

Projection of Retirement Adequacy using Wealth-Need Ratio: Optimistic and Pessimistic Scenarios

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Abstract—Retirement adequacy is estimated using Malaysian Household Income Survey (HIS) 2009 data based on 5881 sample of households with information on income, demographic and socioeconomic characteristics of each household. The adequacy of retirement income is assessed by comparing accumulated projected wealth of an individual's work life at retirement age with his/her total consumption (needs) in retirement. From the idea of life cycle model, the desired retirement income is to maintain the preretirement level of living throughout retirement. Therefore, retirement wealth can be defined as adequate if the total retirement income is equal or greater than the total desired retirement consumption. Based on the wealth-need ratio projections, 69% of households are adequately prepared for retirement. Besides the projection of retirement adequacy, a logistic regression is performed to determine the demographic and socioeconomic determinants of retirement adequacy. In addition, optimistic and pessimistic scenarios are projected to discern the effects of retirement and investment factors on retirement wealth adequacy.

Index Terms—Consumption, regression, retirement, wealth.

I. INTRODUCTION

Life expectancy of the Malaysian population is constantly increasing. The rate of elderly population in Malaysia is growing faster than the population as a whole. Projection of population by age group in Malaysia shows a large increase in elderly population, from 1.4 million in 2010 to 4.4 million in 2040. This increase will lead Malaysia to become an ageing population and deal with longevity risk if the financial situation of future retirees remains unstable and not given the attention it deserves. In the United States, 41% of retirees decide to rejoin labor force due to inadequate retirement income [1].

Resources of retirement income generally include social security, pension benefits and personal savings. In Malaysia, only employees receiving MYR3, 000 per month and less are eligible to obtain coverage of benefits from Social Security Organisation (SOCSO). Personal savings are considered as insecure resources of retirement income because individuals must well-managed their current salaries to allocate

appropriate proportions of savings, which can only happen if they know how to plan their financial situation such as spending less than income or invest in financial assets. However, these actions are difficult to implement in real life.

The purpose of this study is to investigate the adequacy of retirement wealth by projecting pension benefits from defined contribution and defined benefit plans. Household information on current income in 2009 is used to project the accumulated retirement wealth, whereas salary increment and dividend rates are estimated from historical data. In addition, a logistic regression is performed to investigate the demographic and socioeconomic determinants of retirement adequacy. Furthermore, we examine the effects of retirement and investment decisions on retirement wealth adequacy. This study contributes in terms of three main elements; we use the Malaysian household income survey data to study the demographic and socioeconomic determinants of retirement adequacy in Malaysia, we project retirement wealth based on two types of pension benefits in Malaysia namely Employee Provident Fund (EPF) for defined contribution plan and government pension scheme for defined benefit plan, and finally, we project optimistic and pessimistic scenarios to discern the effects of retirement and investment factors on retirement wealth adequacy.

II. REVIEW OF LITERATURE

An analysis of retirement income adequacy requires information on possible resources available during retirement to finance consumption after retirement. Retirement wealth can be defined as adequate if the total retirement income is equal or greater than the total desired retirement consumption (or needs).

Retirement needs can be estimated from a life cycle hypothesis. The key idea of a life cycle hypothesis is that individuals desire to maintain the level of consumption over their entire lifetime [2]. There are several existing approaches for determining sufficient level of retirement consumption. The most common approach is to identify the percentage of pre-retirement income that represents the desired consumption level during retirement, also known as a replacement rate. Previous researchers have set a range of adequate replacement rates. Palmer [3] suggested replacement rates which range from 65% to 85% depending on income level and Duncan et al. [4] suggested replacement rates ranging from 70% to 90%. Several studies applied Palmer's replacement rates to determine retirement consumption [5], [6]. Besides replacement rates, other approaches have been used to calculate retirement needs such as Yuh [7] who applied Consumer Expenditure Survey to predict spending for households where the dataset is

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considered as a proxy for retirement consumption, and Yuh *et al.* [8] and Yao *et al.* [9] who also used the same approach in estimating retirement needs in their studies.

