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Analysing Determinants for Sustainability of Employees Provident Fund (EPF) during Retirement

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ABSTRACT

This study investigates the factors influencing the sustainability of the Employees Provident Fund (EPF) during retirement years in Malaysia, considering the demographic, economic, and health-related challenges faced by the aging population from year 2001 to 2022. The analysis evaluates interactions of seven key determinants: life expectancy, mortality rate, population above age 65, dividend rates, nominal gross domestic product (GDP), exchange rate, and inflation rates. Three significant predictors includes inflation rate, nominal gross domestic product (GDP), and the population above age 65 were identified by using stepwise regression. The findings reveal that nominal gross domestic product (GDP) and population above age 65 have a positive and significant relationship with EPF sustainability indicating the critical role of economic growth and demographic aging in influencing retirement savings. Conversely, the inflation rate exhibits a negative and significant relationship with the EPF sustainability highlighting the adverse impact of inflation on the long-term viability of retirement funds. These results provide valuable insights for policymakers, emphasizing the need to mitigate inflationary pressures while promoting economic growth and addressing demographic challenges to ensure the strength of Malaysia's retirement system.

1. Introduction

Retirement can be defined by Oxford Learner's Dictionary, 10th edition, (2020) as the action of leaving your job and stop working, as due to reaching particular age [8]. According to World Bank [29], there is a significant increase in mortality rate and life expectancy from 57 years in 1960 to 75 years in 2020, while the fertility rate has declined from 6.4 in 1960 to 1.8 in 2020. The demographic shifts highlighted, directly influence Malaysia's dependency ratio, which measures the proportion of dependents relative to the working-age population and reduces the number of young people entering the workforce, shrinking the future working-age population. As a result, fewer working-age individuals must support a growing elderly population. This raises concerns about the financial strain

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on the working population to cover up the pension funds. If this imbalance continues, it could lead to increased poverty rates among the elderly aged 60 and above, as noted by Holzmänn [29].

On the other hand, The World Health Organization [63] has stated that the average healthy life expectancy (HALE) rose by 8% worldwide between 2000 and 2019, going from 58.3 years to 63.7 years. Despite these improvements, retirees still face many years of potential health challenges that require financial support for medical expenses, which could deplete their retirement funds. In addition, chronic diseases are prevalent among individuals aged 60 and above. If the retirees only funds during this age, it may be sufficient for their food, utility expenses, and car maintenance, but not for high medical expenses which demand a large proportion of money. This situation highlights the critical importance of the sufficiency of pension funds to ensure the well-being and survival of these aging populations.

According to EPF [61], only 36% of the active members of EPF age 55 have total savings of RM 240000, which is considered enough by the economic specialist to retire. Pension funds are crucial for ensuring financial security during old age period. Malaysia may have multiple social security schemes, such as the Armed Forces Fund Board (LTAT), the Employees Provident Fund (EPF) for the private sector, the Public Pension Scheme available only to civil personnel, and the Social Security Organization (SOCSO) and Private Retirement Schemes (PRS) [62]. Even though there is a platform to invest for retirement savings, the sustainability of this platform especially Employees Provident Fund (EPF) during retirement is a critical concern as one in four members deplete their savings within only five years. According to United Nations [64], financial security among the retirees is still inadequate for some of them to survive during retirement age. Therefore, this issue is a critical concern in today's socio-economic landscape as Malaysia will be aging by 2030 which consist of a large portion of retirees.

As demographic shifts and economic volatility increase, ensuring that individuals have adequate financial resources in retirement has emerged as a significant issue. The EPF serves as a fundamental pillar of retirement security for many workers, providing a mechanism for accumulating savings that can be drawn upon in later years. However, the EPF's effectiveness in meeting retirees' long-term needs depends on a complex interplay of various determinants. This includes seven key determinants which are life expectancy, population above age 65, mortality rate, inflation rate, exchange rate, dividend rate, and nominal gross domestic product.

Apart from that, EPF also needs to be able to cope with catastrophic events such as sudden spikes in the annual inflation rate and the fluctuation of the exchange rates. These situations may hit the performance in the investment earnings of EPF badly and it could lead to a lower provision of the dividend afterward. The management of EPF also plays a crucial part in avoiding the devaluation of the Malaysian Ringgit since 2016 which lowered the international real value of the fund, impacting retirees' purchasing power [3].

Moreover, according to EPF (2024), EPF account is restructuring from two accounts to three accounts. This change has raised questions about the effectiveness of the new system. This is because the third account is known as a flexible account which plays the same role as a savings account and members are allowed to withdraw money with a minimum of RM50 anytime and a maximum amount of RM250 daily. This situation can reduce the retirement savings by up to 10% of the accumulated savings for retirement years

Therefore, this study aims to investigate the factors that impact the sustainability of EPF during the retirement years, considering the demographic, economic, and health-related challenges faced by the aging population in Malaysia. By examining these various factors, this study is important in spreading awareness on the importance of sustainable retirement funds during the golden age and identifying the significant factors in providing an effective retirement and pension system in Malaysia.

