RETIREMENT ADEQUACY TARGETS FOR SOUTH AFRICAN HOUSEHOLDS

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ABSTRACT
Despite the importance of retirement adequacy targets to public policy, retirement fund design and personal financial planning, there has been little formal research on the estimation of retirement adequacy targets for South African households. This research considered only employed one- and two-adult households. A consumption-smoothing model with a minimum income underpin was used to estimate wealth-earnings targets using data from the Income and Expenditure Survey 2005/2006. It was found that there was no sharp decline in consumption on retirement. Household wealth-earnings targets were estimated to be between 10.5 and 18.2 times annual salary depending on retirement age, household composition, income, location, age, education, household income distribution, home ownership and salary support. Considering current retirement savings rates, retirement before age 67 is unlikely to be affordable for most households.

KEYWORDS
Retirement; adequacy targets; South Africa; wealth-earnings ratios

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1. **INTRODUCTION**

1.1 **Background**

According to the Life Cycle Hypothesis, individuals accumulate savings during their working lives in order to smooth consumption in later life when they are unable to earn through working (Banks, Blundell & Tanner, 1998). Determining the required retirement savings rate is a function of the wealth, or accumulated assets, required at retirement to meet retirement needs sufficiently (Mitchell & Moore, 1998). This required wealth measure is termed a retirement adequacy target. Alternatively, the retirement adequacy target can be thought of as the answer to the question: ‘How much is enough to retire?’

Retirement savings rates, and by implication retirement adequacy targets, are important for household financial planning (Bernheim, Forni, Gokhale & Kotlikoff, 2000; Tacchino & Saltzman, 1999; Groyer & Holtzhausen, 2006), retirement fund design (Groyer & Holtzhausen, 2006) and retirement fund investment strategies (Groyer & Holtzhausen, 2006; Dietz, 1968; Myners 2001; Financial Services Board, 2007). Retirement adequacy targets have particular relevance in South Africa given the government’s intended reform of the retirement fund industry. The Department of Social Development (2007a) and the National Treasury (2004) cited inadequacy of retirement benefits in the current system as evidence of the reform’s necessity. However, the two government departments initially cited conflicting retirement adequacy targets\(^1\) and then failed to state targets at all.\(^3\) This inconsistency may be a result of the lack of published research relating to adequacy targets in South Africa (Groyer & Holtzhausen, 2006).

1.2 **Problem Statement**

This research produced estimates of retirement adequacy targets from official South African data. The research questions addressed were:
- What do South African data suggest retirement adequacy targets should be?
- How do various factors affect the targets?

1.2.1 **Limitation of Scope**

This research paper does not assess whether current pensioners receive adequate incomes or assess the likely financial position of savers at retirement.

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1.2.2 Definition of Adequacy Adopted
The adequacy targets derived were based on ‘comfortably adequate’ income. This was defined to be that required to maintain the higher of the pre-retirement living standard and a socially acceptable standard of living. Maintenance of the pre-retirement living standard in retirement would necessitate consumption being smoothed between the pre- and post-retirement phases and hence this part of the adequacy definition was termed the ‘consumption-smoothing’ element. The level of income sufficient to maintain only a minimum socially acceptable living standard was termed ‘minimally adequate’.

Hence, this research was concerned with finding a retirement adequacy target which would provide the pensioner with an income above a poverty-line measure that would not require the pensioner to economise on expenditure any more in retirement than was done during the pensioner’s working life time.

1.2.3 Expression of Results
Replacement ratio adequacy targets, defined as the annualised income in the month after retirement to salary for the year prior to retirement (McGill et al., 1996) have been derived by Palmer (1989; 1992; 1994; 2008), Burns & Widdows (1990), Mitchell & Moore (1998) and Chia & Tsui (2003). By definition, the replacement ratio refers only to income immediately after retirement without indicating income levels in subsequent years. However, as retirement needs may vary with age (Banks, Blundell & Tanner, 1998; Chia & Tsui, 2003; Palmer, 2008), the choice of the annuity factor used in the calculations is critical as this should match the expenditure pattern required in retirement in order to avoid misleading results (Schieber, 1996). Banks, Blundell & Tanner (1998) have suggested that an appropriate commercially available annuity may not be available.

The wealth-earnings ratio can be defined as total wealth required for consumption-smoothing (Engen, Gale & Uccello, 1999; Engen, Gale & Uccello, 2005) to current income (Moore & Mitchell, 1997; Engen, Gale & Uccello, 1999; Burns & Widdows, 1990). The wealth-earnings ratio avoids the annuitisation and communication difficulties associated with replacement ratios while still allowing comparisons to replacement ratio adequacy measures (Engen, Gale & Uccello, 2005; Chia & Tsui, 2003) and hence wealth-earnings ratios, gross of tax, were used in this research.

1.2.4 Household Sample Scope
The study was limited to one-adult households and two-adult households where both adults were employed, subject to certain restrictions on income sources. The targets were derived from households that were saving for retirement and that were projected to have comfortably adequate benefit needs too high to be satisfied by relying on the State Old Age Grant (SOAG) alone and who may hence benefit from private retirement provision. This corresponded to a minimum income level of R24 424–50 per person per annum (p.p.p.a.) in March 2006 terms.
2. LITERATURE REVIEW
The definition of adequacy adopted suggested the use of a consumption-smoothing model to estimate the retirement adequacy targets. Section 2.1 sets out the literature on consumption-smoothing targets and highlights the chief difficulties associated with these models.

Section 2.2 delineates previous work on minimally adequate income estimates, which are not typically included in consumption-smoothing models, before some suggested retirement adequacy targets are shown in Section 2.3. Section 2.4 elaborates on the factors identified in the literature as having an effect on the retirement adequacy targets.

2.1 Consumption-smoothing models
The literature on consumption-smoothing adequacy targets is largely based on the models described in Palmer (1989). The Tax and Savings (TS) model in Palmer (1989) is an income-led model that estimates post-retirement consumption as pre-retirement consumption adjusted only for changes in tax and savings at the retirement date. The Tax, Savings and Expenditure (TSE) model attributable to Dexter (1984) allows for an additional adjustment for changes in consumption due to aging or retirement which may be positive or negative (Palmer, 1989). The TS and TSE models were used to estimate retirement adequacy targets by Palmer (1989; 1992; 1994; 2008), Mitchell & Moore (1998) and Yuh, Hanna & Montalto (1998).

A key challenge with consumption-smoothing models is that a change in consumption at or in retirement may happen for reasons other than a response to a change in income level. This is discussed in Section 2.1.1 before five other technical issues are identified.

2.1.1 Changes in Consumption and Saving
The change in consumption at retirement is typically assumed to be a work-status effect. Changes in consumption in retirement may be as result of widowhood but other changes may be age-related.

There is little consensus as to if expenditure increases or decreases at retirement. Hamermesh (1984) indicated a drop in consumption at retirement. Haider & Stephens (2007) and Bernheim, Skinner & Weinberg (2001) found that some data sets suggested a drop in consumption while others did not. Hurd & Rohwedder (2005) found that consumption declined at retirement for single pensioners but not married ones. Miniaci, Monfardini & Weber (2003) found no change in consumption at retirement. Robb & Burbidge (1989) found that consumption declined for blue collar workers but not for white collar workers. Despite using a consistent methodology, Palmer (1992; 1994; 2008) did not establish a consistent pattern in changes in consumption at retirement over time as indicated in Figure 2.1.

The literature did not provide consistent estimates of changes in consumption during retirement. However, some authors indicated that consumption declines in old...
age (Hamermesh, 1984; Banks, Blundell & Tanner, 1998; Palmer, 2008). A consistent finding was that healthcare costs increase in retirement (Petertil, 2005; Cook & Settersten, 1995; Stoller & Stoller, 2003; Madrian, Burtless & Gruber, 1994) although this may have been a function of occupation (Case & Deaton, 2005).