Retirement wealth can be defined as adequate if the total retirement income is equal or greater than the total desired retirement consumption. The conceptual framework is summarized as follows [8]:

$$A_R + \sum_{t=1}^{T-R} B_t / (1+r)^t \geq \sum_{t=1}^{T-R} C_t / (1+r)^t \tag{1}$$

where A_R is the total asset accumulated upon retirement at age R , B_t is the pension income at age t , C_t is the consumption at age t , R is the retirement age and T is the age at death.

III. METHODOLOGY

In this study, retirement wealth is defined as retirement income from either defined contribution or defined benefit plans. In Malaysia, defined contribution plan is provided by Employee Provident Fund (EPF) for employees of corporate sectors and defined benefit plan is provided by government pension scheme for government servants. Retirement wealth at retirement age is estimated from the projection of accumulated EPF (for corporate employees) and the present value of total benefits of government pension (for government servants).

The projection of accumulated EPF at retirement age can be briefed using the geometric series summation:

$$K \times S \times (1+i)^n \left(\frac{r^{n+1} - 1}{r - 1} \right) \tag{2}$$

where K is the contribution rate of both employer and employee, S is the first year salary, i is the incremental rate of salary, n is the future service years from age at first year salary to age at retirement, $r = (1+d)/(1+i)$ and $d = i/(1+i)$. Under government pension scheme which is rendered for government servants, the provided formulas are used to project the accumulated retirement wealth [10].

Under the Life Cycle Model, an individual's goal is to maintain the pre-retirement standard of living during retirement. The retirement needs can be defined as the total wealth needed to finance the desired consumption during retirement, and can be summarized as follows:

$$W = H \times RR \times \{ [1 - (1+g)^{-f}] / g \} \tag{3}$$

where W is the retirement needs (or present value of total consumption during retirement), H is the expected annual salary prior to retirement, RR is the replacement ratio, g is the estimated real interest rate from retirement age to expected age of death, and f is the retirement period (or number of years from retirement age to expected age of death). Based on studies from Department of Statistics Malaysia, the average consumption per month for population aging 65 years and above is about 75% of the average consumption per month for population aging 25-64 years [11]. Thus, 75% replacement ratio is appropriate.

The wealth-needs ratio can be defined in percentage as:

$$\frac{\text{Projection of Retirement Wealth}}{\text{Total of Desired Consumption (Needs)}} \times 100$$

IV. RESULTS AND DISCUSSION

TABLE I: SUMMARY STATISTICS FOR HIS SAMPLE 2009

Variables	No of household (%)
Total	100.0
Region	
1 (Kelantan, Pahang, Terengganu)	16.2
2 (Johor, Melaka, Negeri Sembilan)	16.0
3 (Kedah, Perak, Perlis)	15.0
4 (P.Pinang, Selangor, Kuala Lumpur, Putrajaya)	35.0
5 (Sabah, Sarawak)	17.9
Strata	
Urban	64.6
Rural	35.4
Marital status	
Married	87.4
Single Female	6.4
Single Male	6.2
Ethnic	
Bumiputera	68.4
Chinese	23.4
Indian	7.6
Others	0.6
Educational level	
College/University	20.3
High School Grad	44.8
Less than High School	16.3
Others (not attending formal education, religious education, not finishing school)	18.6
Occupational group	
Administrative Supports	21.4
Agriculture and Fishery	3.8
Craft and Repair	9.8
Elementary Occupations	9.4
Operators	16.2
Technicians	22.3
Professionals and Legislators	17.1
Employment status	
Employer	1.6
Government	23.4
Private	68.8
Self Employed	6.1
Subjective life expectancy	
live ≤ 34	18.3
35 ≤ live ≤ 39	19.9
40 ≤ live ≤ 44	21.2
45 ≤ live ≤ 49	22.2
50 ≤ live ≤ 54	18.4
Household income (MYR)	
9.6k – 15k	13.0
15k – 25k	21.6
25k – 40k	24.5
40k – 60k	18.3
60k and above	22.5