The objective for this study are:

- 1) To examine the relationship between EPF fund and sustainability during retirement years which are life expectancy, mortality rate, population above 65 years old, dividend rate, nominal gross domestic product, exchange rate, and inflation rate?
- 2) To investigate the long and short-run relationship between EPF fund and the independent variables.

To achieve the objectives, this study will answer the following questions:

- 1) What is the relationship between EPF balance and sustainability during retirement years with selected independent variables such as life expectancy, mortality rate, population above 65 years old, dividend rate, nominal gross domestic product, exchange rate, and inflation rate?
- 2) Is there a long-run and short-run relationship between EPF balance and the selected independent variables?

2. Literature Review

2.1 Sustainability of Retire Funds

“Retirement” can be defined as the act of retiring oneself from an active working career or the period of being retired, that is, the time after permanently stopping a job or profession. As at current, the legal retirement age of 60 years in Malaysia is governed under the labor law by the Minimum Retirement Age Act 2012 [Act 753]. While sustainability of retirement fund is to ensure that retirement savings and pensions able to provide adequate savings live on throughout their retirement years. However, the matter becomes critical as the retirement funds are reported to be under strain due to increasing life expectancy, growing financial obligations, and an expanding retiree population which can affect a comfortable lifestyle during old age [29].

2.2 Dependent Variable

2.2.1 EPF balance

Employee Provident Fund (EPF) balances play a crucial role in the retirement period as EPF balances will be forming a big proportion of retirement funds. The adequacy and sufficiency of the fund is important for retirees to maintain their lifestyle during retirement years. According to Ismail [10], stated that a significant amount of EPF members have been trapped with the insufficiency of savings especially during the pandemic of Covid-19, which suggests that they need higher contributions to support themselves due to a lack of awareness on preparation for retirement.

This reflects that even though pre-retirement withdrawals were allowed during employment, it will later jeopardize the retirement fund Cheah and Lim stated that a significant amount of EPF members need a higher contribution to support themselves. This shows that the amount of EPF balance can determine the preparedness of the individual for retirement since higher contributions will increase an EPF accumulate saving. In addition, according to Hossain *et al.*, [30], it is found that many retirees are not prepared for retirement, and the strength of financial literacy plays a significant role in smoothing retirement planning. The study also highlighted the pivotal role of financial literacy in providing adequate retirement fund during the retirement period.

According to Newman [50], inadequate retirement savings can lead to increased poverty rates among the elders. Hence, higher demands on government assistance programs such as housing, food assistance, monthly allowance and other welfare programs during old age. This consequence will lead to the strained of government sources. The sufficiency of retirement savings is a vital concern, particularly as Malaysia faces rising living costs and an aging population. To address this, the EPF has introduced the Retirement Income Adequacy (RIA) framework, which aims to enhance retirement planning and ensure financial security for retirees in the country [14].

2.3 Independent Variable

The independent variable refers to a variable that is manipulated to determine the relationship with the dependent variable. This study is focused on seven independent variables which are population age 65 and above, mortality rate, life expectancy, inflation rate, exchange rate, nominal GDP, and investment earnings. These are factors that might influence the dependent variable, EPF savings.

2.3.1 Life expectancy

According to the United Nations [64], the percentage of the older generation is projected to more than double, from 761 million in 2021 to 1.6 billion in 2050. The number of people who are 80 years of age or older is also expected to expand even faster. According to DOSM [42], it is projected that, 15.3% of Malaysians would be 60 years of age or older by 2030, marking the country's aging population. Both statistics evidence shows that Malaysia is moving toward an aging country. However, conditions have worsened considerably when the healthy life expectancy (HALE) slowly decreases [63]. This indicates that the pensioners will spend their retirement age with deteriorating health status during retirement years. This increase raises critical questions on the sustainability of retirement funds as these groups approach the golden age.

According to Bloom *et al.*, [7], an increase in life expectancy has several implications for social security systems and pension funds. As people live longer, as living and healthcare condition improving from time to time, they would require financial resources to support themselves for extended periods after retirement. According to Hong Leong Assurance, arising living cost and health expense, would put pressure on the pension systems, including the EPF to ensure that the funds are sufficient to support the extended retirement years. This also creates new challenges for individuals and policymakers to keep retirement funds sufficient over longer retirements.