Critically, there were conflicting findings as to whether any observed changes in consumption were voluntary (Banks, Blundell & Tanner, 1998; Haider & Stephens, 2007; Tacchino & Saltzman, 1999; Kotlikoff, Spivak & Summers, 1982) or necessitated by lower income (Cooper, 2002; Shefrin & Thaler, 1988; Hamermesh, 1984). The definition of adequacy adopted meant that if retired households had to reduce consumption due to a lower income, that income would not be adequate.

An approach to assessing the changes using cohort data was to match households that differed only by work-status (Schieber, 1996). This multi-factor matching is a refinement of the matched-pairs methodology used by Palmer (1989) that matched only by income. Several factors were identified as directly or indirectly significant determinants of consumption in empirical studies. These included age (Banks, Blundell & Tanner, 1998; Cook & Settersten, 1995), household composition (Hurd & Rohwedder, 2005), work-status (Banks, Blundell & Tanner, 1998), income (Cook & Settersten, 1995), socio-economic group (Robb & Burbidge, 1989; Chia & Tsui, 2003; Case & Deaton, 2005) and health (Hurd & Rohwedder, 2005).

Source: Palmer (1992; 1994; 2008); United States Department of Labor, (20105)

Figure 2.1 Changes in age- and work-related expenses

Source: Palmer (1992; 1994; 2008); United States Department of Labor, (20105)

2.1.2 Other Technical Issues Associated with Consumption-Smoothing Models

The first technical issue related to the treatment of durables such as housing, where consumption and expenditure are typically mismatched. It was suggested that the consumption and savings elements of mortgage payments should be separated in the calculation of pre-retirement savings and consumption (Schieber, 1996; Mitchell & Moore, 1998) and an imputed rental used for consumption (Mitchell & Moore, 1998).

The second technical issue related to whether the model should allow for a bequest motive. The literature suggested that an explicit bequest motive during the retirement period could be ignored (Mitchell & Moore, 1998; Modigliani, 1986; Yaari, 1965) so long as post-retirement savings patterns (Modigliani, 1986) and gifts (Joulfaian, 2005) were considered. The third technical issue was how allowance should be made for a loss of economies of scale arising on the death of a spouse. International studies suggested that the loss of economies of scale on widowhood lie between 6,0% and 60,0% (Atkinson, 1992; Warshawsky & Ameriks, 2001) while South African studies suggested a factor between 0,0% and 25,0% (Streak, Yu & Van der Berg, 2009; Woolard & Liebbrandt, 2006; Yatchew, Sun & Deri, 2003).

The fourth technical issue was how to derive consumption at retirement from current consumption. The literature suggested that pre-retirement consumption moves in line with net income (Palmer, 1989; Palmer, 1992; Palmer, 1994; Palmer, 2008; Hamermesh, 1984; Robb & Burbidge, 1989; Shefrin & Thaler, 1988; Burns & Widdows, 1990; Diamond & Hausman, 1984).

The final technical issue was how to define the household sample. Households deriving income from self-employment or farming activities were excluded by Hamermesh (1984) and Robb & Burbidge (1989). Robb & Burbidge (1989) deemed these exclusions necessary as self-employed and farming households typically have very unreliable income and consumption data as they are unable to distinguish clearly between their own cashflows and those of their business. The minimum age for a head of household used in the projection sample ranged from 25 (Robb & Burbidge, 1989) to 50 (Palmer, 1989; 1992; 1994; 2008).

2.2 Minimum Income underpins

Chia & Tsui (2003) defined minimally adequate consumption as the sum of the subsistence consumption level and an additional amount for healthcare consumption. These consumption levels were then used to derive a minimally adequate income level. South Africa lacks a single official poverty line (National Treasury, 2010) to use for this purpose, but the means-testing of the SOAG provides an implicit official measure that could be used as an alternative (Woolard & Liebbrandt, 2006).

2.3 Estimated targets in the literature

The literature indicated a wide range of optimal replacement ratio adequacy targets, shown in Table 2.1.
Table 2.1 Published optimal replacement ratio targets

<table>
<thead>
<tr>
<th>Author</th>
<th>Recommended replacement ratio target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burns &amp; Widdows (1990)</td>
<td>65%–80%</td>
</tr>
<tr>
<td>Malroutu &amp; Xiao (1995)</td>
<td>70%</td>
</tr>
<tr>
<td>Greninger, Hampton, Kitt &amp; Jacquet (2000)</td>
<td>70%–89%</td>
</tr>
<tr>
<td>Kotlikoff, Spivak &amp; Summers (1982)</td>
<td>80%</td>
</tr>
<tr>
<td>Engen, Gale &amp; Uccello (1999)</td>
<td>70%–80%</td>
</tr>
</tbody>
</table>

In all cases, the provenance of the recommended targets is unclear. It is unclear whether the targets in Table 2.1 are gross or net of tax, but are consistent with gross of tax estimates from Mitchell & Moore (1998) and the various studies by Palmer. In order to obtain net replacement ratios from the gross, an addition of approximately 20% would be required.

Table 2.2 shows these results for different household compositions converted to wealth-earnings ratios using annuity factors calculated by the target estimation model presented in Section 4.

Table 2.2 Wealth-earnings ratio targets (retirement age 65)

<table>
<thead>
<tr>
<th>Target as per Mitchell &amp; Moore (1998)</th>
<th>Gross replacement ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>65%</td>
</tr>
<tr>
<td>Single male</td>
<td>8,1</td>
</tr>
<tr>
<td>Couple (same age)</td>
<td>10,2</td>
</tr>
<tr>
<td>Couple (3 year gap)</td>
<td>10,6</td>
</tr>
<tr>
<td>Single female</td>
<td>9,6</td>
</tr>
</tbody>
</table>

The inflation-adjusted results for the Palmer studies for fully-employed households indicated that wealth-earnings targets between 8,8 and 13,5 times annual salary should be adequate.

2.4 Factors Influencing Retirement Adequacy Targets

Moore & Mitchell (1997) demonstrated that if all income were either saved or consumed, a higher savings rate would lower the retirement adequacy target due to reduced consumption.

Mitchell & Moore (1998) also indicated that increasing retirement age from 62 to 65 resulted in increased retirement adequacy targets for married couples and single
females although the savings rates for attaining these targets were lower. Mitchell & Moore (1998) indicated that the targets for single males decreased with retirement age.

Household composition was an important control variable in Palmer (1989; 1992; 1994; 2008), Mitchell & Moore (1998) and Hatcher (1997) but no strong relationships between household composition and the retirement adequacy target could be established. Yuh, Hanna & Montalto (1998) and Stoller & Stoller (2003) found that for households with no dependents, the targets for singles and couples were not significantly different. Cooper (2002) and Mitchell & Moore (1998) implied that sex was an important control variable, however Yuh, Hanna & Montalto (1998) found that it was not statistically significant. Hatcher (1997), Yuh, Hanna & Montalto (1998) and Palmer (1992) found that retirement adequacy targets decreased with income although Palmer (1989; 1994; 2008) suggested targets may increase at very high income levels.

Yuh (1998) found that for households that consume more than their income, having a mortgage did not increase the targets. However, for households living within their means, mortgage-free home owners had lower targets than renters who had lower targets than mortgage holders. Yuh, Hanna & Montalto (1998) found that debt had a highly significant impact on the targets.

Hatcher (1997) and Yuh (1998) found a positive relationship between years of education and the targets. Health-status was not found to be significant by Hatcher (1997) but was found to be a significant determinant by Stoller & Stoller (2003). Finally, Yuh (1998) did not find geographic region to be a significant determinant for retirement adequacy targets.

