



The Secretary  
Financial System Inquiry  
GPO Box 89  
Sydney NSW 2001

March 31, 2014

**Re: Submission to the Financial System Inquiry**

Dear Sir/Madam,

Please find attached a submission from the Australian Centre for Financial Studies (ACFS) responding to the call for submissions for the Financial System Inquiry. This submission provides information from the first tranche of the *CSIRO-Monash Superannuation Research Cluster* working papers that are relevant to the following sections of the terms of reference:

- 1.3. The current cost, quality, safety and availability of financial services, products and capital for all end users.
- 2.3. Assessing the consequences of financial regulation, including its impact on compliance costs, flexibility, innovation and financial services trade;

Key points raised in the reports relating to the specified sections of the terms of reference follow below:

1. **Research into investor behaviour is crucial for superannuation system design.** There appears to be some key demographic factors (gender, age, balance, income) associated with superannuation account holder behaviour. Other factors such as financial literacy and internet access have also been found to explain investment activity. The most compelling finding is the lack of choice exercised by superannuation account holders.
2. **A decrease in voluntary contributions over the past decade has offset a proportion of the increased retirement savings generated through the Superannuation Guarantee.** Overall, there is a declining pattern evident for both salary sacrifice (SS) and post-tax (PT) contribution participation between 2002/03 and 2011/12. Rates are relatively stable to 2007/08 but from 2008/09 through 2011/12 a drop is observed in both salary sacrifice and post-tax contributions.
3. **Increases in the Superannuation Guarantee can result in increased sequencing risk for superannuation account holders.** Increasing the contributions of workers through the Superannuation Guarantee without appropriately altering the asset allocation strategy of such investments may expose workers to greater sequencing risk, potentially undermining the objectives of the contribution increase. A combination of increased SG and a dynamic



lifecycle approach to default design achieves superior retirement outcomes for plan members

We would be happy to discuss the issues raised in the submission in more detail with the Secretariat if required.

Yours sincerely,



Professor Deborah Ralston  
Cluster Leader,  
CSIRO-Monash Superannuation Research Cluster

# A Review of Retirement Savings Investment Behaviours: Theory and Evidence

June 2013 Report Prepared by

Gordon Clark, Monash University/Oxford University

Huu Duong, Monash University

Paul Gerrans, University of Western Australia

Paul Lajbcygier, Monash University

Carly Moulang, Monash University

Maria Strydom, Monash University

John Vaz, Monash University

Jayasinghe Wickramanayake, Monash University

## Summary

This report has presented an overview of the extant literature relating to retirement savings investment choices, the determinants of investment activity and switch behaviour with preliminary results from a new database of members notably drawn from the retail sector. The report placed a particular focus on the Australian Superannuation System.

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\* Corresponding author, [paul.gerrans@uwa.edu.au](mailto:paul.gerrans@uwa.edu.au)

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## 1 Introduction

Superannuation has become the largest asset of Australian workers after the family home. The superannuation funds that members are enrolled in by their employer, to meet mandatory superannuation contributions obligations, are primarily defined contribution (DC) funds. DC funds place the individual member at the centre of responsibility for investment decisions regarding these contributions and, with time, their accumulated savings balance.<sup>1</sup>

Active choices by members of superannuation funds were assumed to become key forces within the system driving competition and improving overall efficiencies. This view has, however, been acknowledged as “optimistic” (Commonwealth of Australia, 2010b, p.8). The thrust of the more recent wave of regulations such as MySuper challenges this assumption more directly and has reoriented the choice architecture (Thaler and Sunstein, 2008) with the member as a reluctant decision maker at the forefront. This reflects concern about the interest/engagement of members in the task at hand as well as the competency to deal with the sophistication of products offered (Consumer and Financial Literacy Taskforce, 2004).

The dominant framework within investment finance when considering investment choices has at its core rational, utility maximising, risk-averse investors who aim to maximise returns whilst minimising risk. Alternative models have been proposed to consider investment choices, largely drawing on behavioural models from psychology. This report provides review of individual retirement savings decisions, and particularly provides an overview of when and why investors do (or do not) make changes to their superannuation savings.

We start by presenting the Australian setting and reviewing the levels of choice that members of superannuation funds have available. The available literature is reviewed to examine the influences on choice suggested by theory and reported empirically. We pay particular attention to the influence of financial literacy and demographics in these decisions. Next, we turn to potential behavioural explanations for superannuation choices as well as the choices involved in making retirement savings. The review is not exhaustive but attempts to highlight the principal areas of relevance to the Australian setting. Our

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<sup>1</sup> A defined contribution (DC) plan is a type of [retirement plan](#) in which the amount of the employer's annual contribution is specified. Unlike a defined benefit plan (DB), only employer contributions to the account are guaranteed, not the future benefits.

report concludes with a preliminary analysis of member investment activity using a new database provided by Mercer Australia, a major wealth management company.

## 2 Australian Retirement Income System and Choice

Before considering the literature relating to choice within retirement savings, and superannuation specifically, it is useful to review the income support system. Since its first payment in 1909, Australia has had a policy of granting a publicly provided age pension to retirees to insure that older Australians, who cannot work, are protected from the economic fears of old age. The combination of a greater proportion of individuals becoming eligible for the age pension, over a longer period of time, coupled with a declining worker (taxpayer) base to support this has provided impetus to the mandatory, employment linked superannuation system.

