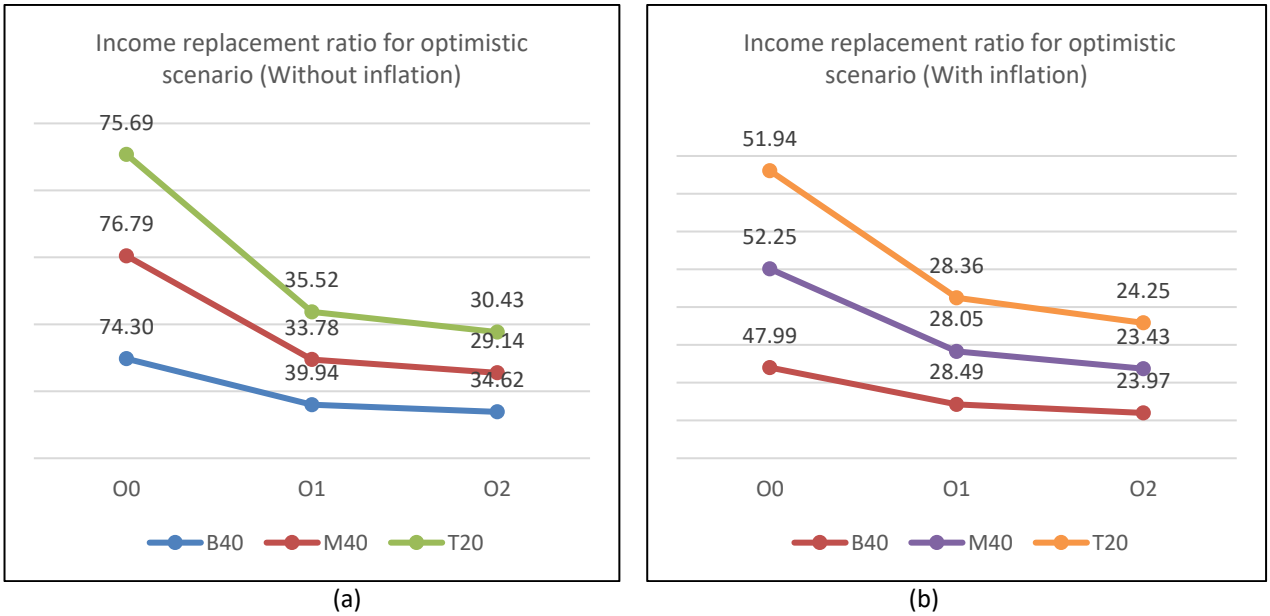
Table 3
Probability of income replacement ratio (RR), RR with and without inflation adjustment for optimistic case

Income group		No inflation adjusted scenarios (%)			Inflation adjusted scenarios (%)		
		O0	O1	O2	O0	O1	O2
B40	RR	74.30	39.94	34.62	47.99	28.49	23.97
	Probability	51.18	41.04	16.64	34.78	0.52	0.52
M40	RR	76.79	33.78	29.14	52.25	28.05	23.43
	Probability	51.48	40.50	39.58	37.08	0.58	0.50
T20	RR	75.69	35.52	30.43	51.94	28.36	24.25
	Probability	51.42	40.74	39.70	35.78	0.57	0.56

The first scenario assumes that no withdrawals are made throughout the period of employment (O0), that the private worker quits early at age 55, and inflation is not taken into consideration. According to the findings, the replacement ratios for B40, M40, and T20 are 74.30%, 76.79%, and

75.69%, respectively. The replacement ratios decrease dramatically when one or two withdrawals are made during the employment period as in Figure 4(a). If one withdrawal is made, with the assumption that the first withdrawal is made for the purpose of buying a first property at age 30 (O1), the replacement ratios for B40, M40, and T20 are 39.94%, 33.78%, and 35.52%, respectively. In the event that two withdrawals are made, with the assumption that the second withdrawal will be made for pre-retirement or investment purposes at age 50 (O2), the replacement rates for B40, M40, and T20 are 34.62%, 29.14%, and 30.43% respectively. The data shown in Table 3 show a similar pattern when accounting for inflation in each scenario. However, the replacement ratios drop significantly for all scenarios as in Figure 4(b). This indicates that the pension amount still not sufficient to sustain the same standard of living and purchasing power among retirees in Malaysia when inflation is taken into account.