3. DATA
3.1 Introduction
The main data requirements were the household consumption data required to test for changes in consumption at and in retirement, and data for working households from which to estimate retirement adequacy targets. The data used for the first purpose was termed the ‘model development sample’ and the second data set was termed the ‘target estimation sample’. Both samples were derived from the Income and Expenditure Survey 2005/2006 (IES 2005/2006) following a process of data validation and imputation. There was a trade-off between data quality and sample size and it was decided to use a small, clean data sample rather than to use a larger sample with data of questionable quality or applicability. Although small, the samples were large enough for meaningful analysis. Both income and expenditure data in IES 2005/2006 may have been understated (Statistics South Africa, 2008; Streak, Yu & Van der Berg, 2009). Part of the expenditure under-reporting related to self-produced food or very low income households (Aliber, 2009) and excluding farming households was expected to alleviate part of this under-reporting. Given the poor debt data, expenditure was used to model consumption.

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3.2 Model development sample and target estimation sample

After an extensive data cleaning and checking process, there were 2,721 household records in the model development sample, which was used to estimate the change in consumption at and in retirement. In 2,094 households, no one in the household was retired. These were termed ‘working households’. A further 93 household records related to households where one person worked and one was retired. These were termed ‘semi-retired’ households. The remaining 534 households were ‘retired’ households, where everyone was retired. By comparison, Palmer (1989) used 2,544 working households and 1,217 retired households.

The model development sample was further refined by removing households with very large age gaps, non-savers and anomalous records to obtain a sample of 625 households for the target estimation sample.

3.3 Variables

The full lists of continuous and categorical variables used are given in Tables 3.1 and 3.2 respectively. The age variables were calculated from the ‘current age’, defined as the midpoint of the five-year age band recorded in the data rounded down to the nearest whole number.

Table 3.1 Continuous variables

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE1</td>
<td>The age of the head of the household</td>
</tr>
<tr>
<td>AGE2</td>
<td>The age of the partner in two-person households, coded as the head’s age in one-person households</td>
</tr>
<tr>
<td>AGEGAP</td>
<td>Age gap in a two-person household</td>
</tr>
<tr>
<td>AGEOLD</td>
<td>Age of the oldest person in the household</td>
</tr>
<tr>
<td>AGEYOUNG</td>
<td>Age of the youngest person in the household</td>
</tr>
<tr>
<td>AVGAGE</td>
<td>Arithmetic average of ages for two-person households and household head’s age for one-person households</td>
</tr>
<tr>
<td>HEXPR</td>
<td>Healthcare expenditure rate</td>
</tr>
<tr>
<td>INCPER1</td>
<td>Percentage income earned by the household head</td>
</tr>
<tr>
<td>INCPOLD</td>
<td>Percentage income earned by the oldest person in the household</td>
</tr>
<tr>
<td>JOINTAGE</td>
<td>Geometric average of ages for two-person households and household head’s age for one-person households</td>
</tr>
<tr>
<td>NHCONSR</td>
<td>Non-healthcare consumption rate</td>
</tr>
<tr>
<td>RSR</td>
<td>Actual retirement savings rate</td>
</tr>
</tbody>
</table>
Table 3.2 Categorical variables

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Description</th>
<th>Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC1</td>
<td>Highest educational attainment of the household head</td>
<td>No schooling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pre-primary or primary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some secondary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Completed secondary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Any further education</td>
</tr>
<tr>
<td>FEMALE1</td>
<td>Sex of household head</td>
<td>Female head</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male head</td>
</tr>
<tr>
<td>HCOMP</td>
<td>Household composition</td>
<td>Male head-female partner ('Male-female')</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female head-male partner ('Female-male')</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two males ('Male-male')</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two females ('Female-female')</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female alone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Male alone</td>
</tr>
<tr>
<td>HEDUC</td>
<td>Household educational attainments</td>
<td>Partner has less education than EDUC1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Both have EDUC1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Partner has more education than EDUC1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One-person household</td>
</tr>
<tr>
<td>HOWNER</td>
<td>Home ownership</td>
<td>Home owned</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Home rented</td>
</tr>
<tr>
<td>HSIZE2</td>
<td>Household size</td>
<td>Two-person</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One-person</td>
</tr>
<tr>
<td>MEDSCMR</td>
<td>Medical scheme membership</td>
<td>At least one person in the household is a medical scheme member</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No medical scheme members in household</td>
</tr>
<tr>
<td>MORT</td>
<td>Mortgage holding</td>
<td>Home mortgaged</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Home owned outright</td>
</tr>
<tr>
<td>RURAL</td>
<td>Type of settlement</td>
<td>Rural</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Urban</td>
</tr>
<tr>
<td>WORKSTAT</td>
<td>Work-status</td>
<td>Working</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Semi-retired</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Retired</td>
</tr>
</tbody>
</table>
3.4  Descriptions of the Samples

3.4.1 Age
The average age of the target estimation sample was 39.6 years while the average ages of working, semi-retired and retired households in the model development sample were 38.1, 55.4 and 70.7 respectively. The target estimation sample was young relative to the age limits imposed in Palmer (1989; 1992; 1994; 2008) and Diamond & Hausman (1984). The average age gap in the target estimation sample where couples were of different ages was 4.8 years.

3.4.2 Income and Dwelling Values
Retired and semi-retired households had lower incomes than working households in the model development sample. The target estimation sample had considerably higher average incomes and income (including income in kind) than the model development sample due to being comprised entirely of working households earning more than R24 424–50 p.p.p.a. as shown in Table 3.3.

| Table 3.3 Average income and income (including income in kind) for the samples |
|---------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
|                                 | Model development sample      | Target estimation sample      |
| Working                        | Semi-retired                  | Retired                       | Total                         |

It is important to note that income (including income in kind) included items such as employer contributions to post-retirement medical scheme arrangements and goods and services received by the elderly from their families. Cash transfers received by the elderly were included as income. As was consistent with Palmer (1989), dwelling values were substantially higher for retired and semi-retired households in spite of lower incomes. Dwelling values for semi-retired households and retired households were approximately 112.1% and 58.3% higher than for working households in the model development sample. The relative incomes from retired and working households cannot be taken as an indication of adequacy as the income received by retired households could be inadequate for their needs.

3.4.3 Savings Rates, Home Ownership and Mortgages
About 18.4% of households in the target estimation sample owned their homes outright with a further 14.4% having mortgages.

Savings rates as a percentage of income (including income in kind) p.p.p.a., given in Table 3.4, were above zero, even for retired households, which indicated
precautionary savings. But, for 64.5% of households in the target estimation sample, retirement savings rates were less than 10%.

Table 3.4 Savings rates as a percentage of income (including income in kind) p.p.p.a.

<table>
<thead>
<tr>
<th></th>
<th>Model development sample</th>
<th>Target estimation sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Working</td>
<td>Semi-retired</td>
</tr>
<tr>
<td>Non-retirement savings rate</td>
<td>5.5%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Retirement savings rate</td>
<td>2.8%</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

The retirement savings rates seem relatively low. However, this is partly a function of the savings rates being expressed as percentage of income including income in kind. The retirement savings rate as a percentage of cash income was somewhat higher at 9.1%. It should be borne in mind that industry statistics will reflect higher retirement savings rates due to the convention of expressing these as a percentage of pensionable salary.

It is also probable that there is an element of under-reporting of employer contributions. The understatement of the retirement savings rate was not expected to have a material impact on the results due to expenditure and not income being used to derive consumption.

4. THE TARGET ESTIMATION MODEL

4.1 Estimating adequacy targets at a household level

Target estimation calculations were performed at a household level, which was consistent with Palmer (1989; 1992; 1994; 2008) and Mitchell & Moore (1998). A cashflow model was adopted in line with Chia & Tsui (2003) and Milevsky & Robinson (2000). The model was run first using hypothetical savings rates as suggested by Mitchell & Moore (1998) and then again using actual household savings rates. Five different retirement ages were considered. It was decided to assume that if there was outstanding mortgage debt when the oldest person in the household retired, the mortgage would be paid in full on the retirement date.

