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Retirement Wealth Adequacy Estimation Based on Income Group Classification: A Case Study in Malaysia

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ABSTRACT

The inadequacy of retirement wealth can significantly impact a country's social support system. The increase of the size of the elderly population in line with the constant growth of life expectancy among Malaysians has triggered a question, are there enough resources to cover needs in retirement years? The main **objective** of this study is to estimate the retirement income adequacy of future retirees under a defined contribution (DC) plan, which is the Employee Provident Fund (EPF). The projection of retirement income adequacy uses cross-sectional data from the Malaysian Household Income Survey (HIS) 2014, based on 14,169 sample households. The households are categorized according to three different income groups, including Top 20% (T20), Middle 40% (M40) and Bottom 40% (B 40). In addition, this research also investigates the demographic and socio-economic determinants of retirement wealth adequacy using OLS and logistic regression. The result shows that 26% of households in the sample have inadequate retirement income, especially households in the B 40 group.

Keywords: welfare; retirement; income; regression; income group

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ОРИГИНАЛЬНАЯ СТАТЬЯ

Определение достаточности пенсионного обеспечения в Малайзии на основе классификации групп по уровню дохода

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АННОТАЦИЯ

Недостаточный уровень пенсионного обеспечения может значительно повлиять на систему социальной поддержки в государстве. Увеличение численности пожилого населения в соответствии с постоянным ростом продолжительности жизни среди малазийцев поставило вопрос о достаточности ресурсов для обеспечения потребностей людей в пенсионном возрасте. Основной **целью** данного исследования является определение адекватности размера пенсионных взносов в Фонд обеспечения работников (EPF) удовлетворению потребностей будущих пенсионеров. Для прогноза достаточности пенсионного обеспечения используются кросс-секционные данные из Малазийского исследования доходов домохозяйств (HIS) 2014 г., основанные на данных 14 169 выборочных домохозяйств. Домохозяйства распределены по трем различным группам по уровню дохода, включая 20% самых обеспеченных (T20), 40% средних (M40) и 40% самых бедных (B 40). Кроме того, в данном исследовании также изучаются демографические и социально-экономические детерминанты достаточности пенсионного обеспечения с помощью метода наименьших квадратов (OLS) и логистической регрессии. Результат показывает, что 26% домохозяйств из исследуемой выборки имеют недостаточное пенсионное обеспечение, особенно это касается домохозяйств из группы B 40.

Ключевые слова: благосостояние; пенсионное обеспечение; уровень дохода; регрессия; группа по уровню дохода

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INTRODUCTION

Malaysia is predicted to become an Aging Nation prior to 2030, by which 14% of the population will be aged 60 and above.[1] This scenario has triggered our consciousness of having enough resources to support living expenses during retirement, especially in terms of wealth and income. Adequate retirement wealth is imperative to maintain the standard of living after retirement, or else the individual is forced to return to their labour force to provide a living.

The emergence of an aging population is closely associated with the mortality rate. The average mortality rate of the Malaysian population is 75 years old, according to the World Health Organization (WHO).[2] Therefore, individuals have to save enough wealth until they reach 75 years old. As for the case in Malaysia, the maximum working service in the government sector is until reaching the age of 60. In general, retirees have to survive for 15 years without their monthly salary during the working period.

Concerning the retirement system, every nation has a Multi-Pillar Pension System. It commonly includes social security, pension benefits and personal savings, and the Malaysian pension scheme is placed under Pillar 2 of the mandatory contributory component. The idea of the Multi-Pillar system is to ensure income security for older people, preventing poverty and reducing inequality.

The main objective of this study is to estimate the retirement income adequacy of future retirees under a defined contribution (DC) plan, which is the Employee Provident Fund (EPF). The projection of retirement income adequacy uses cross-sectional data from the Malaysian Household Income Survey (HIS) 2014, based on 14,169 sample households. The households are categorized according to three different income groups, including Top 20% (T20), Middle 40% (M40) and Bottom 40% (B 40). In addition, this research also investigates the demographic and socio-economic determinants of retirement wealth adequacy using Ordinary Least Square (OLS) and logistic regression.