2.3.2 Inflation rates

According to Nadhirah *et al.*, [49], inflation is one of the reason of the erosion on the real value of savings. This will reduce money's purchasing power, directly affecting the real value of EPF funds. While people are trying to make savings by contributing to EPF every month with the hope that the fund will grow through contributions and declared dividends, inflation diminished the value of the money to buy goods over time. The impact of long-term savings in EPF became small as a 25-year-old contributor may find that their savings at retirement are inadequate to maintain their standard of living due to inflation. The situation is difficult to believe when the contributor has contributed for 35 years but the fund is still inadequate. Rising inflation has caused an increase in the cost of essential goods such as food, housing, and healthcare. This means that retirees may deplete their EPF savings more quickly as their income decreases after retirement, but the inflation is high (Henslin, 2019).

Recent studies by Davis and Tully [13], also stated that if EPF savings do not outpace inflation, the purchasing power of accumulated funds will decrease impacting retirees' standard and living. Undeniably that fluctuations in the exchange rate and an increase in inflation affect retirement funds. For example, with 2% inflation, RM1 million in retirement savings will only be worth RM660,000 after 10 years, and just RM290,000 after 30 years [3]. Inflation significantly impacts the real value of EPF savings by reducing purchasing power and diminishing real returns. A higher inflation rate also threatens the sustainability of the EPF, hence, impossible to maintain its long-term stability.

2.3.3 Exchange rates

According to Miller and Vanderhoff, the exchange rate is one of the external economic factors that significantly affect the long-term performance of pension funds including EPF in Malaysia. It is related since EPF was involved in both domestic and foreign investment to diversify its portfolio and enhance returns. A study by Chinn and Frankel [12] found that EPF funds with significant foreign investments experience considerable volatility in returns due to exchange rate fluctuations as EPF also make foreign investments, it will directly impact the EPF's members. The sustainability of the EPF funds will also be lower when the retirees choose to go on vacation and live abroad. According to Campbell and Viceira, retirees need more Malaysian Ringgit to obtain the same amount of foreign currency especially when the Malaysian Ringgit value depreciates against the foreign currency. It will definitely reduce the purchasing power. A recent study by Arturo *et al.*, [3] stated that the exchange rate impacts the real value of the EPF. The simulation using the Employee Provident Fund-International Real Value (EPV-IRV) model determined how exchange rate changes affect the real international value of the EPF. The exchange rate factor is impossible to be avoided when it is a crucial element in keeping the value of a company's assets. To mitigate the impact of exchange rate fluctuations, the EPF employs a currency diversification strategy in its investment portfolio. The risk of losses in any investment is always present but the way that company mitigates the risk to prevent and minimize the losses is crucial to maintaining the sustainability of EPF funds.

2.3.4 Dividend rate

According to Mohd and Ismail [10], the EPF has consistently provided competitive returns, with an average dividend of 6.20% per annum from 2010 to 2016. This consistency outperformance of the EPF dividends that demonstrates how higher dividend rates can lead to substantial increases in members' retirement savings over time. According to Abdul Rahman and Tan consistent dividend payouts not only enhance the accumulation of retirement savings but also improve members' confidence in the EPF system. They highlighted that stability in dividend rates serves as a hedge against inflation, ensuring that members' purchasing power is preserved.

Higher dividend rates would directly contribute to the growth of individual EPF savings [10]. For example, the average annual dividend rate has been above 5% consistently, which allows members' savings to grow significantly over time and can be reinvest repeatedly until retire. Folger [19] emphasized that the reinvestment of dividends, compounded over time, has a multiplier effect on members' balances, significantly bridging the gap between actual savings and retirement adequacy targets. This underscores the role of the EPF's strategic investment policy in optimizing returns while minimizing the risks which directly impact on dividend rate which represent as company's performance.

Ghadwan *et al.*, [22], also stated that consistent and higher dividends contributes to the overall financial stability of retirees will allow members to plan more effectively for retirement, and could

reduce anxiety about financial adequacy in later years. They also pointed out that higher dividend rates directly contribute to the growth of individual EPF savings which the members will benefit from compounding interest, which accelerates their savings accumulation over time.

2.3.5 Mortality rate

According to World Health Organization [64], global mortality rates have shown a declining trend, which leads to individuals living longer. This will impact retirement planning and the sustainability of pension funds such as EPF. According to KWAP [56], mortality rate and fertility rate are closely related to each other. As mortality rates rising and fertility rates declining, the shrinking of workforce were impacted. This will reduce the capital accumulation and diminished innovation potential that could threaten long-term economic growth and competitiveness.

Research by Brown and Warshawsky [9] highlighted the importance of regularly updating mortality assumptions in actuarial models from time to time due to the improvements in healthcare and living conditions. Their analysis showed that failing to adjust the contribution rates in response to declining mortality rates could lead to underfunding issues in the EPF schemes since the golden period will be lengthen from time to time. It will be more challenging as the retirement age is still 60 years old in Malaysia, but the mortality rate tends to decline throughout the years. Singapore, as one of the aging countries has raised its retirement age from 63 to 64 in 2026 [5]. Raising the retirement age and adjusting benefit formulas are among necessary steps to ensure the sustainability of EPF schemes [38]. As Malaysia is a country toward an aging country, the policymakers may need to do some adjustment to account for longer retirement periods.

