



Demographic Determinants of Population Ageing in Indonesia

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Abstract. The increasing ageing population has become a major global issue impacting developed and developing nations, including Indonesia. This study aims to analyze the demographic determinants of ageing population in Indonesia, specifically examining the effects of total fertility rate (TFR), life expectancy, and net migration. Using time series data from 1985 to 2021, the research explores how these variables influence the proportion of individuals aged 65 and above. Multiple linear regression was employed to identify the relationships between the variables and the ageing population. This study found that declining TFR and increasing life expectancy are Indonesia's primary drivers of population ageing. The reduction in TFR has resulted in fewer births, leading to a shrinking younger population and an increasing proportion of elderly individuals, thus creating an imbalance in the population structure. Rising life expectancy, supported by advancements in healthcare and living conditions, has further contributed to this demographic shift by enabling people to live longer. Conversely, net migration has an insignificant impact on population ageing, as its scale and influence are too small to affect Indonesia's demographic composition. These findings highlight the need for policymakers to address the socio-economic challenges of an ageing population, particularly regarding healthcare, pensions, and labour force sustainability.

Keywords: Ageing Population, Total Fertility Rate, Life Expectancy, Migration.

1 Introduction

The age structure of a population evolves as it undergoes a demographic transition, typically occurring in three stages. In the first stage, often called the Malthusian stage, high birth and death rates result in minimal population growth, as the high mortality offsets the high fertility [1]. In the second stage, a decrease in fertility leads to a slower population growth rate, although growth remains positive. Finally, in the third stage,

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E. P. Kusumah and Y. Yanto (eds.), *Proceedings of the 1st International Conference of Economics, Management, Accounting, and Business Digital (ICEMAB 2024)*, Advances in Economics, Business and Management Research 311, https://doi.org/10.2991/978-94-6463-614-7_19

increased life expectancy leads to a significant rise in the elderly population, while low fertility slows the expansion of the working-age population.

The global population is undergoing a significant transformation in age structure as people live longer and the proportion of older individuals proliferates. By 2050, every country will see an increase in the percentage of its population aged 60 and above [2]. The number of centenarians worldwide is projected to double by 2030, with an estimated 3.4 million centenarians expected by 2050 [2]. Population ageing presents numerous societal and policy challenges. This demographic shift risks reducing labour force participation and savings rates, increasing healthcare costs, and placing pressure on pension and healthcare systems. The growing incidence of noncommunicable diseases, which disproportionately affect the elderly, raises concerns about whether the additional years from increased longevity will be spent in poor health [3]. Additionally, living arrangements for the elderly need careful consideration, as declining workforce participation and increased healthcare demands may hinder economic growth [4]. Population ageing is not uniformly experienced across the globe, nor is it consistently observed within individual nations. As noted by the World Bank [5], Eastern and South-eastern Asia contributed the largest share of the global ageing population in 2019, 37%, with projections showing continued growth through 2050. In contrast, countries such as Western Asia, Northern Africa, and Sub-Saharan Africa are experiencing more modest increases in their elderly populations, with these regions seeing rises from 4% to 6% and 5% to 7%, respectively.

Previous research highlights that declining fertility and increasing longevity during demographic transitions are key drivers of population ageing. Reduced fertility leads to fewer young individuals, resulting in smaller cohorts of the working-age population as low birth rates persist over time [6]. Even with constant longevity, lower fertility leads to a higher Old-Age Dependency Ratio (OADR) and may increase the resource burden on society. Additionally, rising life expectancy contributes to population ageing by increasing the number of older individuals who survive to advanced ages. However, if increased longevity is accompanied by improved health and productivity among the elderly, the economic strain of an ageing population may be mitigated [7]. Migration also influences age structure in open economies, as immigrants are typically younger and of working age. Thus, changes in immigration policy have been proposed as a potential solution to alleviate the challenges posed by population ageing.