LITERATURE REVIEW

Literature-related topics are discussed next in this section. The consumption of an individual determines retirement income adequacy after retirement. The consumption during retirement can be estimated in numerous approaches based on the previous finding by the researchers [1–5]. A number of researchers [1–3] applied the Consumer Expenditure Survey to forecast the spending for households where the dataset was used as the measure of retirement consumption. Consumption (needs) is a big part of this research since we used the wealth-needs ratio to determine retirement wealth adequacy.

According to the life cycle model, savings and assets accumulate during work-life to finance retirement needs [4]. The wealth-needs ratio is explained by the fact that wealth is the accumulated fund projected from individual work-life income divided by needs, which is the consumption of individuals after they retire. The ratio value indicates the level of adequacy of retirement wealth. If the value is equal to or greater than one, it means adequate wealth; otherwise, it is inadequate wealth if the ratio is less than one.

According to the life cycle hypothesis, individuals desire to maintain consumption over their entire lives [5]. Economic theory suggests that consumer behaviour remains the same at retirement age. Then, consumption needs can be estimated. Concerning adequate retirement wealth, the life cycle model infers that the accumulated financial resources pre-retirement is equal to or greater than the financial requirements at the point of retirement [4]. Nevertheless, the expenditure pattern might be different before and after the retirement age.

There are several approaches to estimating future retirement wealth. One of the common approaches is the replacement rate (RR). RR is derived from the pre-retirement income percentage, representing the desired consumption level during retirement. Few kinds of research have highlighted the notable set of the replacement rate range. For example, Palmer [6] suggested an adequate range ranging from 65–85% of income level, while Duncan et al. [7] proposed an adequate replacement rate between 70–90%. Unfortunately, there is no standard RR outlined to indicate the Malaysian population. A replacement rate is convenient in approximating the life cycle model's predictions for how households wish to prepare for retirement [8].

Apart from RR, another approach to estimating the retirement consumption pattern proposed by Yuh [9] used the Consumer Expenditure Survey to predict consumption among the retired individuals. On top of that, most literature used a life-cycle framework to explain the issue concerning retirement.

However, the expenditures at and in retirement are distinct prior to the retirement age [4, 10]. A summary of

[1] KWSP. (2016). Achieving a Better Future. URL: https://www.kwsp.gov.my/documents/20126/144342/Facts_at_a_Glance_2016.pdf (accessed on 27.06.2023).

[2] WHO. (2018). Mortality Rate in Malaysia. URL: https://www.who.int/ (accessed on 27.06.2023).

finding suggests that consumption in retirement is lower compared to before the retirement, thus an extensive study by Alaudin [11] which considers both optimistic and pessimistic scenarios give an inclusive measure of two different scenarios. While Caliendo and Findley [12] demonstrated the optimal level of retirement saving and other dynamic scenarios, they expressed regret for having saved too little for retirement.

METHODOLOGY

Data & Method

Cross-sectional data of Household Income Survey (HIS) 2014 was used in this study. The Department of Statistics Malaysia (DOSM) conducts HIS every five years. The HIS 2014 data is the prevailing data for this research, as HIS 2019 data has not been released until the second half of 2020. The HIS 2014 data contains 24 463 households, comprising information of demographic and socio-economic characteristics. However, the selected sample consists of 14,157 household data that satisfy the following conditions. First, working full-time provides the annual salary data with an increment rate is 6%. Second, households with members between the ages of 30 and 59 presume that those people have stable jobs. Finally, this study considers only workers paid above the poverty line (RM 11,760).

Nonetheless, the data only discloses the proportion of income for EPF contributors. The ratio of wealth from social security and other financial assets will be a limitation because of the shortage of information available. This study defines the projection of accumulated retirement wealth and retirement needs in the same model as in Alaudin et al. [13, 14].

The projection of accumulated fund (EPF) at retirement age can be calculated as follows:

$$C * S * (1+i)^n * \left(\frac{r^{n+1} - 1}{r - 1} \right), \quad (1)$$

where C is the joint contribution rates of employer and employee, S is the first annual salary, i is salary increment rate, n is future service year at the start of the working year and r is calculated as follows:

$$r = (1+d)/(1+i) \text{ and } d = i/(1+i). \quad (2)$$

The salary increment rate is reported at 6% by Bank Negara Malaysia.[3] Meanwhile, the contribution rate of EPF is assumed to be fixed at 23% as it has been used for the past ten years. An average of the past ten years' dividend rate is considered in the calculation, 6.03%, because of fluctuating dividend rate every year.