2.3.6 Population age above 60 years old

According to Mohd *et al.*, [47], as Malaysia toward an aging country, with an increasing population of elderly by 2030, more individuals will reach retirement age and withdraw their EPF savings. This can lead to stress on the fund's resources and potentially affect its sustainability. This situation will burn out resources away from other essential security programs, including the EPF's fund. The same goes to the study by KWAP [56] that stated the senior group is predicted to increase up to 20% by 2040, subsequently transforming Malaysia into an aged nation. This demographic shift poses significant challenges to fiscal health, economic productivity, and sustainability.

According to Bertocchi stated that a declining workforce due to lower fertility rates, combined with longer life expectancy, increases the burden on the working population to fund pensions for a growing number of retirees. This shift also creates a financial strain on pension systems, as fewer workers must support an increasing retiree population, potentially requiring reforms to maintain sustainability. However, another study by Schmillen recommended an increase in retirement age since the population tends to live longer. This can help the enhancement of the average EPF balances at retirement despite shortening the period after retirement. This is one of the initiatives that had been approved and implemented by developed countries. For example, Singapore has increased the retirement age from 63 to 64 and the reemployment age also increased from 68 to 69.

2.3.7 Nominal gross domestic product

Nominal gross domestic product (GDP) is also one of the factors that may affect the retirement fund amounts. According to Johnson and Smith (2021), higher nominal GDP will improve economic growth which leads to better funding of the provident pension funds through higher investment returns and larger contributions from both employers and employees. Chen and Yang [11] has discovered a positive relationship between nominal GDP growth and pension fund investment returns. This indicates that strong economic growth improves the financial health of retirement funds. The relationship between contribution rates and nominal GDP might help to retain the balance of contributions and payouts to ensure long-term fund stability.

According to Martinez and Lopez [43], contribution rates need to be adjusted to ensure the retirement fund's feasibility. This is to ensure that the fund can be capitalized to cover retirees' future financial demands, reducing the risks associated with rising lifespan and demographic shifts. In addition, Morina and Grima [48] found that a growing nominal GDP facilitates an increase in average wages, which directly impacts the EPF contributions. As wages rised in line with the economic growth, the absolute amount of EPF contributions increases, strengthening the retirement savings base.

3. Methodology

The objective of this study is to examine the significance of the determinants of EPF's balance. This study will also examine the existence of short and long-run relationships between independent and dependent variables. A more detailed explanation of the methodology is further discussed below.

3.1 Data Collection

This study focuses on the economic and demographic factors that are expected to give an impact on the dependent variable, EPF balance. Historical data from 2001 to 2022 is used in this study. It is expected to investigate the relationships between EPF balances and the selected determinants, which are nominal gross domestic product (GDP), inflation rates, exchange rates, life expectancy, dividend rate, population above 65, and Malaysia's mortality rate. Data are retrieved from 3 different sources. The Department of Statistics in Malaysia's website provides the annual data on nominal gross domestic product (GDP), while the World Bank's website provides information on life expectancy, inflation, exchange rates, population above 65 years old, and mortality rates. On the other hand, Information regarding the EPF balance and dividend rates were extracted from the annual report. In addition, EPF balance data collected only consider those 55 years old who are nearly retirement age.

Table 1

Summarizes the key variables used in the study, and years

VARIABLES	ACRONYM	DATA SOURCES	YEARS
EPF Balance	BALEPF	EPF Annual Report	2001-2022
Dividend Rate	DIV	EPF Annual Report	2001-2022
Nominal Gross Domestic Product	GDP	Department of Statistics Malaysia (DOSM)	2001-2022
Population Above 60 Years Old	POP60	World Bank Data	2001-2022
Life Expectancy	LIFEXP	World Bank Data	2001-2022
Mortality Rate	MORT	World Bank Data	2001-2022
Inflation Rates	INFL	World Bank Data	2001-2022
Exchange Rates	EXCG	World Bank Data	2001-2022

3.2 Unit Root Test

According to Fowler *et al.*, [20], the Augmented Dickey-Fuller (ADF) test is a useful method in time series analysis for determining whether a dataset is stationary or not. Stationarity is a critical criteria in many econometric models since it ensures that a time series' statistical features, such as mean and variance, are consistent throughout time. Non-stationary data might produce misleading results and misconceptions in regression analysis [17].

By using the ADF test, researchers are able to identify whether data transformation, such as differencing or detrending, is necessary to achieve stationarity [25]. This process ensures the reliability of the analysis and strengthens the validity of the results, making the ADF test an essential step in regression analysis.

