

# Saving for Retirement: Replacement rate projections

by Daniel R Wessels

January 2015

# The four variables determining how much capital will be available at retirement

- Savings rate as a percentage of gross income
- Investment portfolio returns (real = after-inflation)
- Contribution period (savings term)
- Income growth rate relatively to inflation rate

## The Basic Model used to project how much retirement capital will be available

Gross annual income	250,000	
Pensionable salary	187,500	
Contribution towards retirement fund (own & employer)		22.50%
Less risk benefits premium		3.50%
Less admin charges		1.50%
Net contribution towards retirement savings		17.50%
Net savings rate as percentage of gross income .....(1)		12.50%
Growth in annual income..... (2)		5.0%
Inflation rate p.a.		5.0%
Real portfolio return p.a. ....(3)		5.00%
Standard Deviation of annual portfolio return		15.00%
Contribution term (years).....(4)		40
Contributions over term	3,774,993	
Retirement fund value at retirement	31,979,662	
Annualised portfolio return (simulated)		10.8%
Final year's gross income	1,676,188	
Retirement value as factor of final year's gross income	19.08	
Retirement income required as percentage of final year's gross income		100%
Retirement income required	1,676,187.79	
Retirement value as factor of retirement fund value	19.08	
Implied initial withdrawal rate		5.2%
Max initial withdrawal rate "allowed"		5.00%
Implied retirement income as factor of retirement fund value	20.00	
Implied retirement income	1,598,983	
Implied replacement rate		95%

## Notes:

- Contributions (own & employer) towards retirement plan typically only based on pensionable salary; non-pensionable salary, such as bonuses, travel allowances, etc., not included.
- Thus, savings rate of gross income is often not the same as the contribution rate towards retirement plan

## **Replacement rate...**

How much of one's pre-retirement income can be replaced by post-retirement income?

- Post-retirement income...The more the better, but at least 75% of pre-retirement income, ideally 100%, but the sustainability thereof and adjustment of income with future inflation are important...
- Initial drawdown (withdrawal rate) must not be too high, otherwise jeopardizing the ability of future income generation of retirement plan

## ***Implied* replacement rate...**

- Allow a maximum initial drawdown (withdrawal rate) of 5% of retirement capital available, i.e. upper-boundary level.
- How much of pre-retirement income will then be replaced by post-retirement income?

## Methodology

- Test assumptions and project possible *implied* replacement rates by means of Monte Carlo simulations
- 5,000 repetitions to generate a probability distribution
- Probability distribution i.t.o. percentiles
  - 10<sup>th</sup> percentile = 90% of all simulations showed at least equal and better results
  - 25<sup>th</sup> percentile = 75% of all simulations showed at least equal and better results
  - 40<sup>th</sup> percentile = 60% of all simulations showed at least equal and better results
  - Median = midpoint, 50% of simulation results were at least equal and better
  - 60<sup>th</sup> percentile = 40% of all simulations showed at least equal and better results
  - 75<sup>th</sup> percentile = 25% of all simulations showed at least equal and better results
  - 90<sup>th</sup> percentile = 10% of all simulations showed at least equal and better results

## Possible Implied Replacement Rates at different savings rates and contribution periods

**Savings rate 10% of gross income**, real portfolio return = 5% p.a., income growth = inflation

Contribution period (years)	30	35	40	45
90th percentile	59%	85%	114%	156%
75th percentile	43%	59%	78%	103%
60th percentile	34%	46%	60%	78%
<b>median</b>	<b>30%</b>	<b>40%</b>	<b>51%</b>	<b>66%</b>
40th percentile	27%	35%	43%	57%
25% percentile	21%	27%	34%	43%
10th percentile	16%	20%	24%	29%

## Possible Implied Replacement Rates at different savings rates and contribution periods

**Savings rate 12.5% of gross income**, real portfolio return = 5% p.a., income growth = inflation

Contribution period (years)	30	35	40	45
90th percentile	75%	108%	146%	190%
75th percentile	55%	74%	98%	125%
60th percentile	44%	58%	76%	95%
<b>median</b>	<b>38%</b>	<b>50%</b>	<b>65%</b>	<b>81%</b>
40th percentile	34%	43%	56%	68%
25% percentile	27%	35%	43%	53%
10th percentile	20%	25%	30%	37%



## Possible Implied Replacement Rates at different savings rates and contribution periods

**Savings rate 15% of gross income**, real portfolio return = 5% p.a., income growth = inflation

Contribution period (years)	30	35	40	45
90th percentile	89%	125%	169%	227%
75th percentile	64%	88%	115%	150%
60th percentile	51%	70%	89%	114%
<b>median</b>	<b>45%</b>	<b>61%</b>	<b>76%</b>	<b>98%</b>
40th percentile	40%	53%	66%	84%
25% percentile	32%	42%	51%	65%
10th percentile	24%	30%	37%	43%

## Possible Implied Replacement Rates at different real portfolio returns and contribution periods

**Real portfolio return = 4% p.a., savings rate 12.5% of gross income, income growth = inflation**

Contribution period (years)	30	35	40	45
90th percentile	62%	83%	113%	143%
75th percentile	46%	59%	76%	96%
60th percentile	37%	47%	59%	73%
<b>median</b>	<b>32%</b>	<b>41%</b>	<b>50%</b>	<b>62%</b>
40th percentile	28%	36%	43%	53%
25% percentile	23%	29%	34%	41%
10th percentile	18%	21%	25%	28%