In contrast to the contribution rate and dividend rate that have set a fixed value, the withdrawal fund from EFP Account 1 and Account 2 varies, respectively, from EPF members. EPF offers up to 18 types of different withdrawals.

The chosen significant and typical withdrawal schemes are; First, withdrawal for purchasing or building the first house. Second, withdrawal for educational purposes. Third, withdrawal for medical expenses and hospital bills. Fourth, pre-withdrawal at age 50. Based on realistic assumptions and EPF annual report 2019,[4] this research focuses on the scenario of an individual withdrawing 30% from EPF Account 2 at age 31 to purchase the first house. At age 45, withdrawing another 30% for education or medical bills, and finally involving pre-withdrawal at age 50.

Alaudin et al. [14] implied two types of withdrawals: purchasing the first house at 31 and pre-withdrawing at the age of 50. However, this research includes one more realistic scenario, comprising 30% of education withdrawal at age 45. This extension seems more practical, as most parents send their children to pursue studies in higher education. With the continuous increase in education, parents indeed wish to spend more on tuition fees to ensure their children's success [15]. Malaysia and Singapore are among the countries that provide this privilege. Notwithstanding the European countries that barred education withdrawal, fast-developing Singapore also allows for education-purpose withdrawal [16].

In addition, this research also considers the i-Lestari withdrawal program introduced by the government in April 2020 due to the Covid-19 pandemic. The i-Lestari withdrawal program allows contributors to withdraw from RM50 to a maximum of RM 500 per month between 1 April 2020 and 31 March 2021 based on the amount of savings available in the Member's Account 2.[5] However, the i-Lestari withdrawal facility may also affect the adequacy of the retirement wealth of Malaysians since it reduces retirement savings.

For salary projection, all EPF members are assumed to start working at age 19 for high school graduates and at age 24 for college graduates, first degree or advanced diploma. The accumulated wealth is estimated at age

[3] Bank Negara Malaysia. (2019). Bank Negara Malaysia 2018 Annual Report & Amp; Financial Stability And Payment Systems Report (Issue March).

[4] Employees Provident Fund Board. Annual Report 2018. URL: https://www.kwsp.gov.my/documents/20126/974925/6 (accessed on 27.06.2023).

[5] EPF (2020). Frequently Ask Questions. i-Lestari. URL: https://www.kwsp.gov.my/faq-i-lestari (accessed on 27.06.2023).

60 and the total needs during retirement are discounted at age 60, as per the retirement age suggested by the Malaysian Government amendment of December 2012. According to the life cycle model postulate, an individual desires to maintain a standard of living; hence, the retirement needs can be defined as follows:

$$W = T * RR * \left[\frac{\left[1-(1+r)^{-m} \right]}{r} \right], \quad (3)$$

where W represents retirement needs, T is the expected annual salary prior to retirement, RR is replacement rate, r is estimated real interest rate from retirement age to death, m is the retirement period until death, calculated as 75 minus 60 equals 15.

The annual income of household survey 2014 is used to predict consumption during retirement. The replacement rate used is 70% which is a valued place in the range of the suggested RR by previous researchers. The real interest rate, r, is estimated using the real interest rate of 2.75%.

The wealth-to-needs ratio is defined by the following equation:

$$\frac{\text{Projection of Retirement Wealth}}{\text{Total of Retirement Needs}}. \quad (4)$$

Regression Model Specification

This paper highlights the use of the ordinary least squares OLS and Logistic Regression models to identify demographic and socio-economic determinants of retirement wealth adequacy. This research's demographic and socio-economic factors are state, sex, strata, marital status, ethnicity, education level, occupation group, employment type, income group, age, and household size. The models adopted from the general linear model [17], demonstrated as follows:

OLS regression model

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i + \varepsilon, \quad (5)$$

where y is the percentage of wealth-needs ratio, X is determinants, and β is the parameter that indicates the average change in Y that is associated with a unit change in X while controlling for other explanatory variables in the model.