3.3 Cointegration, Long and Short Run Relationship

According to Gianfreda *et al.*, [23], running a cointegration test, along with analyzing short-run and long-run relationships, after performing an Augmented Dickey-Fuller (ADF) test is crucial in time series analysis to ensure proper model specification and accurate interpretation of the relationships between variables. Various methods can be used to determine the presence of cointegration and long-run relationships. However, the methods used depend on the results of the Augmented Dickey-Fuller (ADF) test, which is typically related to the stationarity of the variables. For example, if the variables are non-stationary but become stationary after differencing which resulted that all of the variables integrated of order 1, $I(1)$, cointegration tests such as the Engle-Granger or Johansen tests can be applied to determine the existing of a long-run equilibrium relationship between the variables [16].

Similar goes for short-run relationships test, where various tests that can be used to determine the short-run relationship such as vector autoregressive (VAR), Johansen test, Granger causality test, and Error Correction Method (ECM). These tests also depends on the stationarity test and long-run test used. For example, Autoregressive Distributed Lag (ARDL) is primarily used for examining long-run relationships. However, after the bounds test for cointegration, the ARDL model can be extended to an ECM to analyse short-run relationships [24]. This method has been approached by the study which explores the long-run relationship between energy consumption and economic growth in Malaysia using the ARDL bounds testing approach followed by ECM analysis to analyse the short-run dynamics and the speed of adjustment towards equilibrium [32].

The following model will be used in this stepwise regression:

$$BALEPF = \beta_0 + \beta_1 DIV + \beta_2 GDP + \beta_3 POP65 + \beta_4 LIFEXP + \beta_5 MORT + \beta_6 INFL + \beta_7 EXCG + \varepsilon$$

BALEPF = EPF Balance

DIV = Dividend Rates

GDP = Nominal Gross Domestic Product

POP65 = Population 65 years and above

LIFEXP = Life Expectancy

MORT = Mortality Rates

INFL = Inflation Rates

EXCG = Exchange Rates

β_i = Variables' Coefficient

ε = error term

4. Results and Discussions

This section discussed the results of study of the analysis.

4.1 Descriptive test

Table 2
Descriptive table

	MEAN	MEDIUM	MAXIMUM	MINIMUM	STD DEV.
LNBALEPF	19.945	19.962	20.759	18.91	0.581
INFL	2.110	2.059	5.441	-1.139	1.383
LNGDP	13.675	13.755	14.4	12.773	0.491
EXCG	3.728	-3.800	4.401	3.06	0.415
LIFEXP	74.737	74.815	76.26	73.344	0.8
MORT	7.032	7.000	8.1	6.7	0.3
POP65	5.522	5.301	7.503	4.185	1.011
DIV	5.528	5.675	6.75	4.25	0.722

Table 2 above shows the descriptive statistics for eight key variables of the study which are LNBALEPF (log of Balance of Payments), INFL (inflation), LNGDP (log of GDP), EXCG (exchange rate), LIFEXP (life expectancy), MORT (mortality rate), POP65 (population aged 65 and older), and DIV (dividends). Descriptive statistics are methods used to summarize and explain the main features of a dataset. It makes data easier to understand by organizing it in a simple manner. Descriptive statistics could provide an overview that can guide additional research or decisions. These metrics provide foundational insights into the dataset's central tendencies and variability, which are crucial for identifying patterns and assessing the reliability of the data [18].

The average of LNBALEPF is 19.945, with a relatively narrow range from 18.91 to 20.759 and a standard deviation of 0.581. This indicates that EPF balances are consistently distributed among the observations. According to Gujarati [24], a low standard deviation in financial data often reflects stability in the variable, which in this case could indicate consistent savings behaviour among individuals.

The mean inflation rate INFL of 2.110%, with a higher standard deviation of 1.383, suggests substantial variability over time. Periods of both deflation (-1.139%) and heightened inflation (5.441%) are observed. This indicates the variability in inflation rates throughout the period which can significantly affect the purchasing power of savings, as noted by Blanchard (2018), who emphasized the critical role of inflation in economic stability and its implications for financial planning.

The log of GDP (LNGDP) shows a mean of 13.675 and a small standard deviation of 0.491, indicating a relatively stable economic growth trend. Stability in GDP growth is often associated with predictable investment returns, as noted by Barro and Sala-I-Martin [4], who highlight GDP as a key indicator of economic health and its impact on financial variables.

With a mean of 3.728% and a standard deviation of 0.415, exchange rate growth demonstrates low variability. This stability could contribute to consistent financial forecasting and planning which promotes economic predictability and risk management Dornbusch *et al.*, [15].

The mean life expectancy (LIFEXP) of 74.737 years, with a narrow standard deviation of 0.8, suggests steady demographic trends. Bloom *et al.*, [7] note that life expectancy trends are crucial for retirement planning, as longer life expectancies necessitate larger retirement savings to sustain financial security.