While numerous studies have examined population ageing globally, limited research specifically addresses the demographic factors driving population ageing in Indonesia. Most existing studies focus on fertility rates and life expectancy separately, often overlooking the combined impact of these variables alongside migration patterns on the ageing population. Additionally, while migration is acknowledged as influencing demographic shifts in many countries, its role in shaping population ageing in Indonesia remains underexplored. This research seeks to fill these gaps by investigating how Total Fertility Rates (TFR), life expectancy, and net migration collectively contribute to the ageing population in Indonesia. The study aims to provide a comprehensive analysis of these demographic determinants and their significance in the context of Indonesia's unique socio-economic environment. This study offers crucial insights into the demographic factors driving population ageing in Indonesia, an issue that poses significant

challenges to healthcare, social services, and labour force sustainability. By identifying key drivers such as fertility rates, life expectancy, and migration, the research aims to support policymakers in addressing the socioeconomic implications of an ageing population. Additionally, it contributes to the broader demographic literature by examining the understudied relationship between migration and ageing in Indonesia, providing a foundation for informed policy strategies.

2 Methods

This study utilizes a quantitative research methodology to examine the factors influencing the aging population in Indonesia. The analysis is based on secondary data from The World Bank Group, covering the period from 1985 to 2021 (37 years). Data on the proportion of individuals aged 65 and older as a percentage of the population [8] were used to assess the aging population. Fertility rates were evaluated using total fertility rate data (births per woman) [8], while life expectancy was measured through life expectancy at birth (in years) [8]. Additionally, net migration was calculated as the difference between the number of immigrants and emigrants, encompassing both citizens and noncitizens [9]. This research employed multiple linear regression to evaluate the impact of various factors. The regression model is presented as follows:

$$AP_i = \beta_0 + \beta_1 TFR + \beta_2 LE + \beta_3 NM + \varepsilon$$

Note. AP (Ageing Population); TFR (Total Fertility Rates); LE (Life Expectancy); NM (Net Migration); β_0 (Constant Value); and $\beta_1, \beta_2, \beta_3$ (Regression Coefficient); ε (Error Standard (5%)).

The total fertility rate (TFR) is expected to have a negative effect on the ageing population (AP), as lower fertility rates reduce the number of young individuals entering the population, thereby increasing the proportion of older individuals. Life expectancy (LE), on the other hand, is projected to positively affect the ageing population, as improvements in healthcare and living conditions lead to longer lifespans, increasing the share of elderly individuals within the population. Similarly, net migration (NM) is also expected to have a negative effect on the ageing population, as negative net migration (more emigrants than immigrants), particularly among younger individuals, reduces the working-age population and leaves behind a higher proportion of elderly individuals, thus accelerating the ageing of the population.

3 Results and Discussions

3.1 Results

This study highlights the complex interplay between fertility rates, life expectancy, net migration, and the ageing population. The data for each variable spans from 1985 to 2021, with the results of the descriptive analysis presented in Table 1.

Table 1. Descriptive Statistics

Variables	Mean	Std. Dev	Min	Max	Skewness	Kurtosis
Ageing Population	5.247	0.939	3.805	6.78	-0.885	1.678
Total Fertility Rate	2.654	0.394	2.175	3.711	1.091	3.323
Life Expectancy	66.611	2.670	61.307	70.518	-0.442	2.093
Net Migration	-34.761	43.478	-108.492	37.447	-0.247	2.001

The descriptive statistics (Table 1) reveal notable demographic trends in Indonesia from 1985 to 2021. The ageing population, represented by the percentage of individuals aged 65 and above, has steadily increased, with a mean of 5.25% and a range of 3.81% to 6.78%, reflecting the growing proportion of older individuals in the population. The total fertility rate has gradually declined, averaging 2.65 births per woman, with values ranging from 2.18 to 3.71, consistent with the trend of decreasing fertility as countries develop. Meanwhile, life expectancy at birth has improved significantly, with an average of 66.61 years, increasing from 61.31 to 70.52 years, highlighting advancements in healthcare and living conditions. In contrast, net migration presents more variability, with a mean of -34.76, indicating that more people have emigrated than immigrated to the country during this period.