## Possible Implied Replacement Rates at different real portfolio returns and contribution periods

**Real portfolio return = 5% p.a., savings rate 12.5% of gross income, income growth = inflation**

Contribution period (years)	30	35	40	45
90th percentile	75%	108%	146%	190%
75th percentile	55%	74%	98%	125%
60th percentile	44%	58%	76%	95%
<b>median</b>	<b>38%</b>	<b>50%</b>	<b>65%</b>	<b>81%</b>
40th percentile	34%	43%	56%	68%
25% percentile	27%	35%	43%	53%
10th percentile	20%	25%	30%	37%

## Possible Replacement Rates at different real portfolio returns and contribution periods

**Real portfolio return = 6% p.a., savings rate 12.5% of gross income, income growth = inflation**

Contribution period (years)	30	35	40	45
90th percentile	87%	126%	185%	256%
75th percentile	63%	90%	124%	165%
60th percentile	51%	70%	95%	126%
<b>median</b>	<b>45%</b>	<b>61%</b>	<b>82%</b>	<b>106%</b>
40th percentile	40%	53%	70%	89%
25% percentile	32%	42%	55%	66%
10th percentile	24%	30%	39%	46%

## Possible Implied Replacement Rates at different income growth rates and contribution periods

**Income growth = 1% < inflation**, savings rate 12.5% of gross income, real portfolio return = 5% p.a.

Contribution period (years)	30	35	40	45
90th percentile	89%	131%	188%	260%
75th percentile	64%	92%	124%	170%
60th percentile	51%	72%	95%	128%
<b>median</b>	<b>45%</b>	<b>62%</b>	<b>81%</b>	<b>109%</b>
40th percentile	40%	54%	69%	92%
25% percentile	32%	42%	54%	69%
10th percentile	24%	30%	38%	47%

## Possible Implied Replacement Rates at different income growth rates and contribution periods

**Income growth = inflation**, savings rate 12.5% of gross income, real portfolio return = 5% p.a.

Contribution period (years)	30	35	40	45
90th percentile	75%	108%	146%	190%
75th percentile	55%	74%	98%	125%
60th percentile	44%	58%	76%	95%
<b>median</b>	<b>38%</b>	<b>50%</b>	<b>65%</b>	<b>81%</b>
40th percentile	34%	43%	56%	68%
25% percentile	27%	35%	43%	53%
10th percentile	20%	25%	30%	37%

## Possible Implied Replacement Rates at different income growth rates and contribution periods

**Income growth = 1% > inflation**, savings rate 12.5% of gross income, real portfolio return = 5% p.a.

Contribution period (years)	30	35	40	45
90th percentile	63%	85%	111%	146%
75th percentile	45%	61%	76%	97%
60th percentile	37%	48%	60%	74%
<b>median</b>	<b>32%</b>	<b>42%</b>	<b>52%</b>	<b>63%</b>
40th percentile	28%	36%	45%	54%
25% percentile	23%	29%	35%	42%
10th percentile	17%	21%	25%	29%

## Conclusions:

- The longer the contribution period, the higher the expected replacement rate, i.e. the starting date and retirement dates are important!
- The higher the savings rate, the higher the expected replacement rate,
- The higher the real portfolio return, the higher the expected replacement rate

...but watch out for this counter-intuitive finding:

- The higher the income growth rate relatively to inflation, the lower the expected replacement rate!

i.e. if faster-than-inflation growth in income is not accompanied by an increase in savings rate, then savings won't keep pace with rise in living standards.



# Sensitivity Analysis:

## Base-case scenario

Contribution period = 40 years  
Savings rate = 12.5% p.a.  
Real portfolio returns = 5% p.a.  
Income growth = 5% p.a.  
Inflation rate = 5% p.a.

Probability distribution	Replacement rate
90th percentile	146%
75th percentile	98%
60th percentile	76%
<b>median</b>	<b>65%</b>
40th percentile	56%
25th percentile	43%
10th percentile	30%

## **Sensitivity Analysis:**

**Deviation from base-case scenario: +10% or -10% in assumptions of variables:**

Contribution period = 44 or 36 years

Savings rate = 13.75% or 11.25% p.a.

Real portfolio return = 5.5% or 4.5% p.a.

Income growth = 5.5% or 4.5% p.a. (inflation = 5% p.a.)

**Which change in variable assumption will have the biggest impact on replacement rate projections?**

## Sensitivity Analysis:

**Change in one variable only: Possible implied replacement rate (at median probability)**

Variable	Base-case	+10%	-10%
Contribution period	65%	77%	52%
Real portfolio return	65%	72%	57%
Savings rate	65%	70%	58%
Income growth rate	65%	57%	72%

**Thus, the most important variable assumption is the contribution period, followed by real portfolio return, income growth relative to inflation, and then savings rate.**

And when deviations from variable assumptions are seen together...

Possible implied replacement rates and probability distribution:

	Base-case	+10%	-10%
90 <sup>th</sup> percentile	146%	200%	100%
75 <sup>th</sup> percentile	98%	131%	69%
60 <sup>th</sup> percentile	76%	100%	54%
<b>Median</b>	<b>65%</b>	<b>86%</b>	<b>47%</b>
40 <sup>th</sup> percentile	56%	73%	41%
25 <sup>th</sup> percentile	43%	56%	32%
10 <sup>th</sup> percentile	30%	39%	24%

## Possible implied replacement rate

### 10% Deviation in base-case assumptions



# The influence of one's own behaviour and actions over the outcome of variables and overall retirement savings...

100% Control

No Control

- 
- Contribution period
  - Savings rate
  - Income growth
  - Real portfolio return

DRW

**Investment Research**