The deterministic model used consumption data at the current age to project household consumption pre- and post-retirement, adjusting for changes in consumption at retirement. An expenditure requirement was calculated and the income level gross of tax required to provide for that expenditure was then calculated. The expected present value of the income was calculated at the retirement age. This discounted income need was then increased for the mortgage outstanding at retirement, and divided by earnings at retirement to give a wealth-earnings ratio.

The target estimation model hence had eight principle steps listed below:

— Step 1: Estimation of current consumption from expenditure;
— Step 2: Estimation of consumption at retirement;
— Step 3: Calculation of outstanding mortgage at retirement and associated tax;
— Step 4: Adjustment for the change in consumption at and during retirement;
— Step 5: Estimation of the comfortably adequate income required at each age of retirement;
— Step 6: Calculation of the expected present value of minimally and comfortably adequate incomes;
— Step 7: Adjustment of the expected present value of comfortably adequate incomes for the mortgage outstanding at retirement; and
— Step 8: Calculation of the adequacy levels.

The model limits the cash withdrawal at retirement to that required to settle mortgage debt. This has the effect of minimising the tax burden which results in lower retirement adequacy targets.

It is important to note that the model results presented in this paper do not allow for any source of income in retirement other than the pension and income support from a younger working spouse. No allowance was made for income support by other family members or employer subsidies towards medical schemes.

5. TESTS FOR CHANGES IN CONSUMPTION AND NON-RETIREMENT SAVINGS AT AND IN RETIREMENT

5.1 Introduction
The estimation of consumption changes at and in retirement was an important subsidiary aim of this research. This involved testing for effect of age and work-status. A Chi-Square Automatic Interaction Detection (CHAID) analysis was used. CHAID results in households being divided into exclusive and exhaustive sets where the characteristics of these sets are predictive of a dependent variable (Kass, 1980). This approach was broadly similar to the matched-pairs methodology described in Palmer (1989) but allowed for more than one criterion to be adopted in the matching process.

5.2 Estimation of the change in healthcare expenditure
Healthcare consumption was taken as equal to the change in healthcare expenditure, which was considered reasonable by Miniaci, Monfardini & Weber (2003).

For households with no medical scheme members, any age effect was controlled for by considering sex of the head of the household, work-status and per person income in kind. The analysis indicated that in male-headed households with no medical scheme members, there was increased healthcare expenditure after the last person in the household retired and that the increase was greater for wealthier households. This effect was significant at the 1% level. For all other households there was not a statistically significant change in healthcare expenditure as age or work-status changed. It is noted that the sex of the head of the household was expected to be predictive of healthcare expenditure and it is possible it was detected as a result of confounding.
5.3 Estimation of the change in non-healthcare consumption
Gifting was analysed separately, as Dexter (1984) and Palmer (1994; 2008) found very large increases in gifting at retirement. The gifting rate was defined as gift expenditure divided by income (including income in kind). Gifts can be broadly described as cash or in kind maintenance of or remittance to family members and gifts to non-household members. The CHAID analysis indicated that gifting behaviour was highly complex and work-status may be a significant predictor for renting households earning between R5 505 and R14 938 p.p.p.a. and all households earning R14 938 and R56 164–50 p.p.p.a. However, for these households gifting decreased 49.5% to 89.5% on retirement, and was significant at the 1% level.

Non-healthcare consumption was defined as total consumption of items not related to healthcare, and thus included expenditure on gifting. The CHAID analysis indicated that there was neither an age nor a work-status effect.

5.4 Savings
Non-retirement savings were calculated as savings other than to retirement funds, net of dissavings and adjusted for mortgage payments in excess of home owners’ imputed rental. The CHAID analysis suggested there was no age or work-status effect.

It was noted that healthcare expenditure was not predicted by non-healthcare consumption or non-retirement savings. Similarly, non-healthcare expenditure was not predicted by healthcare expenditure or non-retirement savings, and non-retirement savings was not influenced by expenditure. This presented a paradox as healthcare expenditure was seen to increase significantly at retirement for some groups but there was neither corresponding reduction in other consumption nor reduction in non-retirement savings to fund it. It was, in theory, possible for at least part of this increased healthcare budget share to come from the retirement savings that are eliminated in retirement.

6. TARGET ESTIMATION MODEL PARAMETERS
6.1 Inflation
Given that the target estimation model calculated items in real terms, the retirement adequacy targets would not have been sensitive to the inflation assumption. An inflation assumption of 6.0% p.a. was adopted in line with inflation estimated from bond yields estimates and the upper limit of the South African Reserve Bank's inflation targeting policy.

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6.2 Salary inflation
The salary inflation basis required assumptions for inflation-related salary increases and promotional salary increases. Since 1982, the real salary inflation rate, excluding allowances for improved productivity and promotional growth, has been approximately 2.0% which is consistent with Rusconi (2005). Hence the 2.0% assumption was adopted.

After the rate of promotional salary increase in a UK “example” salary scale (PEN) was multiplied by 1.01, the resultant salary scale was found to be similar to the promotional salary increases in the best estimate valuation basis adopted by Alexander Forbes. In the interests of transparency, the adjusted PEN scale was used. The promotional scale was extrapolated to age 69 by assuming the absence of promotional salary growth after age 64.

The combined inflation-related and promotional scale adopted for this research provided for real increases of approximately 4.5% p.a. from age 20 to 64.

6.3 Tax projection basis
6.3.1 Personal Income Tax Brackets
In order to avoid fiscal drag, the brackets and primary rebate needed to be adjusted for wage inflation. The inflationary salary increase assumption was applied to the brackets and primary rebate in line with historic experience. The secondary rebate had increased by approximately 0.5% less than the primary rebate between 2003 and 2010. Hence, a 1.5% p.a. real rate of increase was adopted for the secondary rebate.

6.4 Mortgage-related assumptions
6.4.1 Fees on Mortgages
Fee structures on mortgages were obtained from ABSA Bank Limited, First National Bank (a division of FirstRand Bank Limited), Nedbank Limited and Standard Bank of South Africa Limited, which had a combined market share of 94.8%. Average fees, weighted by market shares, were then calculated for different salary and outstanding balance profiles. The monthly fees ranged from R17–21 to R28–63 per month in March 2006 rands.

10 Faculty of Actuaries & Institute of Actuaries (2002). Formulae and Tables for Examinations of the Faculty of Actuaries and the Institute of Actuaries. The Institute of Actuaries, London, 190 pages
12 Income Tax Act (Act 58 of 1962); Taxation Laws Amendment Act (Act 30 of 2002); Taxation Laws Amendment Act (Act 8 of 2007)
13 Taxation Laws Amendment Act (Act 17 of 2009)
14 Small Business Tax Amnesty and Amendment of Taxation Laws Act (Act 9 of 2006)
6.4.2 Tax on Debt Settlement
The income required to settle the mortgage at retirement was taxed according to the scale in the Taxation Laws Amendment Act\(^{13}\) and the real tax brackets were assumed to remain constant.

6.5 Minimum income level
Since 22 August 2008, the SOAG payable has been based only on income and not a combination of income and assets.\(^{16}\) The income below which no SOAG is paid has averaged R22,224 p.p.a. in March 2006 rands over the period between August 2008 and April 2010.\(^{16,17}\) This level of income would not be taxable\(^ {14}\) and was assumed constant in real terms. No adjustment was made on the death of a spouse.

6.6 Changes in consumption at retirement
Given the results of the CHAID analysis, it was decided to allow for increases in healthcare consumption at retirement for male-headed households without any medical scheme members, according to Table 6.1.

It was decided to affect this increase on the date of the oldest person’s retirement. No other changes in consumption at retirement were modelled in line with the findings from Section 5.

