CSIRO-Monash Superannuation Research Cluster

WORKING PAPER SERIES

RETIREMENT ADEQUACY OF INDIGENOUS AUSTRALIANS

ROBERT J. BIANCHI*, MICHAEL E. DREW, ADAM N. WALK AND OSEI K. WIAFE

GRIFFITH BUSINESS SCHOOL, DEPARTMENT OF ACCOUNTING, FINANCE AND ECONOMICS, GRIFFITH UNIVERSITY

8 MARCH 2016

CSIRO-MONASH WORKING PAPER N0 2016 - 1

*Corresponding author: r.bianchi@griffith.edu.au.

In addition to the CSIRO-Monash Superannuation Cluster, we gratefully acknowledge the Griffith Centre for Personal Finance and Superannuation (GCPFS) for financial assistance. All errors are our own.

ACKNOWLEDGEMENTS: THIS RESEARCH WAS SUPPORTED BY THE CSIRO-MONASH SUPERANNUATION RESEARCH CLUSTER, A COLLABORATION BETWEEN CSIRO, MONASH UNIVERSITY, GRIFFITH UNIVERSITY, THE UNIVERSITY OF WESTERN AUSTRALIA, THE UNIVERSITY OF WARWICK, AND STAKEHOLDERS OF THE RETIREMENT SYSTEM IN THE INTEREST OF BETTER OUTCOMES FOR ALL.

Abstract

This study examines the retirement adequacy of Indigenous Australian workers. By accessing current Indigenous Australian demographic and employment data, we construct a 40 year savings profile of the typical Indigenous worker. We employ simulation techniques to compute the superannuation balance of the typical Indigenous worker and compare these with the average non-indigenous Australian. We also compare the retirement outcomes of males and females in both cohorts. The findings reveal that the retirement outcomes of Indigenous workers are approximately 27% lower than the average non-indigenous worker. We show that the gender gap in retirement outcomes is wider for non-indigenous workers than the indigenous cohort. Overall, the indigenous female reports the lowest retirement outcomes, and as expected, the non-Indigenous male reports the highest levels of retirement adequacy. We also report that non-indigenous female workers report commensurate retirement outcomes as Indigenous males. Our results show that the plight of the Indigenous male is similar to non-Indigenous females (with no career breaks) in retirement adequacy terms. These differences in retirement outcomes can be attributed to the current earnings gap between the four cohorts at the commencement of their careers. These simulation results suggest that the difference in current earnings of these four cohorts plays an important role in retirement adequacy.

*Corresponding author: r.bianchi@griffith.edu.au.

We gratefully acknowledge the CSIRO-Monash Superannuation Cluster and the Griffith Centre for Personal Finance and Superannuation (GCPFS) for financial assistance. All errors are our own.

Introduction

Since the seminal works of Ando and Modigliani (1963), Merton (1969) and Samuelson (1969), the pension literature has dedicated much attention to estimating optimal solutions for retirement outcomes for the average worker in developed economies (Basu and Drew, 2009b; Lusardi, 1998; Milevsky, 1998; Mitchell and Moore, 1998). The understanding of optimal retirement strategies has become increasingly important as modern workers experience elongated life spans due to lower infant mortality rates and improved medical outcomes in later life, and as public finances are stretched (Almod, Doyle, Kowalski and Williams, 2010; Blake and Burrows, 2001; Blake, Cairns and Dowd, 2006; Krumholz, Nuti, Downing, Normand and Wang, 2015).

The pension literature reveals a number of important variables that determine retirement outcomes for the modern worker. The contribution rate of the individual and the asset allocation of the pension plan are critical elements in determining retirement outcomes (Basu, Byrne and Drew, 2011; Blake, Cairns and Dowd, 2001). Moreover, at a more fundamental level, the level of risk aversion determines the risk an individual is willing to bear which then in turn influences their preferred asset allocation (Jagannathan and Kocherlakota, 1996; Hickman, Hunter, Byrd, Beck and Terpening, 2001). Furthermore, the role of gender is also an important determinant of overall retirement outcomes (Basu and Drew, 2009a; Neelakantan and Chang, 2010; Sunden and Surette, 1998).

Whilst the literature provides an adequate understanding of the retirement outcomes of a typical worker, very little or no research attention has been dedicated to understanding the retirement outcomes associated with the most disadvantaged in a developed economy. More specifically, what is the estimated retirement gap between the average worker and the most disadvantaged socio-economic segment given the effects of time, asset returns and contribution rates? This study examines the experience of indigenous Australians compared to that of the typical Australian worker.

Our findings reveal that the retirement gap between indigenous and non-indigenous Australians is estimated at 23%. The retirement gap between indigenous and non-indigenous males is 27% of the median male balance. The retirement gap between indigenous females and the median non-indigenous male is 39% of their superannuation account balance at retirement. The retirement gap between genders is smaller for indigenous Australians than for their non-indigenous counterparts. An interesting finding from the simulations is that the

retirement balances of indigenous males are very similar to those of non-indigenous females with no career breaks.

The remainder of this study is organised as follows. Section 2 reviews the literature relating to the demographics and educational attainment of indigenous Australians. Section 3 describes the data used in the paper. Section 4 explains the research methodology, while Section 5 summarises the retirement outcomes of the indigenous Australian worker versus the 'median' worker. Finally, Section 6 provides concluding remarks and the implications of these findings for the retirement literature.

Background

People who identify as being of Aboriginal and Torres Strait Islander origin – or "Indigenous Australians" – make up 2.5 per cent of Australia's 21.5 million population (Census of Population and Housing, 2011). According to the 2011 census, New South Wales reports the highest number of Indigenous Australians, 32 per cent of the national total, followed by Queensland and Western Australia. The Northern Territory reports 27 per cent of its population as being of Aboriginal and Torres Strait Islander origin; this is the highest of all the states and territories, with Victoria having the lowest proportion of less than 1 per cent. The age distribution of Indigenous Australians is much younger with the median age of 21 years compared to 38 years for the non-indigenous population. Six in ten Aboriginal and Torres Strait Islander people are aged between 15 and 64 years compared with almost seven in ten non-Indigenous people. The proportion of Aboriginal and Torres Strait Islander people aged 65 years and over is considerably smaller than for non-Indigenous people (4% compared with 14%).