Logistic regression model

$$y_i \sim B(n_i, \pi_i), \quad (6)$$

where Y is a binary variable equal to one if the household has adequate retirement wealth and zero otherwise, n_i is the binomial denominator, and π_i is the probability. The maximum likelihood estimation is used to obtain the regression estimators.

RESULTS AND DISCUSSIONS

The data profile for HIS 2014 data is shown in *Table 1*. The dispersion of samples in regions of Region 1, Region 2 and Region 3 is almost equal, while slightly higher in Region 4 and Region 5, since both regions have wide-scale areas and dense population distributions. Most of the households are male, with 88.2% who act as the family's breadwinner. Strata urban dominates by 76.6% compared to 23.4% in rural areas. A significant majority (84.8%) are married, and more than half (69.1%) are Bumiputera. For education proportion, 55% of the sample are high school graduates (SPM, SPMV, PMR/SRP), college graduates are 16.5. In comparison, higher-level education (degree and advanced diploma) is 14.1% and 14.4% of households with no certificate, respectively.

A large portion of the B 40 group represents 55.9% of the total sample, indicating that more than half of Malaysians people earn less than RM 52,320 annually, followed by the M40 (33.1%) and a few samples of the T20 group of 11.1%. *Table 2* highlights the proportion of households according to different income groups for region, strata and education level. The determinants of the region, strata and education level are significant in explaining retirement wealth adequacy [14]. Moreover, the data distribution by income group provides a clear picture of the income groups divisions.

Table 2 shows that most B 40 comes from Region 5 (Sabah & Sarawak). This situation is reasonable since Region 5 is a less developed region than other regions. Meanwhile, most M40 and T20 income groups are from Region 4 (P. Pinang, Selangor, K. Lumpur, Putrajaya). The households in Region 4 generate higher income than other regions, as the primary economic sector is manufacturing industries that offer higher salaries. In addition, the administration centre is located in this region.

Furthermore, the percentage of households living in urban areas is greater for all income groups. Besides the strata, education level also plays an essential role in earning a higher salary. As shown in *Table 2*, the largest portion of the B 40 income group is made up of households that complete their high school education only. On the contrary, the households of the T20 income group are mostly graduates with a degree or at least an advanced

diploma. The main findings of this research are discussed in the following section.

Results of the projected wealth-needs ratio indicate that 26% of households in the sample data do not have adequate retirement wealth to finance their consumption during retirement. The percentage of inadequacy represents 3,723 households. In comparison with the previous study by Alaudin et al. [14]. The result shows a slight decrease with 26% of households having inadequate retirement wealth, compared to the result of Alaudin et al. [14] showed that 31% of households have inadequate retirement wealth.

The withdrawal from the i-Lestari scheme does not affect much the inadequacy of retirement wealth, since the wealth-needs ratio shows the same result as before, taking into account that 26% of sample households do not have enough wealth during their retirement. This situation might happen because the withdrawal duration is short, only within one year, according to the available amount in Account 2.

Table 3 shows the results of analysis of variance from multivariate OLS regression. The response variable for OLS is the measure of retirement wealth adequacy represented by the wealth-needs ratio, where a ratio greater than one is considered adequate and a ratio less than one is inadequate. All variables are statistically and significantly associated with the wealth-needs ratio at a 95% confidence level, except for household size.

Table 4 provides the estimates, standard errors and *p*-values of the covariates. The results indicate that States, urban strata, male respondents, some occupation groups and employment classes are positively associated with adequate retirement wealth. Correspondingly, married status, non-Bumiputera, education, income group, age and number of household members negatively correlate with the response variable (wealth-need ratio). However, the results show an unexpected situation for higher-income groups (M40 and T20). The M40 income group has inadequate retirement wealth, while the T20 income group has a worse situation. The summary analysis of the OLS model is shown in *Table 5*.