TABLE II: ANALYSIS OF VARIANCE FROM LOGISTIC REGRESSION

Variable	Deviance	p-value
Region	15.4	0.003951**
Strata	3.6	0.056933+
Marital status	19.3	6.579e-05***
Ethnicity	143.1	2.2e-16***
Education level	642.6	2.2e-16***
Occupational group	58.3	9.870e-11***
Employment Status	877.9	2.2e-16***
Expected life expectancy	4690.7	2.2e-16***
Household income	2.5	0.644975
Household size	0.1	0.789614

Note: Analysis of variance chi-squared test for difference of means is statistically significant, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

TABLE III: LOGISTIC REGRESSION OF PROBABILITY OF ADEQUATE RETIREMENT WEALTH

Variable	Estimate	Std. error	p-value
Intercept	44.89083	2207.376	0.9838
Region 1: reference			
Region 2	-0.09078	0.332	0.7845
Region 3	-0.44646	0.32612	0.1710
Region 4	0.13518	0.29539	0.6472
Region 5	0.04385	0.33058	0.8945
Rural: reference			
Urban	0.56040	0.20513	0.0063*
Married: reference			
Single Female	1.43509	0.62353	0.0214*
Single Male	0.14624	0.38241	0.7022
Bumiputera: reference			
Chinese	-0.02706	0.22873	0.9058
Indian	-0.42383	0.30258	0.1613
Other ethnics	-0.02672	1.11466	0.9809
College/University: reference			
High School Grad	-21.9752	962.536	0.9818
Less than High School	-21.9918	962.536	0.9818
Other educational levels	-22.4754	962.536	0.9814
Administrative Supports: reference			
Agriculture and Fishery	0.59805	0.53356	0.2623
Craft and Repair	0.28261	0.32775	0.3885
Elementary Occupations	0.71101	0.40180	0.0768+
Operators	0.27421	0.29396	0.3509
Technicians	0.54350	0.32233	0.0918+
Professionals and Legislators	0.38697	0.36748	0.2923
Employer: reference			
Government	61.63187	1952.037	0.9748
Private	-0.90757	0.79755	0.2551
Self Employed	-0.46432	0.89260	0.6029
live ≤ 34 : reference			
35 \leq live ≤ 39	0.17233	2.778.82	1.000
40 \leq live ≤ 44	-20.9109	1986.462	0.9916
45 \leq live ≤ 49	-44.5123	2207.376	0.9839
50 \leq live ≤ 54	-64.3236	2456.764	0.9791
9.6k – 15k: reference			
15k – 25k	-0.03584	0.28191	0.8988
25k – 40k	0.32257	0.31577	0.3070
40k – 60k	-0.07346	0.35632	0.8367
60k and above	-0.04907	0.37350	0.8955
Household Size	0.01232	0.04622	0.7898

Note: Null deviance: 7278.48 on 5880 degree of freedom
 Residual deviance: 825.01 on 5849 degrees of freedom
 AIC: 889.01
 Number of Fisher Scoring iterations: 22
 Significant: p-value ≤ 0.1 *p-value ≤ 0.05 , **p-value ≤ 0.01 ,
 ***p-value ≤ 0.001

The data are obtained from Household Income Survey (HIS) 2009 conducted by Department of Statistics Malaysia, which are based on 5881 sample of households. Table I shows the summary statistics for the sample.

Based on the results of wealth-needs ratio, 69% of households in the sample have adequate retirement income. Table II shows an analysis of variance from the logistic regression of the probability of adequate retirement wealth. All independent variables are statistically significant except for household income and household size at 10% level.

Logistic regression analysis of the probability of adequate retirement wealth is performed to investigate the income, demographic and socioeconomic determinants of retirement adequacy. The response variable is the measure of retirement wealth adequacy which is expressed as a binary variable equal to one if the household have adequate retirement wealth based on the projected wealth-need ratio, and zero otherwise. Table III provides the logistic regression results.