Of all Indigenous Australians aged 15 years and over, 51 per cent participated in the labour force according to the 2011 Census, compared to 64 per cent of non-indigenous people. About two in five Aboriginal and Torres Strait Islander people aged 15 years and over were employed, compared with about three in five non-indigenous people. The unemployment rate for Aboriginal and Torres Strait Islander people aged 15 years and over in the 2011 Census is 17 per cent, therefore, they are approximately three times more likely to be unemployed in comparison to non-indigenous people.

From a gender perspective, women's pay rates are still much lower than those of men in Australia. In 2015, pay rates were still only 82.1 per cent of males' ordinary time earnings (ABS, 2015). The median indigenous income is approximately 23 per cent lower than the comparable non-indigenous income per week. A possible explanation for the income gap between Indigenous and non-Indigenous Australians is the relative educational attainment level of education of the two populations. The evidence shows that Indigenous Australians have a substantially lower level of educational attainment than their non-Indigenous counterparts. While one in four of Aboriginal and Torres Strait Islander people aged 15 years and over report Year 12 or equivalent as the highest year of school completed, about half of non-Indigenous people report year 12 completion or equivalent (ABS, 2011). Of about 42% of employed indigenous people, 18 per cent of them work as labourers and 17 per cent as community and personal service workers, while professionals, clerical and administrative workers and technicians and trade workers each formed 13 per cent of employees. Reducing the barriers to educational attainment can assist in closing the income gap between the two populations, as the level of income directly impacts the level of superannuation contributions and hence retirement savings of the cohorts.

Overall, this background information suggests that Aboriginal and Torres Strait Islanders experience lower levels of education, employment and income in comparison to non-indigenous Australians. These statistics inform us of the challenges faced by a conventional Aboriginal and Torres Strait Islander worker who seeks to accumulate long-term savings for his retirement. We proceed to construct a computational model of the average indigenous Australian worker by obtaining the inputs from a variety of sources.

Data

To model initial wages and contributions, we refer to weekly income data for indigenous populations from the Australian Bureau of Statistics Census of Population and Housing, 2011 (see Table 1). In the census, 13 per cent of Aboriginal and Torres Strait Islander people aged 15 years and over reported a gross personal income of $1,000 or more

per week. Males were more likely to report an income of $1,000 or more per week than females; 16 per cent compared with 10 per cent of females.

Table 1 Summary of incomes, gender and employment status

This table presents the median weekly income levels for indigenous Australians aged 15 years and over by gender and employment status.

	Employed	Unemployed	Total labour force	Not in the labour force	Labour force status not stated	Total
Median income (Male)	789	219	682	233	268	370
Median income (Female)	654	241	569	274	277	356
Median income (Persons)	724	228	626	257	273	362

2076.0 Census of Population and Housing: Characteristics of Aboriginal and Torres Strait Islander Australians, 2011

We update the income levels of indigenous Australians in Table 1 (2011 levels) to 2013 levels using real income growth rate provided by the ABS. We compare the new income levels to weekly income data reported by non-indigenous Australians. Weekly income data for non-indigenous Australians is collected from Employee Earnings, Benefits and Trade Union Membership (2013) published by the ABS (see Table 2).

Table 2 Median weekly incomes

This table presents a snapshot of median weekly income for males, females and all persons. It is categorised for indigenous and non-indigenous Australians. It also reports the differences in dollar and percentage terms between Indigenous and Non-Indigenous Australian median incomes.

	Indigenous	Non-Indigenous	Difference($)	Difference (%)
Median income (Male)	799	1,121	322	28.68
Median income (Female)	663	790	127	16.12
Median income (Persons)	734	950	216	22.78

Source: Non-indigenous Australian statistics are extracts of Employee Earnings, Benefits and Trade Union Membership (Australian Bureau of Statistics Cat. No. 6310.0 August) and indigenous Australian incomes are authors' calculation.

Historical data on Australian returns are sourced from the Global Financial Data (GFD). We employ five asset classes to simulate investment option returns within an individual's superannuation fund account. These include monthly returns on stocks, bonds

and bank bills. As a proxy for international investments, we use monthly stocks and bonds from the USA. Stocks are referred to as growth style assets and we refer to bonds and bills as conservative assets in the analysis. The data spans 102 years from March 1912 to March 2014.

Table 3 presents the summary statistics of the asset returns employed in this study. The moments of the distributions of returns reflect the salient empirical characteristics of long term asset returns. The standard deviations for both US and Australian stocks are significantly higher than those for bonds and bills, which is consistent with a wider percentile range. Investors in stocks earn higher mean returns, which accords with finance theory that predicts greater reward as compensation for bearing higher levels of risk. As expected, both stock series are negatively skewed and leptokurtotic as expected.

Table 3 Summary statistics of asset class returns

This table presents the summary statistics and distribution of the data used in this study. All statistics are based on real monthly returns, that is, total return less inflation. Aus. Stocks are represented by the Australia S&P/ASX 200 Accumulation Index. Aus. Bonds are represented by the 10-year Australian Government Bond Return Index, Aus. Bills are represented by the Australian T-bills monthly return. US Stocks are represented by the S&P500 return index, and US Bonds are represented by the 10-year US government bond return. Std. Deviation denotes the standard deviation of monthly returns. 5^{th} percentile, median and 95^{th} percentiles denote various percentiles of the empirical distribution of the time series of returns. The numbers reported in parentheses are annual statistics.

	Average	Std. Deviation	5th percentile	Median	95th percentile	Kurtosis	Skewness
Aus. Stocks	0.68% (8.15%)	4.15% (14.36%)	-5.98%	0.88%	6.60%	12.03	-0.91
Aus. Bonds	0.19% (2.27%)	2.25% (7.78%)	-2.95%	0.14%	3.45%	21.12	1.44
Aus. Bills	0.05% (0.66%)	0.59% (2.04%)	-0.98%	0.12%	0.83%	4.54	-1.15
US Stocks	0.57% (6.83%)	4.73% (16.40%)	-6.23%	0.73%	7.56%	7.07	-0.30
US Bonds	0.22% (2.62%)	2.15% (7.46%)	-2.80%	0.10%	3.94%	7.74	0.94

All summary statistics are computed using real asset returns; total returns less inflation. While US monthly Consumer Price Index data is available dating back to the 1800s, Australian quarterly CPI data is only available after 1912. Data prior to this date is annualised. To avoid bias, we use spline interpolation to generate monthly CPI rates using Australia's quarterly rates data beginning in 1912. We are then able to compute real returns given matching monthly inflation rates for the different assets.