Table 6.1 Healthcare consumption increases on retirement

<table>
<thead>
<tr>
<th>Income p.p.a.</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>R24,424–50–R99,341</td>
<td>187.1%</td>
</tr>
<tr>
<td>R99,341 or more</td>
<td>184.3%</td>
</tr>
</tbody>
</table>


6.7 Changes in consumption in retirement

6.7.1 Inflationary Changes

It was decided to use assumption that healthcare inflation was 2,5% above price inflation and non-healthcare inflation was 0,19% below price inflation which is consistent with observed inflation statistics over the period 2001 to 2008.\(^{18,19}\)

Due to the higher inflation on healthcare consumption than non-healthcare consumption, over time the budget share for healthcare would dominate the non-healthcare budget share unless capped. Hence, it was decided to limit the healthcare budget share to 10% which was similar to the caps used by Russel (2005) and Xu et al. (2003). It is noted that some South African research indicates that pensioners can spend at least 25%\(^{20}\) of their net of tax pensions on healthcare, however adopting a higher threshold would have only served to increase the retirement adequacy targets.

6.7.2 Loss of Economies of Scale

It was assumed that the per person comfortably adequate consumption increased by 9,25% on widowhood in line with Streak, Yu & Van der Berg (2009). This implied an immediate decrease in housing consumption on widowhood which may not be realistic.

6.8 Assumptions relating to the annuitisation of the post-retirement income

Some households would find it preferable to manage their longevity risk by purchasing commercial annuities with their retirement wealth (Levitan, Dolya & Rusconi, 2010; Albrecht & Maurer, 2002; Kotlikoff & Spivak, 1981). It was hence decided to use discounting assumptions that would be consistent with those used to price commercial annuities.

6.8.1 Post-Retirement Investment Return Assumptions

Real investment returns net of fees and capital charges on a with-profits annuity series offered by a large South African insurer were approximately 4,0% p.a. over the eight years to 2010.\(^{21}\) This investment return was gross of the insurer’s expense, risk and profit loadings and hence is not equivalent to an after retirement interest rate on a with-profits policy. Consideration of long-dated index-linked bond yields\(^{8,22}\) and regulatory fee adjustments\(^{22}\) provided an interest rate estimate of 2,7%. Optimal portfolio research produced a range of real investment return assumptions, some of which

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22 Minimum Reserve Regulations: Board Notice 37 in terms of the Pension Funds Act No. 24 of 1956 (2007)
were consistent with Rusconi (2005) which used a rate of 5.0% p.a. Consequently, a pessimistic rate of 3.0%, a best estimate rate of 4.0% and an optimistic rate of 5.0% were adopted.

6.8.2 Insurer’s Profit Margin and expenses
With-profits annuity data,\(^{21}\) suggested a profit margin of 0.5% p.a., which was in line with Chia & Tsui (2003). Administration fees were set at 2.04% of each annuity payment. The maximum commission on life annuities of 2.0% (excluding VAT) was also levied on the expected present value of monthly income needs. It was not levied on the wealth required to settle the mortgage outstanding at retirement. These assumptions were consistent with disclosed fees and commissions on with-profits annuities.\(^{21}\)

6.8.3 Mortality
Mortality was ignored in the household before the oldest person retired. For retired persons, the South African Annuitant Standard Mortality Tables 1996–2000 Male Lives (SAIML98) and the South African Annuitant Standard Mortality Tables 1996–2000 Female Lives (SAIFL98) developed by Dorrington & Tootla (2007) were used for male and female lives respectively. Mortality improvements were factored through a reduction of one year of age for every twenty years projected from 1998 (Dorrington & Tootla, 2007).

7. STATISTICAL MODELS
7.1 Best estimate targets without salary support
A CHAID analysis indicated the data should be segmented before modelling into two groups:
— Female alone, male-female and female-male households (‘Group 1’); and
— Male alone and same-sex couples (‘Group 2’).

There was also statistical justification for segmentation of Group 2 households by income.

7.1.1 Regression Analysis
7.1.1.1 Group 1 households
For all retirement ages, the target could be estimated using a model:

\[
\hat{\text{Target}} = \hat{\alpha} + \hat{\beta}_1 \text{FEMALE} + \hat{\beta}_2 \text{RURAL} + \hat{\beta}_3 \text{AVGAGE} + \hat{\beta}_4 \text{PPINCOME} \tag{7.1}
\]

where:
- \(\hat{\text{Target}}\) is the estimated retirement adequacy target;
- \(\hat{\alpha}\) is the estimated intercept; and
- \(\hat{\beta}\) is the estimated slope coefficient for the associated independent variable.

The estimated regression parameters are given in Table 7.1.
### Table 7.1 Regression parameters for Group 1 households

<table>
<thead>
<tr>
<th>Retirement age</th>
<th>Interceptor</th>
<th>Female1</th>
<th>Rural</th>
<th>Average</th>
<th>PPINCOME</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>13.33 ***</td>
<td>1.15 **</td>
<td>-1.30 **</td>
<td>0.07 **</td>
<td>-5.36×10^{-6} *</td>
<td>0.1224</td>
</tr>
<tr>
<td>63</td>
<td>12.09 ***</td>
<td>1.13 **</td>
<td>-1.28 **</td>
<td>0.07 ***</td>
<td>-4.25×10^{-6} *</td>
<td>0.1337</td>
</tr>
<tr>
<td>65</td>
<td>11.52 ***</td>
<td>1.20 **</td>
<td>-1.20 **</td>
<td>0.08 ***</td>
<td>-4.72×10^{-6} **</td>
<td>0.1556</td>
</tr>
<tr>
<td>67</td>
<td>10.90 ***</td>
<td>1.11 **</td>
<td>-1.15 **</td>
<td>0.07 ***</td>
<td>-4.48×10^{-6} **</td>
<td>0.1529</td>
</tr>
<tr>
<td>70</td>
<td>10.00 ***</td>
<td>0.86 **</td>
<td>-1.12 **</td>
<td>0.06 ***</td>
<td>-4.32×10^{-6} **</td>
<td>0.1442</td>
</tr>
</tbody>
</table>

*Significant at the 5% level  **Significant at the 1% level  ***Significant at the 0.01% level

### 7.1.1.2 Group 2 Households

In order to obtain normally distributed error terms, the data were segmented into households earning less than R50 000 p.p.p.a. and those earning R50 000 p.p.p.a. or more. A model with normal error terms could not be obtained for the poorer group, although a model was obtained for the wealthier subset and is set out in equation (7.2).

\[
\text{Target} = \alpha + \hat{\beta}_1 \text{HOWNER} + \hat{\beta}_2 \text{RSR} + \hat{\beta}_3 \text{AGEYOUNG} + \hat{\beta}_4 \text{PPINCOME} \quad (7.2)
\]

Table 7.2 gives the estimated regression parameters. The age of the youngest household member was significant for only for retirement ages of 65 and older.