Before conducting the regression analysis, the researcher performed several classical assumption tests, including normality, multicollinearity, and heteroskedasticity assessments. Based on the Shapiro Francia W' Test, the p-values of all variables are greater than 0,05, indicating that the residuals of these variables are approximately normally distributed. Furthermore, the Variance Inflation Factors (VIF) and tolerance values suggest no multicollinearity problems, with all VIF values below 10 and tolerance levels above 0.1. The Breusch-Pagan Test results also show no evidence of heteroskedasticity, as the p-values are all greater than 0.05, indicating constant variance across the residuals. Additionally, the Durbin-Watson test shows no signs of autocorrelation, with a value of 1.985, which is higher than the upper bound ($dU = 1.7232$) for a sample size of $n = 37$ and $k = 4$ variables, indicating that there is no autocorrelation present in the model.

Table 2. Multiple Linear Regression

Ageing Population	Coefficient	Std. Error	T	P-Value	Prob>F	R-Squared
Constant	-6.692	4.158	-1.61	0.117	0.000	0.933
Total Fertility Rate	-3.614	1.551	-2.33	0.026		
Life Expectancy	0.178	0.063	2.83	0.008		
Net Migration	0.002	0.001	1.41	0.169		

The multiple linear regression analysis shows a constant value of -6.692, indicating that when TFR, life expectancy, and net migration are zero, the ageing population is 2.067. The regression coefficients for TFR, life expectancy, and net migration are -3.614, 0.178, and 0.002, with corresponding p-values of 0.026, 0.008, and 0.169. This suggests

that a 1-point decrease in TFR increases the aging population by 3.614, while a 1-point increase in life expectancy and net migration raises the aging population by 0.178 and 0.002, respectively. Furthermore, the analysis of the coefficient of determination shows an R Square value of 0.933, meaning that TFR, life expectancy, and net migration can explain 93.3% of the variation in the aging population. The remaining 6.7% is influenced by other factors not included in this study. It can be concluded that TFR has a negative and significant effect on the aging population (H1 accepted), while life expectancy has a positive and significant effect (H2 accepted). However, the relationship between net migration and the aging population is insignificant, meaning net migration does not affect the aging population in Indonesia (H3 rejected).

3.2 Discussions

The Effect of Total Fertility Rates on Ageing Population in Indonesia

The research indicates a significant decline in Indonesia's TFR from 3.711 in 1985 to 2.175 in 2021, with an average of 2.654. This decline contributes to a growing elderly population due to the lower birth rate. The regression analysis shows a negative relationship between TFR and the aging population, where a one-unit decrease in TFR increases the aging population by 3.614 points. TFR has a statistically significant impact on this relationship. A decline in TFR means fewer children are born, which reduces the proportion of younger individuals in the population. Over time, this demographic shift leads to an increase in the proportion of elderly individuals as the existing population ages, and there are fewer young people to offset the growing number of older adults. This demographic transition is a well-documented trend in many countries experiencing declining birth rates, where the population structure shifts towards an older demographic, leading to a rise in the percentage of the population aged 65 and above. A sustained decrease in fertility rates alters the age distribution and influences the overall dependency ratio, with more elderly individuals reliant on a shrinking working-age population. This imbalance can lead to socio-economic challenges, such as increased demand for healthcare, pensions, and social services for the elderly, while fewer younger individuals contribute to economic productivity. In Indonesia, this trend may be exacerbated by improvements in life expectancy, further increasing the proportion of elderly in the population. This finding aligns with previous studies by Ching Yuen Luk [10], and Gietel-Basten et al. [11], who also demonstrated that declining fertility rates contribute substantially to accelerating population ageing. As fertility rates decrease, fewer young individuals enter the population, leading to a higher proportion of older individuals. This trend reinforces the established demographic transition theory, highlighting fertility rates as a key factor in shaping population age structures.

The Effect of Life Expectancy on Ageing Population in Indonesia

The study reveals a notable increase in Indonesia's life expectancy, rising from 61.307 in 1985 to 67.57 in 2021, with an average of 66.611. This growth has contributed to a larger elderly population, as improvements in healthcare, nutrition, and living conditions have allowed individuals to live longer. The regression analysis demonstrates a