Methodology

Our investment horizon begins when participants are 25 years old and in some form of full-time employment. We assume a starting superannuation balance of $5,000 and a 40 year horizon, with individuals retiring at age 65. The choice of starting superannuation balance is based on ASFA superannuation balance estimates (Clare, 2014). For the 40 working years, individuals contribute 9.5 per cent of their pre-tax annual income to their superannuation fund account. The individual's account balance may be invested in one or more different strategies; however, here we report results based on a typical static Balanced strategy[1].

Using historical returns, we simulate portfolio returns using the bootstrap simulation technique developed by Efron (1979). This method involves resampling row vectors with replacement to construct a large number of synthetic time series of returns. Since the row vectors are comprised of the different asset returns, this technique preserves the cross-correlations between asset classes.[2] Resampling with replacement also allows this technique to generate a wide range of outcomes including many possible yet unlikely scenarios such as several 1987 crashes in succession. The Efron (1979) bootstrap technique has been used previously in the relevant pension finance literature, including the literature on lifecycle investing (see, for example, Basu and Drew, 2010).

Finally, at the decumulation phase of retirement, we estimate how much guaranteed income a retiree is able to obtain with her retirement balance. This is akin to calculating an annuity equivalent given different terminal wealth values at the investment horizon. This

[1] Target date, Dynamic lifecycle, All-Stock, and All-Conservative strategies have also been simulated in parallel and the results are available upon request.
[2] A limitation of the Efron (1979) method is it resamples single row vectors, therefore, it does not preserve the time series characteristics in the data.

enables a comparison of incomes generated from retirees' superannuation balances to what the Association of Superannuation Funds of Australia (ASFA) reports as the estimated income required for a comfortable retirement. We exclude the impact of receiving a full or part Age Pension on the retirement outcome because of uncertainty regarding future Australian Commonwealth government policies on assets and income tests makes this difficult to forecast.

At retirement age 65, the accumulated superannuation balance for individuals in the different job categories are compared to the present value of wealth that will provide for a comfortable retirement[3]. The level of income required for a comfortable retirement is based on ASFA's Retirement Standards as at March 2015 (ASFA, 2015). This is currently $42,569 per annum for a single retiree and $58,326 per annum for a retired couple, in today's dollars. We then calculate how much wealth, in today's dollars, is required to provide this level of future income, that is, what lump sum is required for retiree to drawdown the comfortable retirement equivalent.

For simplicity, the present value of wealth required to provide the annuity equivalent income for life is calculated based on current annuity rates by Challenger Limited ("Challenger"). The firm Challenger is the biggest annuity provider in Australia and the annuity rates used in this research are based on rates reported on the Challenger website as at June 21, 2015[4]. This life annuity is not indexed for inflation and has 100 per cent withdrawal guarantee in the first 15 years. The lump sum amounts required to generate annual payouts equivalent to the comfortable and modest retirement standards which are indexed for inflation are approximately $890,000 and $490,000, respectively.

We consider the worst superannuation balances for both indigenous and non-indigenous Australians after the 40 year investment horizon, estimated using two tail risk measures, namely the Value-at-Risk (VaR) and the Expected Tail Loss (ETL). The VaR of a portfolio measures the potential loss in value of over a defined period for a given confidence interval. By choosing a confidence level of α, we are interested in the $(1-\alpha)$ quantile of the distribution of our retirement portfolio. To estimate the VaR for our retirement outcomes at age 65 years for the probability p, where p is the probability of worst percentage of

[3] With the differences in life expectations, a comfortable retirement level may be different for the two populations. We explain this in the further discussion section.
[4] See current Challenger Annuity rates here (http://www.challenger.com.au/products/rates.asp)

distribution of outcomes with a confidence level of α, then $p = (1- \alpha)$. The p-quartile of the distribution, Q_p, is the measure of the VaR and is calculated as:

$$VaR = Q_p$$

The expected tail loss (ETL) provides the probability weighted average of terminal wealth estimates that fall below the VaR at the given confidence level. For our VaR at a confidence level of α, ETL measures the probability weighted average of 100(1- α) per cent of superannuation wealth outcomes. For the *i-th* wealth outcome, W_i, with a probability *i*, ETL is given by:

$$ETL_\alpha = \frac{1}{1-\alpha}\sum_{i=1}^{\alpha} W_i i$$

Table 4 Distribution of retirement balances (non-indigenous and indigenous)

This table reports descriptive statistics of superannuation ending balances for Indigenous and Non-indigenous Australians. We report various percentiles of the ending balance, the Mean, Median and Maximum balance. We also report the differences in dollar and percentage terms between Indigenous and Non-Indigenous Australians. Accumulated balances are based on real investment returns.

	Non-Indigenous	Indigenous	Difference ($)	Difference (%)
1st Percentile	239,009	187,093	51,916	27.75
5th Percentile	309,114	241,702	67,412	27.89
10th Percentile	365,254	285,602	79,651	27.89
25th Percentile	481,392	377,231	104,161	27.61
75th Percentile	947,230	744,869	202,362	27.17
Mean	768,737	603,941	164,796	27.29
Median	665,685	522,180	143,505	27.48
Maximum	5,723,283	4,539,538	1,183,745	26.08

Results

Table 4 presents a summary of the distribution of superannuation balance estimates at retirement age 65 years for the indigenous and non-indigenous Australians. We find significant differences between the two subjects in terms of their superannuation balances after the 40 year investment horizon. The non-indigenous full-time worker accumulates approximately 27 per cent more superannuation wealth, on average, than the indigenous worker at all percentiles. This translates to approximately $165,000 in extra superannuation savings for the average non-indigenous worker. Both subjects have medians which are 15 per

cent lower than their means, reflecting the high upside potential of the superannuation balances. This result suggests that the means are driven by high balances which are accrued by significantly less than half of the simulated return paths. Lower superannuation balances for the indigenous Australian are likely a function of lower salaries, since superannuation contributions are, by construction, a function of salary levels. Further analysis show that approximately 15 per cent of the indigenous cohort achieves a comfortable retirement compared to over 30 per cent for the non-indigenous Australians (at the 85^{th} and 70^{th} percentiles for the indigenous and non-indigenous workers, respectively). Finally, half the population of indigenous full-time workers at retirement will have a superannuation balance which is, on average, $245,000 less than the mean superannuation balance of the non-indigenous Australian and up to $340,000 short of the comfortable retirement standard.