### Table 7.2 Regression parameters for Group 2 households earning R50 000 p.p.p.a. or more

<table>
<thead>
<tr>
<th>Retirement age</th>
<th>Intercept</th>
<th>HOWNER</th>
<th>RSR</th>
<th>AGEYOUNG</th>
<th>PPINCOME</th>
<th>R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>13.78 ***</td>
<td>0.78 *</td>
<td>5.42 **</td>
<td>-9.23×10^{-6} ***</td>
<td>-9.23×10^{-6} ***</td>
<td>0.1134</td>
</tr>
<tr>
<td>63</td>
<td>12.63 ***</td>
<td>0.75 *</td>
<td>4.92 **</td>
<td>-8.55×10^{-6} ***</td>
<td>-8.55×10^{-6} ***</td>
<td>0.1144</td>
</tr>
<tr>
<td>65</td>
<td>11.29 ***</td>
<td>0.70 *</td>
<td>4.46 **</td>
<td>-8.76×10^{-6} ***</td>
<td>-8.76×10^{-6} ***</td>
<td>0.1443</td>
</tr>
<tr>
<td>67</td>
<td>10.64 ***</td>
<td>0.66 *</td>
<td>4.16 **</td>
<td>-8.33×10^{-6} ***</td>
<td>-8.33×10^{-6} ***</td>
<td>0.1442</td>
</tr>
<tr>
<td>70</td>
<td>9.66 ***</td>
<td>0.63 *</td>
<td>3.66 *</td>
<td>-8.43×10^{-6} ***</td>
<td>-8.43×10^{-6} ***</td>
<td>0.1590</td>
</tr>
</tbody>
</table>

*Significant at the 5% level  **Significant at the 1% level  ***Significant at the 0.01% level
7.1.2 **Interquartile Ranges**
The spread of the retirement adequacy targets calculated by the target estimation model was explored using interquartile ranges. The range between the 25th and 75th percentiles for the three household groups identified by the CHAID analysis is given in Table 7.3.

### Table 7.3 Interquartile ranges for best estimate targets without salary support

<table>
<thead>
<tr>
<th>Retirement age</th>
<th>Group 1</th>
<th>Group 2 earning less than R50 000 p.p.p.a.</th>
<th>Group 2 earning R50 000 p.p.p.a. or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>13.9–17.0</td>
<td>13.4–14.6</td>
<td>12.2–14.2</td>
</tr>
<tr>
<td>63</td>
<td>12.9–15.9</td>
<td>12.3–13.4</td>
<td>11.1–13.0</td>
</tr>
<tr>
<td>65</td>
<td>12.6–15.5</td>
<td>12.3–13.1</td>
<td>10.8–12.7</td>
</tr>
<tr>
<td>67</td>
<td>11.9–14.7</td>
<td>11.6–12.4</td>
<td>10.2–12</td>
</tr>
<tr>
<td>70</td>
<td>10.7–13.3</td>
<td>10.6–11.3</td>
<td>9.1–10.8</td>
</tr>
</tbody>
</table>

N 226 236 172 177 214 215

The segmentation suggested by the CHAID analysis was not intuitive. The upper-quartile values for the retirement adequacy targets for each household composition are set out in Table 7.4.

### Table 7.4 Seventy-fifth percentile of the best estimate retirement adequacy targets

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>18.2</td>
<td>14.3</td>
<td>16.5</td>
<td>15.8</td>
<td>15.1</td>
<td>14.0</td>
</tr>
<tr>
<td>63</td>
<td>16.9</td>
<td>13.2</td>
<td>15.4</td>
<td>14.6</td>
<td>14.0</td>
<td>12.8</td>
</tr>
<tr>
<td>65</td>
<td>16.6</td>
<td>12.9</td>
<td>15.1</td>
<td>14.1</td>
<td>13.7</td>
<td>12.4</td>
</tr>
<tr>
<td>67</td>
<td>15.7</td>
<td>12.2</td>
<td>14.3</td>
<td>13.2</td>
<td>12.9</td>
<td>11.7</td>
</tr>
<tr>
<td>70</td>
<td>14.3</td>
<td>11.1</td>
<td>12.8</td>
<td>12.1</td>
<td>11.7</td>
<td>10.5</td>
</tr>
</tbody>
</table>

7.2 **Sensitivity of the results to the interest rate**
The impact of a change in the interest rate on the targets and the effect of salary support can be observed by consideration of the interquartile ranges. The interquartile ranges for the targets are given in Table 7.5.
Table 7.5 Interquartile ranges of targets for various interest rate assumptions

<table>
<thead>
<tr>
<th>Household composition</th>
<th>Basis</th>
<th>Retirement age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Group 1</td>
<td>Pessimistic</td>
<td>15,5–19,2</td>
</tr>
<tr>
<td></td>
<td>Best estimate</td>
<td>13,9–17,0</td>
</tr>
<tr>
<td></td>
<td>Optimistic</td>
<td>12,5–15,3</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>226</td>
</tr>
<tr>
<td>Group 2 earning less than R50 000 p.p.a.</td>
<td>Pessimistic</td>
<td>14,8–16,2</td>
</tr>
<tr>
<td></td>
<td>Best estimate</td>
<td>13,4–14,6</td>
</tr>
<tr>
<td></td>
<td>Optimistic</td>
<td>12,1–13,3</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>172</td>
</tr>
<tr>
<td>Group 2 earning more than R50 000 p.p.a.</td>
<td>Pessimistic</td>
<td>13,5–15,8</td>
</tr>
<tr>
<td></td>
<td>Best estimate</td>
<td>12,2–14,2</td>
</tr>
<tr>
<td></td>
<td>Optimistic</td>
<td>11–12,9</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>214</td>
</tr>
</tbody>
</table>

The interquartile ranges for the impact of salary support on the retirement adequacy targets at various retirement ages and on the three interest rate bases are given in Table 7.6.

Table 7.6 Interquartile ranges of the effects of salary support for various interest rate assumptions

<table>
<thead>
<tr>
<th>Retirement age</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
</tr>
<tr>
<td>Pessimistic</td>
</tr>
<tr>
<td>Best estimate</td>
</tr>
<tr>
<td>Optimistic</td>
</tr>
<tr>
<td>N</td>
</tr>
</tbody>
</table>

7.3 The effect of salary support on the best estimate targets
Salary support was defined as the wages or salary earned by the working person in a semi-retired household. The impact of salary support on the retirement adequacy targets was estimated by subtracting the estimated retirement adequacy target for a household allowing for salary support from the estimated retirement adequacy target.
not allowing for salary support. After eliminating outliers, the model described in equation (7.3) was found to be consistent for various retirement ages:

\[ SS = \hat{\alpha} + \beta_{AGEGAP} + \beta_{PPINCOME} + \beta_{FEMALE1} + \beta_{YRSID1} + \beta_{INCPOLD} \]  (7.3)

Where SS is the estimated effect of salary support on the retirement adequacy targets. The regression parameters are given in Table 7.7.

### Table 7.7 Regression parameters for the effect of salary support on the targets on a best estimate basis

<table>
<thead>
<tr>
<th>Retirement age</th>
<th>60</th>
<th>63</th>
<th>65</th>
<th>67</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.70 ***</td>
<td>3.59 ***</td>
<td>3.53 ***</td>
<td>3.22 ***</td>
<td>3.47 ***</td>
</tr>
<tr>
<td>GAP</td>
<td>0.34 ***</td>
<td>0.32 ***</td>
<td>0.32 ***</td>
<td>0.28 ***</td>
<td>0.28 ***</td>
</tr>
<tr>
<td>PPINCOME</td>
<td>5.06×10^{-7} *</td>
<td>6.32×10^{-7} **</td>
<td>6.60×10^{-7} **</td>
<td>5.69×10^{-7} **</td>
<td>4.75×10^{-7} *</td>
</tr>
<tr>
<td>FEMALE1</td>
<td>0.10 *</td>
<td>0.11 *</td>
<td>0.12 *</td>
<td>0.13 **</td>
<td>0.12 *</td>
</tr>
<tr>
<td>YRSID1</td>
<td>0.02 **</td>
<td>0.02 *</td>
<td>0.02 *</td>
<td>0.02 *</td>
<td>0.02 **</td>
</tr>
<tr>
<td>INCPOLD</td>
<td>-5.69 ***</td>
<td>-5.45 ***</td>
<td>-5.37 ***</td>
<td>-4.86 ***</td>
<td>-5.07 ***</td>
</tr>
<tr>
<td>R²</td>
<td>0.9866</td>
<td>0.9822</td>
<td>0.9793</td>
<td>0.9786</td>
<td>0.9765</td>
</tr>
<tr>
<td>Model F</td>
<td>1 176.22 ***</td>
<td>905.19 ***</td>
<td>665.65 ***</td>
<td>750.45 ***</td>
<td>682.01 ***</td>
</tr>
</tbody>
</table>

*Significant at the 5% level **Significant at the 1% level ***Significant at the 0.01% level

#### 7.3.1 Interquartile ranges

The range of the effect of salary support on the retirement adequacy targets from the 25th to the 75th percentile is given in Table 7.8.