The average mortality rate (MORT) is 7.032 per 1,000 individuals, with minimal variability (SD=0.3). This stability aligns with findings from Preston *et al.*, [55], who state that steady mortality rates are indicative of stable health outcomes within a population. So the people with live longer and need an adequate fund throughout the longer term.

The proportion of individuals aged 65 and above (POP65) shows a mean of 5.522% and a standard deviation of 1.011, reflecting moderate variability. According to Lee and Mason [37], this trend underscores the increasing aging population's potential implications for retirement savings and policy planning.

The mean dividend rate (DIV) is 5.528%, with moderate variability (SD=0.722). Consistent dividend payouts are critical for compounding growth in retirement savings, as noted by Gates *et al.*, [21], who highlight the role of financial returns in enhancing fund performance.

4.2 Correlation Matrix

Table 3

The relationship between various economic and demographic variables

	LNBALEPF	INFL	LNGDP	EXCG	LIFEXP	MORT	POP65	DIV
LNBALEPF	1							
INFL	-0.076	1						
LNGDP	0.993	0.012	1					
EXCG	0.411	-0.197	0.346	1				
LIFEXP	0.956	-0.090	0.953	0.411	1			
MORT	-0.736	-0.112	-0.760	-0.006	-0.712	1		
POP65	0.967	-0.118	0.944	0.564	0.923	-0.635	1	
DIV	0.529	0.091	0.565	-0.216	0.464	-0.423	0.368	1

A correlation matrix displays correlation coefficients for pairs of variables, showing how closely related the variables are. Each cell in the matrix contains a value ranges from +1 to -1 which represents the correlation coefficient. A value of -1 and +1 indicates a perfect negative and positive correlation respectively while 0 indicates no correlation at all.

Based from Table 3, it shows the relationship between various economic and demographic variables. LNBALEPF has strong positive correlations with LNGDP, LIFEXP, and POP65 which are 0.9929, 0.9556, and 0.9670 respectively. This indicates that improvements in GDP, life expectancy, and the elderly population are associated with increased balance of payments. In contrast, LNBALEPF has a significant negative correlation with MORT which is -0.7364, suggesting that higher mortality rates lead to a decrease in the balance of payments. The sign of each of correlation discussed are similar with previous study that indicate these variables show the same impact on the EPF balance [27].

INFL does not show any difference with negative correlations with most variables, with its strongest negative relationship being with EXCG which is -0.197, implying that higher inflation is weakly associated with lower exchange rates. Inflation disproportionately affects older individuals as they often have limited income flexibility. Health and living expenses tend to rise with age, worsening the issue [39]. On the other hand, LNGDP maintained shows strong positive correlations with all of the other variables except with MORT reflecting that higher GDP leads toward a positive impact but suggesting that economic growth tends to reduce mortality rates.

The dividend rates have a positive relationship with EPF balance which is 0.529. According to Morina and Grima [48], economic growth positively impacts pension fund asset investment, suggesting a potential link between higher GDP and increased dividend returns. Despite its relevance, this factor has not been the subject of dedicated studies with the other variables in this study, leaving a gap in the literature that could provide valuable insights into the sustainability and effectiveness of EPF savings.

Overall, this correlation matrix answer the first objective of the study which provides an overview of the linear relationships between these economic and demographic variables, highlighting key associations that could be further explored in a more detailed analysis.

4.3 ADF test

Augmented Dickey-Fuller (ADF) test is a statistical test used to check if a time series set of data is stationary or non-stationary. Stationary data indicates that the statistical properties of the series, such as the mean and variance, do not change over time while non-stationary data indicates that the statistical properties change over time. The presence of unit root would indicate that the time series is non-stationary.

The hypothesis testing for ADF test are follows:-

- Null Hypothesis (H_0): The series has a unit root (non-stationary).
- Alternative Hypothesis (H_1): The series does not have a unit root (stationary).

When the series is stationary, the null hypothesis can be rejected which indicates the absence of a unit root. ADF test also helps ensure that the data forecasted are reliable. However, if the ADF test indicates that the data is non-stationary, additional steps need to be taken to transform to stationary before proceeding with the analysis. Table 4 below shows the result of the stationarity test by using the Automated Dickey-Fuller test.