Table 5 Retirement wealth ratios

This table presents the Retirement Wealth Ratios of the top five industry profiles and the 'average' Australian. We report various percentiles of the RWR, the Mean, Median and Maximum RWR.

	Non-Indigenous	Indigenous
1st Percentile	4	4
5th Percentile	5	5
10th Percentile	6	6
25th Percentile	8	8
75th Percentile	16	16
Mean	13	13
Median	11	11
Maximum	95	97

In terms of lump sum amounts at retirement, the mean superannuation balance for the non-indigenous Australian at retirement age is 15 per cent lower than what is required for a comfortable retirement ($768,737 vs $890,000); while exceeding the modest retirement standard estimate by up to 57 per cent ($768,737 vs $490,000). Indigenous Australians; however, accrue a superannuation balance at retirement which has a mean that is 46 per cent lower than what is required for a comfortable retirement ($603,941vs $890,000). This mean exceeds the modest retirement standard estimate by 23 per cent ($603,941vs $490,000). Since we use the median income levels, this finding suggests that up to the 50th percentile of both indigenous and non-indigenous Australians will be unable to attain a comfortable retirement

based solely on the wealth held in their superannuation funds. While a significant proportion of non-indigenous Australians may attain the modest retirement standard, the same cannot be said of indigenous Australians. A significant proportion of indigenous full-time workers will still need some form of government assistance to attain even a modest retirement income estimate.

Table 5 shows that Retirement Wealth Ratios (RWRs) are nearly identical for both indigenous and non-indigenous populations at different percentiles. Mean and median RWRs are 13 and 11, respectively, for the two populations. The maximum RWR is slightly higher for the indigenous population compared to the non-indigenous and this is expected. While both populations have a mean RWR which appears to be adequate, it does not necessarily indicate equity between the two populations. A mean RWR of 13 is more attractive to the non-indigenous Australian as he earns a higher income level compared to the indigenous worker and hence has a higher ending salary. A high multiple of this higher final salary denotes a higher ending balance and higher probability of sustaining one's retirement portfolio compared to the same multiple for a lower ending salary assuming each individual draws down at the same rate.

Table 6 Tail estimates of retirement balances

This table presents the Value-at-Risk (VaR) and Expected Tail Loss (ETL) for the indigenous and non-indigenous populations. We also report the differences in dollar and percentage terms.

	Indigenous	Non-Indigenous	Difference ($)	Difference (%)
VaR	314,978	246,452	68,526	28.81
ETL	268,068	209,450	58,619	17.50

Table 6 estimates the worst outcomes of the superannuation balances for the indigenous and non-indigenous Australians using the Value-at-Risk (VaR) and the Expected Tail Loss (ETL) estimates. The VaR signifies the minimum level of loss at a given, sufficiently high, confidence level for a predefined time horizon. Our choice of the 95% confidence level gives us the threshold loss at the 5^{th} quantile of the distribution of simulated superannuation balances at age 65 years. The ETL provides the probability weighted average of terminal wealth estimates that fall below the VaR threshold. Expressed another way, at the

95 per cent confidence level, ETL measures the average of the worst 5 per cent of simulated superannuation wealth outcomes.

VaR is higher for the non-indigenous Australian compared to the indigenous populations. The ETL is also higher for the non-indigenous Australian than the indigenous Australian. The VaR is 28 per cent lower for the indigenous Australian than the non-indigenous, reflecting the difference in starting salary levels. As one would expect, a higher starting salary results in a higher level of wealth at risk and superior expected tail loss; the worst superannuation balance outcomes are worse (in dollar terms) for the cohort with the lower salary than the cohort with a higher salary.

Figure 1 Distribution of retirement outcomes

This figure illustrates the distribution of retirement outcomes using historical asset returns at 9.5 per cent for the non-indigenous Australian and 9.5 per cent and 12 per cent contribution rates for the indigenous Australian. The y-axis shows the number of retirees and the x-axis, their respective superannuation balances at retirement age 65. The dotted line represents the distribution of retirement outcomes for the indigenous Australian at a 9.5 per cent contribution while the dashed line represents a similar distribution based on a 12 per cent contribution rate. The solid line represents the distribution of retirement outcomes for the non-indigenous Australian at 9.5 per cent contribution rate. The vertical line shows the level of superannuation balance required for an ASFA 'comfortable' retirement estimate in the absence of government supported pensions. For illustrative purposes, superannuation balances higher than 3.5 x 10^6 have been truncated.

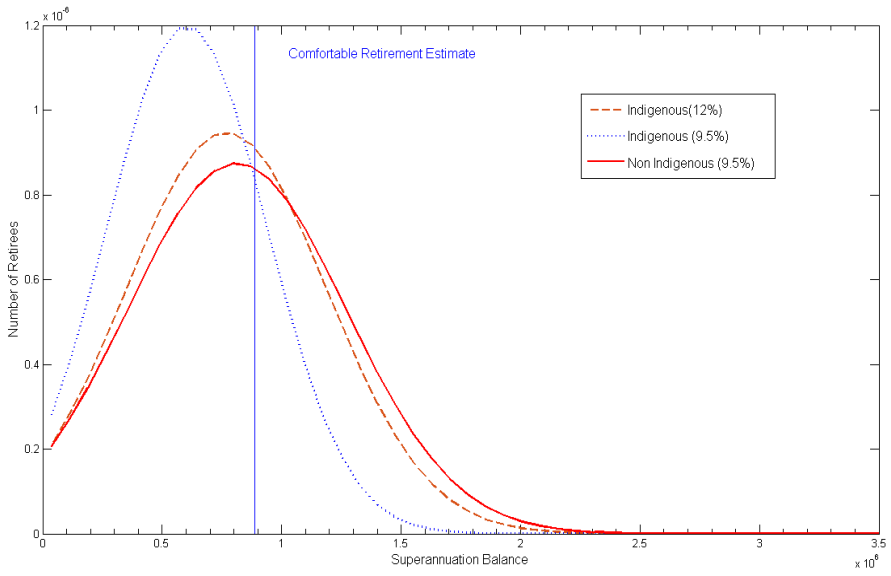


Figure 1 shows the distribution of superannuation balances for the indigenous and non-indigenous Australians given a 9.5 per cent superannuation contribution rate over a 40 year working life. It also shows the superannuation balance distribution at age 65 years of the Indigenous Australian given a superannuation contribution rate of 12 per cent over same

period. We show the comfortable retirement estimate as a vertical line cutting through the superannuation balance distribution at $890,000.