The results in Table 3 show that, if no withdrawal is taken during working years, the probabilities of receiving 70% or more in income replacement ratio without taking inflation into account are 51.18%, 51.48%, and 51.42% for B40, M40, and T20, respectively. These figures also imply that there is a considerable chance that Malaysian EPF contributors' income replacement ratio will exceed the World Bank criteria if they do not take any withdrawals during their working years. The probabilities of surpassing the minimal criterion of 70% in the event of a single withdrawal (O1) during employment are 41.04%, 40.50%, and 40.74% for B40, M40, and T20 respectively. The probabilities of obtaining an income replacement ratio higher than the benchmark in the event of two withdrawals (O2) are 16.64% for B40, 39.58% for M40, and 39.7% for T20. Including inflation in each scenario reduces the chance of reaching a replacement ratio higher than 70% compared to not including inflation. Thus, these results also proved that the private workers in Malaysia would not have sufficient pension amount for their retirement.



(a) (b)

Fig. 4. Income replacement ratio for optimistic scenario (a) without inflation and (b) with inflation

4. Conclusions

When inflation is not taken into consideration and no withdrawals are made during employment, the income replacement ratios are deemed good as they approach the minimal criterion of 70% established by the World Bank. The highest ratios were recorded if the retirement age is extended to age 65. However, the replacement ratios significantly decrease if one or two withdrawals are made

during the employment period. When inflation is considered in the simulation, the income replacement ratios recorded are significantly lower as compared to the minimum ratio (70%) set by the World Bank standard. The Department of Statistics Malaysia [24] research also indicates that 2.91 million individuals in the B40 group earn an average monthly salary of RM4,849, which is deemed insufficient for retirement because inflation reduces the purchasing power of income over time.

The results also show that the higher the number of withdrawals, the lower replacement ratios recorded for all income groups. Moreover, the findings also show that the probability of exceeding the minimum standard set by the World Bank standard is still low for all income groups. In conclusion, the EPF's fund is still insufficient to support the retirement years and hence maintain the purchasing power of the private workers in Malaysia. Thus, the government should take some action to overcome this issue to provide a better quality of life among retirees.

Acknowledgement
This research was funded by the Ministry of Higher Education of Malaysia (MOHE) under the Fundamental Research Grant Scheme (FRGS/1/2020/STG06/USIM/02/6).