Significant variables at 10% level are strata (urban), marital status (single female) and occupational group (elementary occupations and technicians). The probability of adequate retirement wealth increases with urban area compared to rural area. The result indicates that households living in urban area have higher retirement adequacy compared to rural area. As for marital status, the probability of adequate retirement wealth increases with single female individuals, implying that single female households have higher retirement adequacy. With respect to the occupational group, households working in elementary occupations and households working as technicians are positively associated with the probability of adequate retirement wealth, suggesting that both groups have higher retirement adequacy.

Optimistic and pessimistic scenarios are projected to discern the effects of retirement and investment factors on retirement adequacy. In this study, retirement and investment factors comprise planned retirement age, EPF dividend rate, and household income. For planned retirement age, we assume 58, 60 and 62 years old respectively for pessimistic, mean and optimistic scenarios, whereas for rate of EPF dividend, we assume 6.5%, 6.91% and 7.4% respectively for pessimistic, mean and optimistic scenarios. Table IV reports the effect of planned retirement age on retirement adequacy. Positive relationship is found between retirement adequacy and planned retirement age. 76% of households who plan to retire at age 62 and later (optimistic) have adequate retirement wealth, compared to 58% of households that plan to retire at age 58 or earlier (pessimistic). This result indicates that higher retirement age have higher retirement adequacy.

Table V exhibits the effect of EPF dividend rate on retirement wealth adequacy. The results show that dividend rate has a linear relationship with adequacy of retirement wealth. At 6.5% dividend rate (pessimistic), the proportion of household with adequate retirement wealth is 56.1%. As expected, the proportion increases to 60.1% at 7.4% dividend rate (optimistic), suggesting that households with higher dividend rate have higher retirement adequacy.

The effect of household income on retirement wealth adequacy is provided in Table VI. Chi-squared test demonstrates that the proportion of households with adequate retirement wealth is significantly different across the five

retirement income groups with p -value less than 0.001. 85% of households with income between MYR 9,600 and MYR 15,000 have adequate retirement wealth, indicating that this group has the highest proportion of retirement adequacy. Households belonging to this group are presumably consuming only on their limited earnings and thus, have lower consumption needs during retirement. They are also presumably adjusting their modest lifestyle by maintaining discretionary spending.

TABLE IV: EFFECT OF PLANNED RETIREMENT AGE ON RETIREMENT WEALTH ADEQUACY

Retirement Age	58 (pessimistic)	60	62 (optimistic)
Adequate (%)	58.0	69.0	76.0
Inadequate (%)	42.0	31.0	24.0

TABLE V: EFFECT OF INVESTMENT RETURNS ON RETIREMENT WEALTH ADEQUACY

Investment Returns (%)	6.5 (pessimistic)	6.91	7.4 (optimistic)
Adequate (%)	56.1	59.6	60.1
Inadequate (%)	43.9	40.4	39.9

TABLE VI: EFFECT OF HOUSEHOLD INCOME ON RETIREMENT WEALTH ADEQUACY

Household Income (%)	9.6k-15k	15k-25k	25k-40k	40k-60k	60k above
Adequate (%)	85.0	53.0	56.0	60.0	57.0
Inadequate (%)	15.0	47.0	44.0	40.0	43.0
Total (%)	100.0	100.0	100.0	100.0	100.0
100.0%	36.12	18.36	18.36	12.54	14.62

Chi-square = 437.0938, p -value \leq 0.001

V. CONCLUSIONS

The projection of wealth-need ratio shows that 69% of households in the sample have adequate retirement income. The result from logistic regression shows that retirement adequacy increases for households living in urban areas, households who are single and female, households working in elementary occupations and households working as technicians. The result from the projected scenarios indicates that the highest proportions of households with adequate retirement are provided by planned retirement age at 62, dividend rate at 7.4% and household income within the range of MYR 9,600 to MYR 15,000, whereas the lowest proportions are provided by planned retirement age at 58, dividend rate at 6.5% and household income within the range of MYR 15,000 to MYR 25,000.

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