positive relationship between life expectancy and the aging population, with a one-unit rise in life expectancy leading to an increase of 0.178 points in the elderly population. Life expectancy has a significant influence on this trend. As life expectancy rises, individuals live longer, resulting in a larger proportion of the population reaching older. This demographic shift occurs because improvements in healthcare, living conditions, and nutrition enable people to live beyond the traditional working years, thereby increasing the percentage of individuals aged 65 and above. As more people survive into older age, the aging population naturally expands, leading to a higher proportion of elderly individuals in the overall population. Additionally, as life expectancy increases, the proportion of younger age groups tends to shrink, particularly when combined with declining fertility rates. The extended lifespan of older individuals means they remain part of the population for a longer period, contributing to the overall demographic shift towards an aging society. Our research further supports the well-established connection between life expectancy and the ageing population, an extensively examined relationship in the literature. Previous studies, such as those by Brink [12] and Chen & Zhang [7], have consistently shown that increased life expectancy leads to a higher proportion of older individuals within the population, contributing to demographic shifts where older individuals constitute a larger share of society.

The Effect of Net Migration on Ageing Population in Indonesia

The net migration data for Indonesia from 1985 to 2021 exhibits notable fluctuations. The regression analysis indicates that net migration has an insignificant impact on the ageing population, as a one-unit increase in net migrations only results in a minimal 0.002-point change with a p-value of 0.169, which does not significantly affect the proportion of elderly individuals. Therefore, net migration does not directly influence the aging population. A lower or negative net migration, where more people emigrate than immigrate, can increase the aging population. This occurs because young, working-age individuals are often more likely to emigrate, leaving behind a higher proportion of elderly individuals within the population. As a result, the overall demographic composition shifts, with a greater percentage of the population aged 65 and above. Emigration tends to reduce the younger population, which could help balance the demographic structure, contributing to a higher proportion of elderly residents. Thus, countries with negative net migration often experience a faster rate of population aging due to the outflow of younger generations. However, the findings of this study suggest that net migration does not have a significant effect on the aging population in Indonesia. The scale of migration in Indonesia is not large enough to significantly alter the population's age distribution. Additionally, the demographic profile of migrants may not be predominantly young, or the number of returning elderly emigrants might counterbalance the impact of youth emigration. Furthermore, other demographic factors, such as fertility rates and life expectancy, play a more dominant role in shaping the aging population, thus overshadowing the influence of migration. The findings of our research diverge from several prior studies that have explored the relationship between net migration and the ageing population. While previous studies, such as those by Ambrosetti [13] and Dou et al. [14], suggested that net migration could play a role in moderating the ageing population by introducing younger individuals into the demographic structure,

our study found no significant effect of net migration on the ageing population. Despite the expected influx of younger migrants, the results indicate that migration alone may not be sufficient to influence the overall ageing trend, highlighting the complexity of demographic shifts.

4 Conclusion

The ageing population is a significant global challenge that affects both developed and developing countries. This research concludes that declining TFR and increasing life expectancy are the key determinants of population ageing in Indonesia, while net migration has a negligible effect. The reduction in TFR has resulted in fewer births, leading to a shrinking proportion of younger individuals in the population and a corresponding increase in the elderly population. This demographic shift creates an imbalance, with fewer younger individuals to support a growing number of older adults, intensifying the pressure on social support systems. Concurrently, rising life expectancy, driven by advancements in healthcare, nutrition, and living conditions, has allowed more people to live longer, thereby further increasing the proportion of the elderly. Although migration could influence demographic trends by reducing or increasing the working-age population, the scale and impact of net migration in Indonesia are insufficient to alter the ageing population significantly.

Despite successfully achieving the research objectives, this study has certain limitations that warrant consideration. This study is based on historical data from 1985 to 2021, which may not fully capture the most recent demographic trends or potential policy changes impacting fertility rates, life expectancy, or migration patterns. Future research should incorporate updated data to provide a more current analysis of population ageing in Indonesia. Additionally, this study focuses primarily on the quantitative relationship between demographic variables and ageing, without considering qualitative factors such as cultural or societal shifts that may influence demographic behaviours. Future studies could explore these qualitative aspects to better understand the social drivers behind fertility and ageing trends. The minimal impact of net migration on the ageing population could be further examined by investigating specific migration flows, such as labour or return migration among older individuals, to understand their demographic effects better. Lastly, expanding the scope of the research to include regional variations within Indonesia could offer more nuanced insights into how different areas are affected by population ageing, guiding region-specific policy responses.

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