### Table 7.8 Interquartile ranges for the effect of salary support on the targets

<table>
<thead>
<tr>
<th>Retirement age</th>
<th>60</th>
<th>63</th>
<th>65</th>
<th>67</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary Support</td>
<td>2.2–3.5</td>
<td>2.1–3.3</td>
<td>2.1–3.2</td>
<td>1.9–2.8</td>
<td>2.0–3.0</td>
</tr>
<tr>
<td>N</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

#### 7.4 Repeated measures ANOVA and post-hoc tests

Repeated measures ANOVA tests were performed at a household level to test whether increasing the retirement age impacted on the target. The pairwise comparisons of
means using a Bonferroni adjustment showed that as retirement age increased, the target decreased and this effect was significant at the 0,01% level.

Using the simulated targets for hypothetical retirement savings rates and retirement ages, it was possible to assess the impact of varying both retirement age and savings rate using a repeated measures ANOVA test. Both these factors and their interaction were found to be significant at the 0,01% level. The differences in least squares means indicated that as retirement age and savings rates increase, the target may decrease.

8. DISCUSSION, CONCLUSIONS AND IMPLICATIONS
8.1 Changes in consumption and savings at retirement
8.1.1 Methodology
The CHAID analysis was more sophisticated than the matched-pairs methodology used by Palmer (1989; 1992; 1994; 2008) that matched households only by income and household composition. The CHAID analysis suggested that income (including income in kind), medical scheme membership, home ownership status, dwelling value and education of household head were also significant.

8.1.2 Consumption
The research suggested that consumption did not decline on retirement and for certain households, healthcare consumption may have increased sharply. However, it should be noted that healthcare expenditure formed a relatively small part of household budget share and the fact that healthcare expenditure data in IES 2005/2006 was collected over a period of only one month meant the healthcare expenditure effect should be interpreted with caution.

For households that experienced an increase in healthcare expenditure on retirement, the increase in annual healthcare consumption was equal to approximately 59,2% of the annual retirement savings, which indicated that it is feasible for the increase in healthcare consumption on retirement to have no impact on other consumption.

8.1.3 Non-retirement savings
The fact that there was no age or work-status effect on non-retirement savings suggested that if income levels were high enough, pensioners would continue to save. The retirement adequacy targets derived in this research did not include provision for savings in retirement. A 15,0% upward multiplicative adjustment would approximately adjust for savings.

8.1.4 Tax
In South Africa reduced tax rates are a function of age and not of work-status, and the earliest benefit is seen only at age 65. It is possible for individuals retiring at age 65 to have a sudden drop in their marginal tax rate. However, there would be not necessarily be a sharp drop in tax liability at retirement.
8.1.5 Summary
Apart for retirement savings, there is no reason to assume that a household that retires has gross income needs any lower than an identical household that continues working.

8.2 Limitations and areas for future research

8.2.1 Data and Sample Definition
The small sample size was a reflection of the controls employed to ensure, firstly, the integrity of the data and, secondly, that the households used were appropriate in terms of restrictions discussed in the literature. The resulting data sample was considered reasonable and complete. Replicating this research on a larger data sample and updating the tax assumptions used may improve the applicability of the results.

8.2.2 Children
Completely removing children from the sample avoided complicated adjustments for childcare costs, typically assumed to reduce in retirement (Engen, Gale & Uccello, 1999). However, it introduced the implicit assumption that, once children leave home, consumption patterns return to the levels they were before the birth of children. Stoller & Stoller (2003) suggested that consumption levels may be higher for empty-nesters due to gifting behaviour. The target estimation sample may have included both childless households and households with grown children who had left home. If Stoller & Stoller (2003) are correct, the resultant targets would be sensitive to the mix of these households in both the model development sample and the target estimation samples. There is no logical reason to associate the cessation of childcare costs with retirement. In certain households, childcare costs may cease well before retirement, while in others they continue for years into retirement.

8.2.3 Sensitivity to the Interest Rate
The estimated targets were found to be extremely sensitive to changes in the interest rate assumption, particularly at early retirement ages. From a retirement planning perspective, short-term changes in interest rates may cause fluctuations in annuity rates and wealth which may, in turn, influence the individual’s ability to secure an adequate income in retirement. Ensuring that pre-retirement and post-retirement investment strategies are matched would reduce this effect.

8.2.4 Sensitivity to Mortality
The sensitivity of the retirement adequacy targets to the mortality assumptions has yet to be tested.

8.2.5 Updating the Taxation Assumptions
Changes were introduced during the 2011/2012 tax year to personal income tax and to the taxation of cash withdrawals from retirement funds at retirement. These have yet to be incorporated into the model.
8.2.6 Income Support in Retirement
No allowance was made for income support by family members other than a spouse and this is an area of future model development.

8.3 Effect of retirement age and retirement savings rate on the target
8.3.1 Retirement Age
The repeated measures ANOVA confirmed that as retirement age increases, the targets decrease. The smallest reduction was observed for increasing the retirement age from 63 to 65. For all household types, the reductions were an increasing function of the deferment period.

8.3.2 Retirement Savings Rate
The repeated measures ANOVA on the hypothetical savings rate indicated that the model was calculating targets correctly, and that retirement adequacy targets decreased as the retirement savings rate increased as per Mitchell & Moore (1998). However, using actual savings rates resulted in contradictory findings which may result from a combination of reporting errors, confounding, spurious selection and the modelled relationship between savings and consumption which ignores debt.

8.4 Factors that influence the targets
It is difficult to comment on how various factors influence targets for Group 2 households earning under R50 000 p.p.a. as an examination of simple correlations may have given spurious results. As there were only 35 same-sex couples and seven female-male households in the target estimation sample, results for these households should be interpreted with caution.

8.4.1 Factors that Influence the Targets without Salary Support
The results suggested that targets for the following household groups were different:
— Male-female households in rural areas;
— Male-female households in urban areas;
— Single female and female-male households in rural areas;
— Single female and female-male households in urban areas;
— Single male and same-sex households earning less than R50 000 p.p.a.;
— Single male and same-sex households earning more than R50 000 p.p.a. that rent; and
— Single male and same-sex households earning more than R50 000 p.p.a. that own their homes outright or with a mortgage.

Higher incomes were associated with lower targets as was living in a rural area, which may be associated with lower consumption. Older households and home owners tended to have higher targets although this may be a result of higher unpaid housing debt at retirement. A second possible explanation for the home ownership effect is
that owners tended to have higher dwelling values as a multiple of annual salary than renters, and this may have influenced other consumption behaviour such as paying higher maintenance costs, rates and taxes. The dwelling value to annual salary ratio for wealthy Group 2 households was 0.8 for renters and 1.4 for owners, which supported this hypothesis. Having a female head of household tended to increase the cost of the annuity and hence increase the targets.

8.4.2 Factors that Influence the Effect of Salary Support on the Targets
Separating the dates of retirement for two-person households where there was a discernable age gap resulted in the retirement adequacy target being reduced, because the rate of increase of consumption during the semi-retirement phase was suppressed and retirement was deferred. There were a small number of households with age gaps of ten years or more, but the median reduction in the best estimate target due to salary support ranged from 2.4 to 2.6 times annual salary with the greatest reductions for lower retirement ages.