At the 9.5 per cent contribution rate per year, the non-indigenous full-time worker has a superannuation balance distribution with a lower peak and bigger spread compared to the distribution of the indigenous Australian's retirement outcomes. About a third of the non-indigenous cohort is able to attain the comfortable retirement estimate; with a good spread of superannuation balance outcomes on both sides of the vertical line. The mean and median of the distribution is not very significantly lower than the retirement standard estimate. The same; however, cannot be said of the indigenous population, with a lower proportion of the cohort accruing superannuation levels that exceed the comfortable retirement estimate. The distribution lies to the left of the comfortable retirement estimate. The mean and median of this superannuation distribution are significantly lower than the comfortable retirement estimate; having a narrow spread around the low mean.

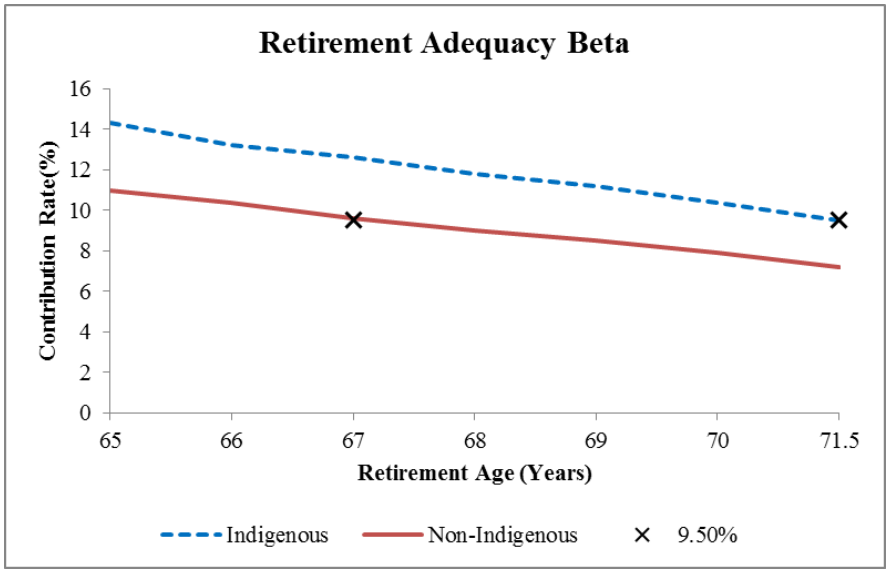
Furthermore, Figure 1 reveals that the indigenous full-time worker contributing 12.5 per cent of their salary into their superannuation funds per year over their working lives will attain a distribution of balances commensurate with the non-indigenous Australian. At this higher contribution rate, the indigenous Australian worker has a higher probability of attaining the ASFA comfortable retirement estimate. The mean superannuation balance of the indigenous Australian equals the AFSA comfortable retirement standard estimate when he contributes 14.3 per cent over his working life, almost 5 per cent higher than the current superannuation guarantee. The non-indigenous Australian on the other hand attains this comfortable retirement outcome level, on average, by contributing 11per cent over his working life.

Figure 2 reports the Retirement Adequacy beta, which illustrates the contribution rate required to attain the ASFA comfortable retirement estimate at different ages in retirement. The horizontal axis of the graph represents retirement ages, in years, while the vertical axis represents the different annual superannuation contribution rates, in percentages. The inverse linear relationship between the contribution rate and retirement age is expected; we expect retirees who contribute at a higher rate in their superannuation funds to be able to retire comfortably at an earlier date compared to retirees who contribute at a lower rate. Of the two lines trending downward, we find they exhibit very similar steepness as we determine the contribution and retirement age by the distribution of the whole outcome distribution rather

than a point estimate. On the Retirement Adequacy graph, the line that lies to the left (or under) the other line represents a more superior outcome for the cohort relative to the other cohort.

Figure 2 Retirement adequacy beta

This figure presents the relation between contribution rates and retirement age for the indigenous and non-indigenous Australians using historical returns. Contribution rates represent the level of contribution an individual requires to save per year in order to accumulate superannuation balances equivalent to what is deemed as adequate for a comfortable retirement. Retirement age refers to the age at which superannuation balances reach the comfortable retirement estimate at given contribution levels and the individual is able to retire comfortably.



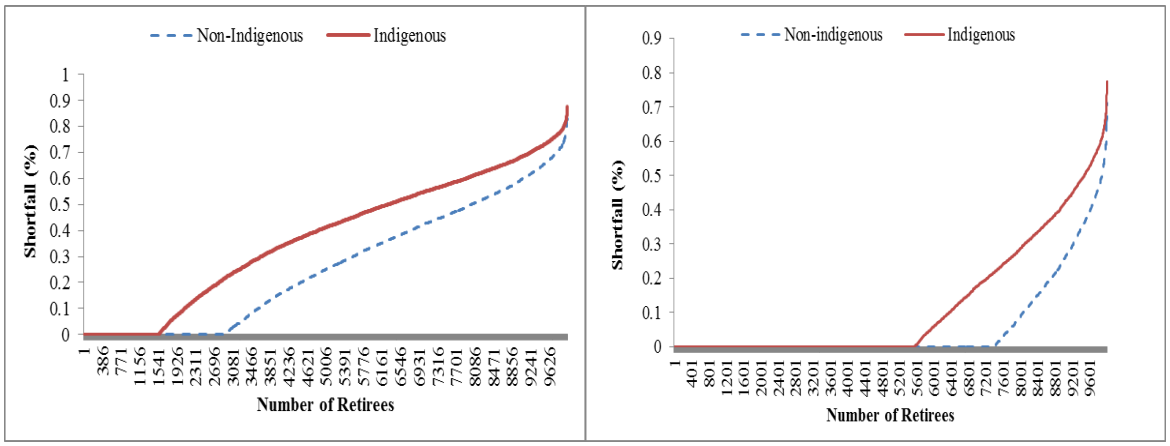
As highlighted above, the indigenous Australian requires a superannuation contribution rate equivalent of 14.3 per cent to retire comfortably at age 65 years (according to the ASFA Retirement Standard definition). This contribution rate is 30 per cent more than the non-indigenous Australian, who requires 11 per cent of annual contributions to attain the same level of well-being, on average. By maintaining the superannuation guarantee level at 9.5 per cent, the non-indigenous Australian is able to retire with adequate income at age 67 years. The indigenous Australian who wants to retire comfortably on a 9.5 per cent annual contribution must work until age 71.5 years, 6 and half years over the current retirement age. It is worth noting that both of these ages are significantly higher than the observed average retirement ages for recent retirees, which is 63.3 years for males and 59.6 years for females (ABS, 2013).