The result of the highest annual income households (T20) who are more likely to experience inadequate retirement wealth, is rather unexpected. However, since the RR is used as a proxy for consumption level and is assumed to be directly proportional to the annual income, it is expected that households with higher incomes will have higher consumption, thus, reducing the adequacy of retirement wealth. The unexpected situation also happens for the determinant of age, where older households tend to face inadequacy in

Table 1

Data Profile for HIS Sample 2014

Variables	The proportion of households (%)
Region	
1 (Kelantan, Pahang, Terengganu)	13.8
2 (Johor, Melaka, Negeri Sembilan)	17.1
3 (Kedah, Perak, Perlis)	14.2
4 (P. Pinang, Selangor, K. Lumpur, Putrajaya)	28.5
5 (Sabah, Sarawak)	26.4
Sex	
Male	88.2
Female	11.8
Income Group	
B 40	55.9
M40	33.1
T20	11.1
Strata	
Urban	76.6
Rural	23.4
Marital Status	
Single	9.6
Married	84.8
Separated	5.7
Ethnic	
Bumiputera	69.1
Non-Bumiputera	30.9
Education Level	
Degree/Advance Diploma	14.1
Collage Graduate	16.5
High School Graduate	55.0
No. Certificate	14.4
Occupation Group	
1 (Professional)	7.5
2 (Administrative)	6.8
3 (Associates and Higher Technician)	29.8
4 (Agriculture and Aquaculture)	16.5
5 (Craft and Repair)	14.7
6 (Elementary Occupation)	24.7
Employment Class	
Civil Servant	1.9
Private Sector	21.8
Employer	66.7
Self Employed	9.0
Others (Pensioner & Family Business)	0.5
Age Group	
Less Than 34	16.5
35 ⩽ Age ⩽ 44	31.6
45 ⩽ Age ⩽ 54	39.5
54 and above	12.4
Total	100

Source: Author's calculation, Microsoft Excel 2016.

Table 2

Data Distribution by Income Group

B 40 55.9%	M40 33.1%	T20 11.1%
Region 1 9.34% 2 9.30% 3 9.67% 4 11.41% 5 16.15%	**Region** 1 3.55% 2 6.65% 3 3.64% 4 11.40% 5 7.81%	**Region** 1 0.90% 2 1.19% 3 0.88% 4 5.65% 5 2.46%
Strata Rural 17.69% Urban 38.17%	**Strata** Rural 4.75% Urban 28.30%	**Strata** Rural 0.93% Urban 10.15%
Education Degree/Adv Dip 1.37% College Graduate 4.43% No Cert 11.98% High School Grad. 38.09%	**Education** Degree/Adv Dip 6.12% College Graduate 6.85% No Cert 2.26% High School Grad. 17.82%	**Education** Degree/Adv Dip 6.58% College Graduate 2.02% No Cert 0.19% High School Grad. 2.29%

Source: Author's calculation, Microsoft Excel 2016.

Table 3

Analysis of Variance

Variable	Wealth-Need Ratio	*P*-Value
Region	70.8	0.0000
Strata	15.7	0.0000
Sex	1.5	0.0000
Marital status	514.4	0.0000
Ethnicity	95.0	0.0000
Education level	317.2	0.0000
Occupational group	62.6	0.0000
Employment class	157.6	0.0000
Age	6194.9	0.0000
Income group	146.6	0.0000
Household size	0.2	0.2100

Source: Author's calculation, R-studio Programming Language.

retirement although they are from the T20 income group compared to younger households. The older households probably have larger commitments to their children or spend more on health and medical expenses.

Table 6 shows the analysis of variance from the logistic regression model. The response variable for the logistic regression model is expressed as a binary variable that is equal to one, if the households have adequate retirement wealth (or the projected wealth-need ratio is equal to or greater than one) and zero otherwise.

Table 7 provides the results for the logistic regression model at the 5% significant level. Significant variables are higher education (degrees and advanced diplomas) and a medium number of household members. The probability of adequate retirement wealth increases if sample respondents have higher education.