Table 4

Result of the stationarity test by using the Automated Dickey-Fuller test

Variable	ADF		Conclusion
	Level	First difference	
Lnbailepf	-0.0311 (0.8084)	-3.7364 (0.0433)*	I(1)
Excg	-0.1429 (0.2560)	-3.4165 (0.0074)*	I(1)
Infl	-4.2743 (0.0148)*	-	I(0)
Lifexp	-5.4581 (0.0013)*	-	I(0)
Lngdp	-0.3018 (0.0622)	-4.7080 (0.0071)	I(1)
Mort	-8.8385 (0.0000)*	-	I(0)
Pop65	-0.0261 (0.1191)	-2.3973 (0.0283)*	I(1)
Div	-2.1869 (0.4719)*	-5.3095 (0.0023)*	I(1)

Note: Figures in the parentheses are p-values. * shows the null is rejected at the five percent level of significance

The results of the ADF test in Table 4.3 above show that INFL, LIFEXP, and MORT are stationary at the level (I(0)), while LNBALEPF, EXCG, LNGDP, DIV, and POP65 become stationary after the first differencing (I(1)). This differentiation between I(0) and I(1) variables is crucial for further econometric analysis, such as determining the appropriate models for cointegration testing. This result is literally different from previous study which all of the variables are stationary at first level form of differencing, I(1), [27]. This may be due to different sets of data were used in this study.

4.4 Cointegration and Long Run Relationship

Due to the different result outcomes of the stationary test, this study used another approach to test the cointegration and long-run relationship of the variables. This study employs an alternative method, the autoregressive distributed lag (ARDL) approach, to analyze the data and investigate the relationships between variables. The ARDL method is used in this study to determine the long-run relationship of the variables due to its ability to include variables integrated at different orders, specifically I(0) and I(1).

Table 5

Relationship between independent variables and dependent variables

F-Bound Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif	I(0)	I(1)
Asymptotic: n=100				
F-statistics	29.46388	10%	1.92	2.89
k	7	5%	2.17	3.21
		2.5%	2.43	3.51
		1%	2.73	3.9

As in Table 5 above, the cointegration exists, since the value of 29.46388 exceeds the critical value of 5%, 3.21 in the F-test. This means that the independent variables have a long-run relationship with the dependent variable.

On the other hand, Table 6 below show the long-run relationship between independent variables which are dividend rate, exchange rate, inflation rate, life expectancy, gross domestic product (GDP), mortality rate and, population age above 65 and dependent variables, EPF balance:-

Table 6
Long-run relationship between independent variables

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DIV	0.065228	0.013930	4.682398	0.0016
EXCG	0.062048	0.014944	4.151961	0.0032
INFL	-0.023144	0.004561	-5.074690	0.0010
LIFEXP	-0.000846	0.020425	-0.041430	0.9680
LNGDP	0.733592	0.064535	11.36730	0.0000
MORT	-0.167088	0.022050	-3.210140	0.0124
POP65	0.084777	0.033167	2.556065	0.0339
C	10.07864	1.733966	5.812475	0.0004

The Table 6 above shows that the Dividends (Div) have a positive and significant impact, with a coefficient of 0.0652, indicating that a one-unit increase in dividends leads to a 6.52% increase in the dependent variable. This finding was parallel with the previous by Mohd and Ismail [10] and according to them, consistency out performance of the EPF dividends relative demonstrates how higher dividend rates can lead to substantial increases in members' retirement savings over time.

Similarly, the exchange rate (Excg) also has a positive long-run effect, with a coefficient of 0.0620, showing that an increase in exchange rates contributes to a 6.20% rise in the dependent variable. According to Madura [41], the relationship between exchange rates and financial variable such as investments is also positive and significant. Conversely, inflation (Infl) has a negative and significant impact, where a one-unit increase in inflation causes a 2.31% decrease in the dependent variable. According to the previous study by Madukwe and Okeke [52] the result in Nigeria also has a negative impact which an increasing in inflation rate could lead to the decrease in purchasing power. However, both studies admitted that inflation and exchange rate gave a negative impact to the performance company including pension institute since it is related to investment returns which lead to poor performance of the company.

The analysis also highlights that GDP (Lndgp) is a crucial driver, with a coefficient of 0.733592, suggesting that one-unit increase in GDP results in a substantial of 73.36% increase in the dependent variable, making it the strongest factor in the long run. According to The Star Online [61], Malaysian EPF highlighted the impact of GDP growth on its performance. For example, Budget 2024 includes measures such as incentives for retirement savings and expanding programs such as i-Saraan and i-Sayang, demonstrating a link between economic growth, resource allocation, and retirement security [60]. The EPF anticipates that GDP-driven investment inflows and business confidence will further strengthen retirement contributions and financial sustainability for EPF's members.

In this study, the coefficient for POP65 is positive and significant, suggesting that an increase in the proportion of the elderly population is associated with a rise in the dependent variable. However, earlier studies resulted a negative impact, suggesting that an aging population burdens public resources, reduces labor force participation, and lowers economic productivity [7]. According to Lee and Mason [37], the positive relationship may reflect the growing economic participation of the

elderly, supported by policies encouraging post-retirement employment or increased financial contributions from aging populations in developed or rapidly developing economies.