In summary, the retirement adequacy beta brings into perspective the superannuation contribution rates required to make informed decisions regarding an appropriate retirement age. Any level of increase in contributions over an individual's working life has an impact on his retirement age and the probability of attaining a comfortable retirement. The current superannuation guarantee at 9.5 per cent remains inadequate for both indigenous and non-indigenous Australians to obtain a comfortable retirement should retirement age remain at age 65. Planned periodic increases in contribution rates should be considered for both indigenous and non-indigenous populations, but more importantly for the former if the ASFA comfortable estimate is the benchmark. These increases in the contribution rate should not be a standalone approach but in conjunction with policies regarding retirement age as well as health improvement measures to increase indigenous life expectations.

Figure 3 Simulation estimates of income shortfall

This figure reports the extent of income shortfall based on 10,000 simulations of indigenous and non-indigenous Australians relative to the comfortable and modest retirement income benchmarks. The y-axis shows the amount of shortfall, in percentages, and the x-axis shows the number of retirees experiencing the level of shortfall. The solid line represents the shortfall levels of the indigenous Australian while the dashed line represents various shortfall levels for the non-indigenous Australian. Panel A presents the income level shortfalls relative to the ASFA 'comfortable' retirement income estimate while Panel B reports the income level shortfalls relative to the ASFA 'modest' retirement income estimate.

Panel A: Panel B:



Panel A of Figure 3 illustrates the income shortfall for the indigenous and non-indigenous Australian cohorts relative to the annual income estimate required for a 'comfortable' retirement according to the ASFA estimates based on 10,000 simulations. Panel B presents the income shortfall for both cohorts relative to the 'modest' annual income

estimate according to ASFA. The horizontal axis represents the number of total simulations whilst the vertical axis represents the extent of shortfall. Retirees who lie on the horizontal line experience no shortfall, as the line rises, retirees experience some level of shortfall, with the extent of shortfall rising to 100 per cent of the income level for individuals whose portfolios run into ruin.

From Panel A, we estimate that up to 3,000 of the non-indigenous retirees (representing 30 per cent of the 10,000 simulations) do not experience a shortfall in their retirement income relative to the comfortable retirement standard estimate. This is significantly higher than the 1,400 (14 per cent) indigenous retirees who do not experience any income shortfall. Based on the total simulations, half of the indigenous population will experience an income shortfall of at least 40 per cent of the comfortable retirement estimate. Non-indigenous full-time workers on the other hand experience shortfall levels approximately 22 per cent and higher for half of the population. The shortfall levels for the two groups rise gradually, with approximately one per cent of both groups experiencing total shortfall.

Panel B, on the other hand, shows more retirees not experiencing income shortfall mainly because of the more modest expectations. Up to 55 per cent of indigenous full-time workers attain the modest income estimate, and approximately 75 per cent of non-indigenous Australians attain this income threshold. Whilst the median superannuation balance of the indigenous Australian exceeds the modest income estimate, more than 40 per cent of the cohort experiences some level of shortfall. The extent of shortfall for non-indigenous and indigenous Australians rises steeply for both groups, reaching 70 and 90 per cent, respectively, in the bottom percentile.

One of the important goals of superannuation is to provide a sustainable source of income in retirement. While spending patterns may change in retirement, one cannot underscore the need to achieve a reasonable income level which ensures a comfortable retirement. According to ASFA's estimation, a single retiree requires $42,569 income per year to experience a retirement which caters for a broad range of leisure and recreational activities and to maintain a satisfactory standard of living. After a 40 year working life, given current median income levels, historical asset returns and the current superannuation guarantee rate, one in five indigenous Australians are able to accumulate superannuation wealth that translates into this level of income for their retirement. Over the same saving

horizon and given similar conditions, one in three non-indigenous Australians is able to achieve this retirement income level. For a modest income of $23,489 per annum in retirement, one in two indigenous Australians do not attain this level of income. In contrast, four in five non-indigenous Australians will not experience an income shortfall at this modest level.

Table 7 Distribution of retirement outcomes

This table reports a summary of retirement outcomes for both male and female indigenous and non-indigenous employed Australians. We report various percentiles of the ending balance, the Mean, Median and Maximum balance. We also report the differences in dollar and percentage terms between genders. The accumulated balances are based on real investment returns.

	Indigenous				Non-Indigenous			
	Male	Female	Difference ($)	Difference (%)	Male	Female	Difference($)	Difference(%)
1st Percentile	201,283	169,949	31,335	18.44	278,768	200,528	78,240	39.02
5th Percentile	267,630	219,091	48,539	22.15	369,847	258,816	111,031	42.90
10th Percentile	314,279	258,820	55,459	21.43	434,134	305,501	128,633	42.11
25th Percentile	410,483	341,706	68,778	20.13	566,026	403,122	162,904	40.41
75th Percentile	795,476	679,313	116,163	17.10	1,093,738	799,306	294,432	36.84
Mean	654,585	549,801	104,784	19.06	900,150	647,104	253,046	39.10
Median	570,831	474,988	95,843	20.18	786,014	560,016	225,998	40.36
Maximum	5,163,656	4,147,907	1,015,749	24.49	6,971,716	4,846,435	2,125,282	43.85

Table 7 compares the differences in retirement outcomes to evaluate the gender gap for both indigenous and non-indigenous Australians. For both subjects, we find the distribution of male worker terminal wealth outcomes dominate the distribution of female workers across all percentiles. The differences between the mean retirement outcomes are; however, more significant for non-indigenous Australians than for the indigenous. Whilst indigenous male workers have retirement outcomes which are, on average, 19 per cent higher than their female counterparts, non-indigenous males accumulate average balances of up to 39 per cent more than non-indigenous females. This suggests that the gender gap, although it exists between indigenous Australians, is not as significant as the gap between the non-indigenous populations. The median terminal wealth outcomes difference by gender for the non-indigenous populations is also less significant for indigenous Australians.