Table 4

OLS of Retirement Wealth Adequacy Regression Coefficients

Variable	Estimate	Standard Error	*P*-Value
Intercept	2.9637	0.0189	0.0000
Region 1: reference			
Region 2	0.0163	0.0073	0.0256
Region 3	0.0042	0.0075	0.5746
Region 4	0.0209	0.0069	0.0026
Region 5	0.0171	0.0066	0.0092
Rural: reference			
Urban	0.0109	0.0051	0.0316
Female: reference			
Male	0.0106	0.0073	0.1478
Single: reference			
Married	−0.0518	0.0074	0.0000
Separated	−0.0716	0.0109	0.0000
Bumiputera: reference			
Non-Bumiputera	−0.0209	0.0047	0.0000
College Grad: reference			
Degree/Adv. Diploma	−0.0035	0.0076	0.6502
High School Grad	−0.0328	0.0062	0.0000
No. Cert	−0.0215	0..0084	0.0105
Income Group B 40: reference			
M40	−0.0143	0.0049	0.0034
T20	−0.0357	0.0082	0.0000
Occupation Group Professional: reference			
Administrative	0.0083	0.0115	0.4711
Associates and Higher Technician	0.0004	0.0087	0.9644
Agriculture and Aquaculture	0.0191	0.0099	0.0535
Craft and Repair	0.0060	0.0102	0.5525
Elementary Occupation	−0.0040	0.0098	0.6782
Employment Class Civil Servant: reference			
Private Sector	0.0057	0.0162	0.7211
Employer	0.0205	0.0154	0.1844
Self Employed	−0.0044	0.0164	0.7852
Others –Pensioner & Family Business	−0.0502	0.0324	0.1216
Age Group Less than 34: reference			
35 ⩽ Age ⩽ 44	−0.9602	0.0061	0.0000
45 ⩽ Age ⩽ 54	−1.8084	0.0061	0.0000
54 and Above	−2.2146	0.0079	0.0000
Household Size 1–3: reference			
4–6	−0.0056	0.0048	0.2451
7–9	−0.0138	0.0070	0.0497
10 and above	−0.0168	0.0144	0.2404

Source: Author's calculation, R-studio Programming Language.

Table 5

Summary Analysis of OLS Model

Explanatory Variable	Linkage	Influence
Region 4 (P. Pinang, Selangor, K. Lumpur, Putrajaya)	People living in Region 4 are likely to have adequate retirement wealth, which may be influenced by good job opportunities with a higher salary in developed states. Kuala Lumpur and Putrajaya are the capital cities and centers of administration of Malaysia, offering many job opportunities. The sample of households in Region 4 is mainly from the B 40 and M40 groups	Positive
Region 5 (Sabah, Sarawak)	The source of income is mainly from traditional economic activities (sea-produce, logging). The sample of households in Region 5 consists of B 40 groups, and the result might be influenced by the higher percentage of respondents from East Malaysia	Positive
Strata Urban	The urban area is influenced by 0.0109 of the adequate ratios. Living in an urban area provides many facilities and opportunities to better live Over 75% of the households live in the urban area, comprising a higher percentage of M40 and T20 groups	Positive
Married	Every married household will lose 0.0518 of the wealth-to-needs ratios. Married heads of households have less adequate wealth since the consumption is more significant with the family's commitment. The spending is multiplying with the addition of new family members	Negative
Non-Bumiputera	Non-Bumiputera influence wealth-needs ratio by reducing 2.09%	Negative
Degree/Advanced Diploma	Higher education levels will have more accumulated income resulting from higher salaries Education level is highly associated with the income group of the sample. B 40 households with lower education levels (primarily high school graduates) have lower retirement wealth adequacy. In contrast, M40 and T20 households with higher education backgrounds (Degree or Advance Diploma graduates) have higher retirement wealth adequacy	Negative
Income group	Households with higher income accumulate more assets, and higher-income groups M40 & T20 have lower adequate retirement wealth, which is unexpected. The evidence suggests that T20 possess other assets (financial and non-financial) besides EPF savings	Negative
Age group	Households with a later retirement age have a longer period to accumulate retirement wealth	Negative
Household size: More than ten members	A larger number of households have lower retirement adequacy as spending increases, and savings for retirement decrease	Negative

Source: Author's explanation.

CONCLUSIONS

In conclusion, this study has found the adequacy of retirement wealth in Malaysian society as a whole using the wealth-need ratio indicator. The estimation of adequacy is based on the panel data that cover all regions across Malaysia, including peninsular and east Malaysia, of which the most concentrated region is placed in the capital of Malaysia. More than half of Malaysian citizens are classified as low-income (B 40), accounting for 55.9% of the data. It indicates that more than half of Malaysians earn less than RM 52,320 annually.