References

[1] Karunarathne, Wasana. "Mandatory savings and retirement adequacy: Portfolio simulation of EPF in Sri Lanka." In *Globalisation of Pension Fund Investments, 13th Australian Colloquium of Superannuation Researchers, Centre for Pensions and Superannuation, Australian School of Business at University of New South Wales (UNSW) Sydney Australia,* 2005.
[2] Thillainathan, R. "MALAYSIA: Pension & Financial Market Reforms and." In *Workshop organized by the Employees Provident Fund in Kuala Lumpur on August*, vol. 14, p. 15. 2000.
[3] Alaudin, Ros Idayuwati, Noriszura Ismail, and Zaidi Isa. "Projection of retirement adequacy using wealth-need ratio: Optimistic and pessimistic scenarios." *International Journal of Social Science and Humanity* 6, no. 5 (2016): 332-335. https://doi.org/10.7763/IJSSH.2016.V6.667
[4] Okeiga, Daniph A. "The Impact of Pension Savings Scheme on Kenya's Investment Growth-an Empirical Analysis." PhD diss., University of Nairobi, 2015.
[5] Bernama, (2023). Available at https://www.nst.com.my/news/2016/05/145726/only-22-cent-epf-contributors-have-sufficient-savings-retirement, last accessed 2022/11/15.
[6] Bernama. (2023). Available at https://www.thestar.com.my/news/nation/2023/11/20/epf-63-million-members-under-55-have-less-than-rm10000-savings
[7] Department of Statistics Malaysia Homepage, https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=116&bul_id=aHNjSzZadnQ5VHBIeFRiN2dIdnlEQT09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09, last accessed 2022/11/15.
[8] Rauf, Ira Nadhirah Abdul, Norhana Abd Rahim, and Yumn Suhaylah Yusoff. "The effect of inflation, interest rate and dividend rate on private pension benefits in Malaysia." In *AIP Conference Proceedings*, vol. 2895, no. 1. AIP Publishing, 2024. https://doi.org/10.1063/5.0192305
[9] Outlook, O. P. (2021). A framework for assessing the adequacy of retirement income (2021): 1–27.
[10] Fashagba, M. O. "The Influence of Inflation on Pension Income with the Contributory Pension Scheme in Nigeria." *Afro Asian Journal of Social Sciences* 6, no. 2 (2016).
[11] Bank Negara Malaysia. (2020). Economic and Annual Report Monetary Review.
[12] Jackie, W. U. Unemployment Benefits Systems: The International labour Organization's Recommendations (Hong Kong Legislative Council Secretariat, Hong Kong, 2000).
[13] Saidi, Nurul Athirah Nabila, Mazlynda Md Yusuf, and Mohamad Yazis Ali Basah. "Assessing the adequacy of contribution rates towards employees' provident fund in Malaysia." In *AIP Conference Proceedings*, vol. 1830, no. 1. AIP Publishing, 2017. https://doi.org/10.1063/1.4980934
[14] Palmer, Bruce A. "Retirement income replacement ratios: An update." *Benefits Quarterly* 10, no. 2 (1994): 59-75.
[15] Duncan, Greg J., Olivia S. Mitchell, and James N. Morgan. "A framework for setting retirement savings goals." *Journal of Consumer Affairs* 18, no. 1 (1984): 22-46. https://doi.org/10.1111/j.1745-6606.1984.tb00317.x
[16] Yuh, Yoonkyung. "Assessing adequacy of retirement income for US households: A replacement ratio approach." *The Geneva Papers on Risk and Insurance-Issues and Practice* 36 (2011): 304-323.

[17] Purcell, J.P. "Income Replacement Ratios in Health and Retirement Study." *Social Security Bulletin*, 2012. 72(3):37-58.
[18] Binswanger, Johannes, and Daniel Schunk. "What is an adequate standard of living during retirement?." *Journal of Pension Economics & Finance* 11, no. 2 (2012): 203-222. https://doi.org/10.1017/S1474747211000618
[19] Metzger, Christoph. "Who is saving privately for retirement and how much? New evidence for Germany." *International Review of Applied Economics* 31, no. 6 (2017): 811-831. https://doi.org/10.1080/02692171.2017.1338676
[20] Khalid, M. A. "Income Security for Older Persons in Malaysia." *SDD-SPPS Project Working Papers Series: Income Security for Older Persons in Asia and the Pacific,* 2016. https://hdl.handle.net/20.500.12870/849
[21] Wiener, Mitchell, S. B. Wardhani, M. V. Auwera, and J. Ahmed. "Assessment of Fiscal Cost of Social-Security-Related Programs in Indonesia-Report on Preparatory Studies on National Social Security System in Indonesia." *Asian Development Bank* (2007).
[22] Asher, Mukul G. "Managing National Provident Funds in Malaysia and Singapore." *Management* 24 (2001): 26.
[23] Kamal, Zarul Khaliff, Siti Mardhiah Isa, Ros Idayuwati Alaudin, and Noriszura Ismail. "Adequacy of Retirement Wealth in Malaysia: Spending Behaviour Analysis." *The Journal of Social Sciences Research* (2018): 429-435. https://doi.org/10.32861/jssr.spi6.429.435
[24] Department of Statistics Malaysia (2020). Household Income and Basic Amenities Survey Report 2019. Available at https://v1.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=120&bul_id=TU00TmRhQ1N5TUxHVWN0T2VjbXJYZz09&menu_id=amVoWU54UTl0a21NWmdhMjFMMWcyZz09, pages 429-435:6.