Life expectancy (LIFEXP) on the other hand, shows an insignificant effect, which had a negative impact, often linked to higher healthcare and pension costs, reducing resources for productive investment. Due to the strong healthcare systems and economic stability in Malaysia, the higher cost of healthcare expenses for the elderly leading to the negative impact of rising life expectancy.

Similar with mortality rate (MORT) which has a negative and significant relationship, consistent with previous findings by Islam *et al.*, [31]. This is also supported by another study of Rocco *et al.*, [57], stated that a decline in mortality rates often correlates with improved health standards and productivity, potentially fostering economic growth.

In conclusion, variables such as Div, Excg, Infl, Lndgp, Mort, And Pop65 exhibit significant long-run relationships, with GDP showing the strongest positive impact, while mortality has a significant negative effect. Life expectancy, however, does not significantly influence the dependent variable in the long run. This result answer the second objective of the study which provides the long run relationship of the independent variables with the dependent variable.

4.5 Short Run Relationship

Table 7

Estimation results

Variable	Coefficient	Std. Error	t-Statistic	Probability
Div	0.027468	0.002581	10.64258	0.0000
Infl	-0.003390	0.002581	-3.040923	0.0160
Pop65	0.800225	0.029098	27.50078	0.0000
CointEq(-1)	-0.857192	0.037222	-23.02932	0.0000

The estimation results reveal important short-run relationships and a strong long-run adjustment mechanism. According to previous study by Hassan [27], only 2 variables have short run relationship with the dependent variable that are mortality rate and population age above 65.

However, in this study, dividends (Div) have a positive short run relationship and highly significant impact on the dependent variable, with a coefficient of 0.027468. According to Chek and Ismail [10], this may be due to directly contribute to the growth of individual retirement accounts. In the short run, dividends act as additional income that compounds within the account, boosting balances quickly. This immediate effect reflects how higher or more frequent dividends enhance savings growth. Moreover, participants tend to reinvest dividends, leveraging compounding effects, which further increases the account balance [22]. This relationship emphasizes the role of dividends in ensuring robust retirement fund growth towards financial security for retirees.

Inflation (Infl), on the other hand, has a negative and significant effect on EPF balance. According to Rauf et al., (2024), this may be caused by high inflation that reduces the real value of savings as the cost of goods and services rises faster than the returns from investments. For example, if the inflation rate exceeds the returns on EPF investments, members' purchasing power diminishes over time, impacting retirement adequacy.

One of the most remarkable findings is the influence of the population aged 65 and above (Pop65), which has a very large positive effect, with a coefficient of 0.8002. The coefficient of the elderly population has a significant change from positive to negative sign may be due to different sets of data were used in this study. According to World Bank Group [29], this might be caused by older populations often prioritizing retirement savings and seeking financial security. This could lead to increased contributions to savings funds, such as EPF, as well as investments in income-generating

assets. The shift in the elderly population's impact from negative to positive on EPF balances over a decade and may result from improved economic factors, such as better GDP and dividend rates boosting fund growth [33]. Changes in variables included such as inflation and exchange rates capture modern dynamics. Additionally, EPF policy reforms and a better fund management likely would enhance sustainability, offsetting the strain of aging demographics. These factors collectively explain the positive relationship seen today as compared to the past.

In conclusion, this result also answer the second objective of the study which provides the short run relationship of the independent variables with the dependent variable.

5. Conclusion

In conclusion, this study explored the factors influencing the Employees Provident Fund (EPF) balance in Malaysia, incorporating variables such as GDP, inflation, life expectancy, mortality rate, population aged 65 and above, exchange rates, and dividend rates. Through a detailed analysis, the findings effectively addressed the first research question delving into the relationship of the independent variables and EPF balance. The analysis identifies the cointegration of a long-run relationship by using the Autoregressive Distributed Lag (ARDL) approach. A similar goes to the short-run analysis by using the Error Correction Method (ECM) which indicates that DIV, INFL, and POP65 have a short-run relationship. This determines the second of the research question.

Recommendations from this study emphasize the urgent need for policymakers to focus on sustainable economic growth and consistent dividend strategies to bolster the EPF balances. Additionally, rising life expectancy and aging population trends call for an enhancement retirement planning policies such as minimum retirement age to address the growing financial pressures on the EPF system.

However, this research is subject to certain limitations. The dataset was limited to specific variables, potentially excluding other critical factors impacting EPF balances. Future studies should expand the scope by incorporating broader datasets and alternative variables, such as financial literacy levels or savings behaviour. Furthermore, employing additional statistical techniques could also offer deeper insights into the short and long-term relationships between variables.

This study provides a better understanding of the factors affecting EPF balances in Malaysia, as a guide for policymakers and stakeholders in ensuring the adequacy and sustainability of retirement funds, especially among old age.

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