The male non-indigenous Australian has a mean retirement outcome which is 38 per cent higher than the male indigenous Australian. This translates into a difference of

approximately $246,000. While this is a matter of concern, the difference between the non-indigenous male and indigenous female is alarming. The mean superannuation terminal wealth balance for the indigenous employed female is 64 per cent lower than the non-indigenous male. This is a difference of approximately $350,000 in today's dollars. The female non-indigenous Australian accumulates retirement wealth that is 28 per cent higher, on average, than the female indigenous Australian but not significantly different from the male indigenous worker, falling short by 1 per cent to the latter. In summary, while the existence of a gender gap is not new in the retirement literature, we find that the gap is more significant for non-indigenous Australians than the indigenous Australians. The retirement outcomes of the male indigenous worker are not significantly different from the non-indigenous female, but it is considerably lower than the non-indigenous male. The indigenous female accumulates significantly low retirement balances and potentially faces the biggest financial challenge in retirement.

Figure 4 Lifetime retirement gap

This figure illustrates the proportion of average retirement outcomes in comparison to the retirement outcomes of the male non-indigenous Australian.

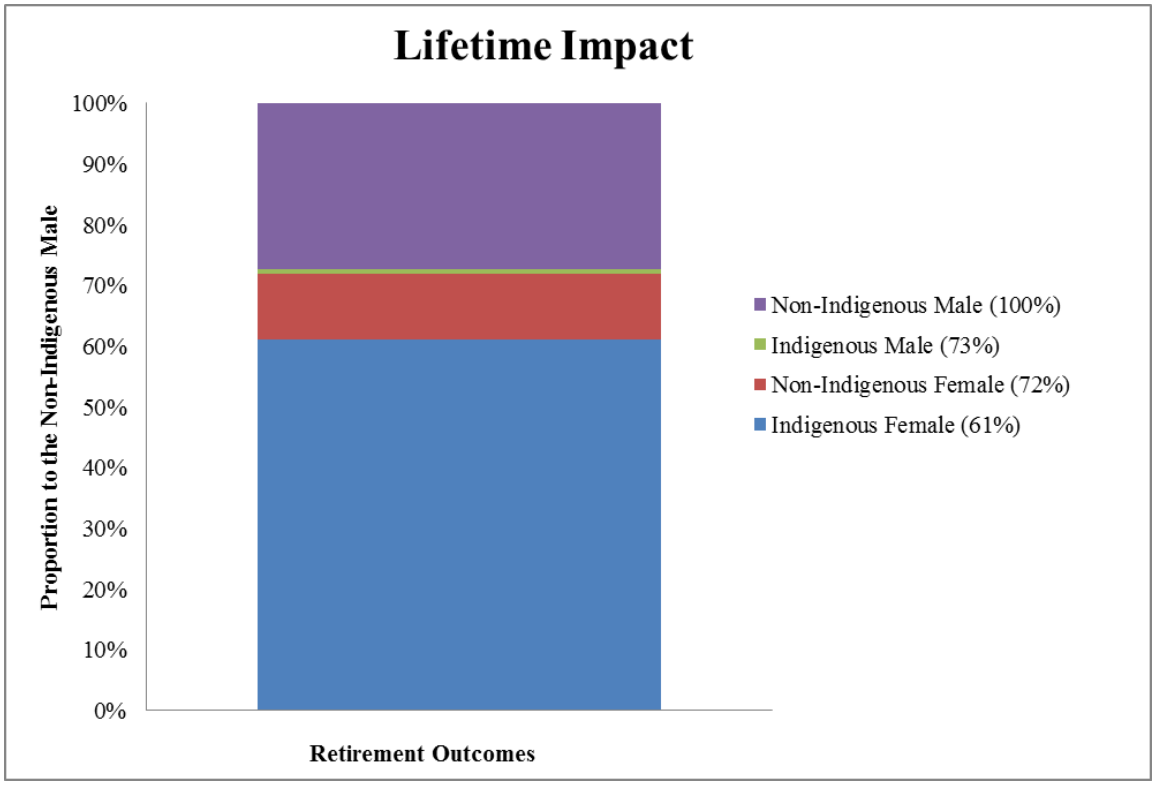


Figure 4 illustrates the estimated lifetime impact of earnings differences on retirement outcomes for the various cohorts examined in this study. The average retirement outcome of the male non-indigenous is used as the benchmark for the different categories. The average retirement outcomes of the female non-indigenous Australian and both the male and female indigenous Australians are expressed as a percentage of the retirement outcomes of the male non-indigenous Australian. The indigenous male, on average, reports an estimated superannuation balance that is 73 per cent of the average male non-indigenous Australian. This is only a percentage point greater than the average retirement outcome of the non-indigenous female, who has a retirement gap of 28 per cent compared to the male non-indigenous Australian. The indigenous female reports the lowest average retirement outcome due to the largest difference in earnings. This difference equates to a 39% retirement gap between the indigenous female and the non-indigenous male.

Indigenous Retirement in Perspective

While our previous analyses have found the indigenous worker to fall short in different aspects of retirement adequacy, it may be erroneous to assume that adequacy levels are the same for both indigenous and non-indigenous Australians. Due to differences in life expectancy, a lower retirement balance does not necessarily place the indigenous retiree at an absolute disadvantage. To put this in perspective, the estimated life expectancy at birth for Aboriginal and Torres Strait Islander males in 2010–2012 is 69.1 years, and 73.7 years for females. This is 10.6 and 9.5 years lower than the life expectancy of non-Indigenous males and females, respectively (AIHQ, 2014). Whilst life expectancies at retirement age may be higher than at birth levels, there remains a significant difference in life expectancies between indigenous and non-indigenous Australians. Lower life expectancies for indigenous Australians means we may be overestimating the required income for a comfortable retirement considering the ASFA retirement standard estimates.

This however brings to the fore several important policy implications which are outside the scope of this paper. While a higher contribution rate to superannuation increases the probability of meeting retirement adequacy levels, will indigenous Australians be better off with lower or current levels of contributions to superannuation, thereby encouraging higher spending during their working lives? This spending could be directed into different channels to increase educational attainment as we find this factor as a primary driver of income. This

re-allocation of resources will also help in the accrual of both superannuation and non-superannuation wealth which will assist in reducing the retirement gap with non-indigenous Australians. In place of increased contributions, these funds could be channelled into programs to help improve indigenous health. This outcome will lead to increase life expectancies to non-indigenous Australians and increase overall well-being. Increasing contributions into superannuation will amount to substantial welfare losses if the individuals barely live to retirement age or have significantly lower life expectancies than what is considered in the development of comfortable retirement income estimates. When life expectations are improved for the indigenous population, we are then able to consider other measures to narrow the retirement gap such as higher contribution rates.