Mathematically, the salary support factor is equal to the annuity factor for the household multiplied by the percentage of the household income earned by the younger person. The effect of salary support on the targets was a function of five different factors, namely the age gap, income p.p.p.a., sex of household head, number of years of education of the household head and the percentage of household income earned by the older person in the household. However, on closer investigation sex of the household head and years of education were all associated with larger age gaps. Higher incomes were associated with higher annuity factors.

8.5 The level of the targets suggested by South African data

8.5.1 Relative to Published Targets
The derived retirement adequacy targets were found to be higher than, or in the highest ranges of, the targets suggested in the literature. On a best estimate basis, the upper quartiles of the retirement adequacy targets ranged from between 12.4 and 16.6 times annual salary at age 65 while the targets in the literature ranged from 8.1 to 13.5 times annual salary.

8.5.2 Relative to Other Household Compositions
There was very little overlap of the interquartile ranges for Group 2 households earning more than R50 000 p.p.p.a. and Group 1 households, suggesting that the targets for Group 1 households may be higher than those of wealthy Group 2 households. This was consistent with the relationships in Mitchell & Moore (1998) and Palmer (1994; 2008).
8.5.3 Relative to Targets used by South African Retirement Funds

Most retirement funds used a replacement ratio target of between 70% and 79%\(^{23}\) which this research suggests may be inadequate. A gross replacement ratio target of 79% was inadequate for at least 82.0% of single females and at least 88.7% of single males. Allowing for salary support, the target would be inadequate for at least 50.4% of male-female and female-male households and 40.0% of male-male and female-female households. The cumulative distribution function of the retirement adequacy targets on a replacement ratio scale, shown in Figure 8.1, implies that a net replacement ratio target of 100% would be adequate for most households.

8.5.4 Relative to what is Obtainable through Saving

Table 8.1 indicates the percentage of salary required to be saved annually to retirement age in order to obtain a target wealth-earnings ratio, using a net real rate of return of 5.0% p.a. and given different ages at which the household starts to save.


![Figure 8.1](image-url)
Table 8.1 Savings rates required to meet a given wealth-earnings ratio target

<table>
<thead>
<tr>
<th>Wealth-earnings ratio</th>
<th>Retirement age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Start age</td>
</tr>
<tr>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td>9</td>
<td>6,1%</td>
</tr>
<tr>
<td>10</td>
<td>7,6%</td>
</tr>
<tr>
<td>11</td>
<td>10,0%</td>
</tr>
<tr>
<td>12</td>
<td>10,9%</td>
</tr>
<tr>
<td>13</td>
<td>11,8%</td>
</tr>
<tr>
<td>14</td>
<td>12,7%</td>
</tr>
<tr>
<td>15</td>
<td>13,6%</td>
</tr>
<tr>
<td>16</td>
<td>14,5%</td>
</tr>
<tr>
<td>17</td>
<td>15,4%</td>
</tr>
<tr>
<td>18</td>
<td>16,3%</td>
</tr>
<tr>
<td>19</td>
<td>17,2%</td>
</tr>
</tbody>
</table>

If savings are made consistently from age 22, on a best-estimate and optimistic basis, a contribution rate of 10,9% of income p.p.a. should be sufficient to provide an adequate retirement benefit for most households from age 65 upwards. Even using a pessimistic post-retirement investment return assumption, a 10% savings rate is sufficient to secure a comfortably adequate retirement income from the ages of 67 or 70 for about 75% of target estimation sample.

However, consistent saving from age 22 ignores the possibility of unemployment and the leakage of retirement savings which may accompany it. The analysis of the savings rates required from age 30 indicates that many households will not be able to enjoy a comfortable retirement should they retire before age 67. A comfortable retirement at age 67 may not be feasible for single women, couples of the same age, and some poorer single males and same-sex couples, unless post-retirement interest rates are very favourable. However, couples where there is an age gap of five years or more may be able to achieve their targets at age 67 on a best-estimate basis.

Given that the average retirement savings rate in the target estimation sample was 7,7%, the results suggest that retirement before age 67 is not feasible. However, there are a number of stakeholders in the retirement decision, including the state, the...
retirement fund, the employer and the employee. The Income Tax Act defines ‘normal retirement age’ as the age at which members of retirement funds become entitled to retire but allows any withdrawal after age 55 to be taxed as a retirement benefit. If the employer’s retirement fund rules were worded to make members ineligible as fund members after the normal retirement age and the conditions of employment necessitate active membership of the retirement fund, there would be no contractual protection for employees to remain employed after normal retirement age. Such provisions may make it difficult for fund members to reach the retirement adequacy targets, especially for normal retirement ages of 65 or less.

8.6 Conclusions and findings
The conclusions from this research can be summarised as follows:

- Non-healthcare consumption does not decrease at retirement;
- Healthcare expenditure may increase at retirement;
- The effect of retirement savings on the retirement adequacy target is unclear;
- The retirement adequacy target decreases with retirement age;
- Salary support can lower the adequacy target by more than extending the retirement age;
- Different targets apply based on household characteristics, particularly household composition, income, home ownership and location;
- Retirement adequacy targets may decrease with income;
- Single females and female-male households may have higher targets than male-female households; and
- Home ownership can increase targets.

8.7 Implications
The research has practical implications for policy makers, retirement fund trustees, financial planners and individuals saving for retirement. However, it is also important to note that that an individual achieving the retirement adequacy target does not guarantee an adequate income in retirement. The targets were calculated based on certain assumptions, including transferring the longevity risk to an insurer though the purchase of an annuity. Should individual behaviour and experience differ from the assumptions, the retirement adequacy target may be more than sufficient or inadequate.

8.7.1 Retirement Adequacy Targets may be Higher than Previously Suggested which may Require Remedial Action
Replacement ratio retirement adequacy targets of between 75% and 79% may be insufficient for between 40% and 90% of fund members depending on the household compositions, before allowing for post-retirement savings. In order to meet these higher adequacy targets, funds could:

24 Act 58 of 1962
— Increase retirement ages, as discussed in Section 8.3.1;
— Encourage semi-retirement in two-person households where there is an age gap, as discussed in Section 8.4.2;
— Increase retirement savings rates, although this may not reduce the targets themselves as discussed in Section 8.3.2; and
— Increase expected investment return net of all expenses.

The final point relates to pre-retirement wealth accumulation as opposed to retirement adequacy targets and hence was not discussed in detail in this research although the retirement adequacy targets should be considered in setting investment strategies as discussed in Section 1.1. An investigation into the relative merits of these arrangements is beyond the scope of this research.

Given the initial replacement ratio adequacy targets of 40% and 75%, policymakers involved in the reform of retirement funds may need to increase their expectations of what is sufficient.

8.7.2 It is Unlikely there is a Single Target that is Appropriate for all Households

The retirement adequacy targets were found to be complex functions of a number of factors. Although quartile analysis provided insight into what target may be appropriate for a group of people who are, say, members of the same retirement fund or the target population for a state retirement savings scheme, changes in the mix of household characteristics could influence the target for the group.

Depending on the household composition, 75th percentiles of the targets were in the region of 14.0 to 18.0 times annual salary for retirement age 60 and reduced to between 12.5 and 16.5 and between 10.5 and 14.5 times annual salary for retirement ages 65 and 70 respectively.

8.7.3 Later Retirement Ages may Improve the Feasibility of Meeting the Targets

Given the information in Table 8.1 and reported savings levels for the target estimation sample, a comfortable retirement at age 65 would require a favourable combination of full employment and net real investment returns of 5.0% p.a. or more. The research suggested that retiring at 67 or 70 may allow for more households to experience a comfortably adequate retirement.

8.7.4 It Could be Difficult to Apply the Target Estimation Model to Retirement Funds

In theory, the target estimation model could be applied at a retirement fund level. However, only the very largest funds would have sufficient households containing only one or two adults to allow for a meaningful analysis.
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