The estimated wealth-need ratio shows that 74% of the households from the sample of 14,157 respondents

Table 6

Analysis of Variance from Logistic Regression

Variable	Deviance	*P*-Value
Region	66.7	0.0000
Strata	9.4	0.0022
Sex	7.7	0.0055
Marital status	278.8	0.0000
Ethnicity	69.6	0.0000
Education level	399.5	0.0000
Occupational group	73.7	0.0000
Employment class	406.9	0.0000
Income group	186.7	0.0000
Age	7620.0	0.0000
Household size	32.5	0.0000

Source: Author's calculation, R-studio Programming Language.

have adequate retirement income. In contrast, more than a quarter of the total samples are unable to maintain their level of consumption in retirement years. A slight improvement in the percentage of the sample having adequate retirement income compared to the previous study. The percentage of households with adequate retirement wealth is 74% in this study, compared to 69% found in Alaudin et al. [14]. This situation may happen because of a marginal improvement of income earned in recent years and economic stability.

Besides the wealth-need ratio indicator, this study has investigated other determinants of adequate retirement wealth through multivariate OLS and logistic regression models.

Variables of state region, strata, sex, marital status, ages, ethnicity, education, occupational group, employment class and income group are statistically and significantly associated with the wealth-needs ratio at a 95% confidence level. The effects of demographic and socio-economic factors are also investigated.

According to the findings, States, urban strata, male respondents, some occupation groups, and employment classes are all positively associated with adequate retirement wealth. While married status, non-Bumiputera, education, income group, age, and number of household members have a negative correlation with the response variable (wealth-need ratio). The outcome of the highest annual income households (T20) group being more likely to have insufficient retirement money is relatively unexpected. The rationale that can be pictured is that high-income Malaysians have higher spending behaviour.

For future studies, the projection of the wealth-needs ratio can be improved by including other accessible assets such as financial assets (stocks, equities, bonds) and non-financial assets (gold and real estate). Meanwhile, consumption patterns in retirement age should be considered since consumption affects the adequacy level of retirement wealth. In addition, the possible consumption can be included, such as the cost of digital technology, since this element is a necessity at the moment. As for the model scoring, it can be further revised with a comparison to other established actuarial models for retirement.

Table 7

Logistic Regression of Probability of Adequate retirement wealth

Variable	Estimate	Standard Error	*P*-Value
Intercept	7.3893	1.0359	0.0000
Region 1: reference			
Region 2	0.0534	0.1028	0.6038
Region 3	0.0242	0.1032	0.8148
Region 4	0.1224	0.1006	0.2239
Region 5	0.1893	0.0932	0.0423
Rural: reference			
Urban	0.0121	0.0716	0.8654
Female: reference			
Male	0.2138	0.1099	0.0516
Single: reference			
Married	−0.3583	0.1540	0.0199
Separated	−0.2987	0.1807	0.0984
Bumiputera: reference			
Non-Bumiputera	−0.1532	0.0688	0.0259
College Grad: reference			
Degree/Adv. Diploma	0.3967	0.1220	0.0011
High School Grad	−0.2548	0.0986	0.0097
No. Cert	−0.3881	0.1223	0.0015
Income Group B 40: reference			
M40	−0.3081	0.0704	0.0000
T20	−0.5015	0.1181	0.0000
Occupation Group Professional: reference			
Administrative	0.0071	0.1666	0.9662
Associates and Higher Technician	0.0727	0.1209	0.5477
Agriculture and Aquaculture	0.1408	0.1370	0.3039
Craft and Repair	0.0299	0.1389	0.8294
Elementary Occupation	−0.0042	0.1339	0.9751
Employment Class Civil Servant: reference			
Private Sector	0.1503	0.2214	0.4973
Employer	0.4875	0.2092	0.0198
Self Employed	0.0051	0.2205	0.9814
Others -Pensioner & Family Business	−0.9616	0.5528	0.0819
Age Group Less than 34: reference			
35 ⩽ Age ⩽ 44	0.6775	1.4146	0.6320
45 ⩽ Age ⩽ 54	−7.0390	1.0011	0.0000
54 and Above	−26.0830	154.5127	0.8660
Household Size 1–3: reference			
4–6	0.3759	0.0724	0.0000
7–9	0.4445	0.0985	0.0000
10 and above	0.0695	0.1892	0.7134

Source: Author's calculation, R-studio Programming Language.

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