We conclude the analysis with a discussion of the important limitations of this research. The first limitation is the assumption that individual earnings are the only source of income. The implication of this assumption means that private sector savings outside of the superannuation system are excluded from the analysis. The second limitation in this study is the exclusion of all forms of social security or other government funded benefits that may be paid to indigenous or non-indigenous Australians. While the focus of this study highlights indigenous Australian workers, there are social security benefits available to all individuals who cannot secure employment. The third limitation in this study is the assumption that all workers are fully employed during the entire 40 year simulation period. At the time of writing, there are no statistics available on indigenous Australians which measure the average length of time they spend outside of full-time employment.

Concluding Remarks

This study is the first contribution in the literature to provide baseline estimates of the expected superannuation account balances of indigenous Australian workers. Our simulation evidence reveals a significant retirement gap of 27% and 39% for males and females, respectively, when compared to the median non-indigenous male worker. Interestingly, we reveal that the retirement balances of indigenous males and non-indigenous females are nearly identical due to their current similar median income levels. Our simulation evidence shows that the differences in current income between the various cohorts drive the variations in future retirement outcomes.

The two factors that can improve the retirement experience of indigenous Australians are changes to current income levels and improving the shorter life expectancies of this segment of the population. Policies that can improve the education, employment and income outcomes of indigenous Australians will translate directly into higher levels of superannuation savings for these individuals. Second, policies aimed at lengthening the life expectancy of indigenous Australians will also lengthen the non-working phase of these individuals who are more likely to experience a shortened retirement. All else being equal, closing the income and life expectancy gaps between indigenous and non-indigenous Australians will assist in improving the future retirement outcomes for this segment of the Australian population.

References

ABS, 2011, Census of Population and Housing: Characteristics of Aboriginal and Torres Strait Islander Australians. Cat. No. 2076.0

ABS, 2013, Retirement and Retirement Intentions, Australia. Cat. No. 6238.0

ABS, 2015, Average Weekly Earnings, Australia, May 2015, Cat. No. 6302.0

Almond, D., Doyle, J., Kowalski, A. and Williams, H., 2010, Estimating marginal returns to medical care: Evidence from at-risk newborns, *Quarterly Journal of Economics* 125(2), 591-634.

Ando, A. and Modigliani, F., 1963, The "life cycle" hypothesis of saving: Aggregate implications and tests, *American Economic Review* 53(1/1), 55-84.

ASFA, 2015, ASFA Retirement Standard Figures - Detailed budget breakdowns. Association of Superannuation Funds of Australia (ASFA), ASFA Research and Resource Centre.

Australian Institute of Health and Welfare, 2014. Mortality and life expectancy of Indigenous Australians: 2008 to 2012. Cat. no. IHW 140. Canberra: AIHW.

Basu, A., Byrne, A. and Drew, M., 2011, Dynamic lifecycle strategies for target date retirement funds, *Journal of Portfolio Management* 37(2), 83–96.

Basu, A. K. and Drew M. E., 2009a, The case for gender-sensitive superannuation plan design, *Australian Economic Review* 42(2), 177-189.

Basu, A. K. and Drew M. E., 2009b, Portfolio size effect in retirement accounts: What does it imply for lifecycle asset allocation funds?, *Journal of Portfolio Management* 35(3), 61-72.

Blake, D. and Burrows, W., 2001, Survivor bonds: Helping to hedge mortality risk, *Journal of Risk and Insurance* 68(2), 339-348.

Blake, D., Cairns, J. and Dowd, K., 2006, Living with mortality: Longevity bonds and other mortality-linked securities, *British Actuarial Journal* 12(1), 153-197.

Campbell, J. and Viceira, L., 2001, Who should buy long-term bonds?, *American Economic Review* 91(1), 99-127.

Clare, R., 2014, An update on the level and distribution of retirement savings, Association of Superannuation Funds of Australia (ASFA) http://www.superannuation.asn.au/policy/reports

Efron, B., 1979, Bootstrap methods: Another look at the jackknife, *Annals of Statistics* 7(1), 1-26.

Employee Earnings, Benefits and Trade Union Membership, 2013, Australian Bureau of Statistics. Cat. No. 6310.0

Gray, M., Hunter, B & Lohoar, S., 2012, Increasing Indigenous employment rates. Closing the gap clearinghouse. http://www.aihw.gov.au/closingthegap/documents/issues_papers/ctg-ip03.pdf

Hickman, K., Hunter, H., Byrd, J., Beck, J. and Terpening, W., 2001, Life cycle investing, holding periods, and risk, *Journal of Portfolio Management* 27(2), 101-111.

Jagannathan, R. and Kocherlakota, N.R., 1996, Why should older people invest less in stocks than younger people?, *Federal Reserve Bank of Minneapolis Quarterly Review* 20, 11-23.

Krumholz, H., Nuti, S., Downing, Normand, S. and Wang, Y., 2015, Mortality, Hospitalizations, and Expenditures for the Medicare Populations Aged 65 Years or Older, 1999-2013, *Journal of the American Medical Association* 314(4), 355-365.

Lusardi, A., 1998, On the importance of the precautionary saving motive, *American Economic Review* 88(2), 449-453.

Merton, R.C., 1969, Lifetime portfolio selection under uncertainty: The continuous-time case, *Review of Economics and Statistics* 51, 247-257.

Milevsky, M. A., 1998, Optimal asset allocation towards the end of the life cycle: To annuitize or not to annuitize?, *Journal of Risk and Insurance* 65(3), 401-426.

Mitchell, O. and Moore, J., 1998, Can Americans afford to retire? New evidence on retirement saving adequacy, *Journal of Risk and Insurance* 65(3), 371-400.

Neelakantan, U. and Chang, Y., 2010, Gender differences in wealth at retirement, *American Economic Review* 100(2), 362-367.

Samuelson, P.A., 1969, Lifetime portfolio selection by dynamic stochastic programming, *Review of Economics and Statistics* 51, 239-246.