Mandatory superannuation contributions, introduced with the Superannuation Guarantee Act in 1992, had their genesis in the 1980s *Accords* between the Hawke-Keating government and the union movement. Notwithstanding the tremendous growth in superannuation assets, reflecting the mandatory and widespread coverage of Australian employees, the age pension will remain a central part of the Australian retirement income system. Treasury estimates that the proportion who *will not* receive any pension by 2050 will not exceed 25 per cent (Commonwealth of Australia, 2010a) though the mix of full-rate pensions will decline. This is important to remember when considering questions of choice relating to superannuation as the age pension will remain an important component of the retirement income portfolio and choices may be influenced by member expectation of receiving the old age pension.

Australians are afforded various levels of choice in the accumulation of retirement savings. Members of superannuation funds enjoy three distinct levels of choice relating to superannuation contributions and accumulated superannuation balances, distinguished by who offers the choice and the obligations in offering this choice.

The first choice is the “investment strategy choice” within a particular superannuation fund. This choice is available in 67 per cent of funds though these funds account for 98 per cent of industry assets (Australian Prudential Regulation Authority, 2013). This choice is offered by the funds themselves as a product feature to meet member demand and as a point of competition, but under no obligation to do so. Funds vary in how frequently this is allowed as well as how the choice can be applied by members. That is, whether it is applied to future

contributions, accumulated balances, or both. Funds may charge members for this choice and subsequent changes or may allow a certain number of free changes within the year.

The second level of choice is the choice of fund, where available, to receive compulsory Superannuation Guarantee contributions. This is a mandatory choice required through the Superannuation Legislation Amendment (Choice of Superannuation Funds) Act, legislation which had a long gestation period having been initially announced in 1996 and which only came into effect in July 2005. Eligible new employees must be presented with the choice within 28 days of joining an employer.

The third, and arguably more consequential choice than the choice of fund, is the ability to choose to transfer accumulated savings to another fund as permitted under the Superannuation Industry (Supervision) Regulations. Since July 2004, fund members have been able to request the transfer of the full or partial balance from their fund to a complying superannuation fund.

Much of the literature discussed in this review focuses on the first choice as very little analysis is available on choices two and three, notwithstanding their significance when exercised.



### 3 Influences on individuals' retirement savings investment decisions

In describing the literature relating to decisions and choices in retirement savings and investments it is important to emphasise a key finding upfront: **most people do not make active choices**. This is a surprise given the wealth of choices provided to superannuation members in the Australian system and the persistence of attempts to make various types of choice available. In any review of member choice in superannuation, the most salient fact is that little or no exercise of choice occurs.

In the next sections we will explore different explanations for this fact. The questions explored include: How prevalent is member choice “inertia”?; What are the causes for member inertia?; Does the exercise of member choice change over different demographics?; Do financial advisors spur and influence the exercise of member choice?; and to what extent can we explain member inertia using psychology? Each of these questions and many more will be addressed in the next section.

#### 3.1 Prevalence of Inertia

Across countries and systems a common finding is lack of choice by individuals and prevalence of “default behaviour” both in acceptance of the default level of savings and default investment strategies. For example, in the U.S. across a large sample of 1.2 million workers in 1,530 401(k) plans Mitchell, Mottola, Utkus and Yamaguchi (2006) report pervasive inertia. Almost 80% of accounts initiate no trades, and an additional 11% make only a single trade, in a two-year period. Average turnover, defined as average trade divided by average balance, was 18 per cent. The mean (median) number of trades for those who do trade is three. Agnew, Balduzzi and Sunden (2003) find that 87 per cent of members in one large 401(K) plan had zero trades over a four year period and only seven per cent had more than one trade. Also in the US, Ameriks and Zeldes (2004) find that 75 per cent of members in one plan made no change over a decade. Choi, Laibson, Madrian and Metrick (2002) suggest that employees take “the path of least resistance” when it comes to 401(k) retirement plans and highlight the control that employers ultimately have in the savings choices of their employees. Choi et al. (2002) find that there is acceptance of default contribution levels and default investment options in a large sample of individuals and

suggest how this evidence of passive decision making can be used to increase participation and contributions levels. They show, for example, that auto-enrolment dramatically increases plan participation, though also in the default investment allocation, this is also shown by Madrian and Shea (2001). Thaler and Benartzi (2004) offer prescriptive advice to overcome the procrastination and self-control they argue as underlying the inertia reported. They provide evidence from a “Save More Tomorrow” program, an acknowledged “libertarian paternalistic” (Sunstein and Thaler, 2003) approach, whereby employees are approached to commit to increases in savings from future pay rises. A high proportion commit (78%) and remain (80%) in the program after four years.

Bowman (2003) suggests similar default behaviour for Australian funds with only 10 to 15 per cent of members exercising investment choice. Over a 40-month period Gerrans, Gardner, Speelman and Clark-Murphy (2006) find only eight per cent of members in a single fund made an investment switch over a 40-month period. Gerrans (2012) examined superannuation investment choice both pre- and post-GFC and also found significant inertia even through the GFC with some spike in activity during late 2008 and early 2009. It is clear, that a large majority of investors do not exercise choice with their superannuation investment.

These findings are clearly confirmed in two major surveys on fund members’ attitude to superannuation showing the general apathy of fund members in engaging themselves in their retirement savings. Based on a sample of 1738 super fund members aged 25-70 years carried out in January 2012, the Sunway-ASFA Super Attitude Survey (2012) indicates that 42% of men and 52% of women (in total 47% of the sample) found that superannuation was too complicated for them to understand. Fifty eight per cent of respondents (53% men and 63% women) were concerned that they will not have enough superannuation savings at retirement age. For forty one per cent of respondents (34% men and women 47%) super is just a ‘set and forget’ decision. In a second recent survey (ANZ, 2011) conducted in July-August 2011, broadly similar conclusions have been drawn on financial literacy using a sample of 3,502 randomly selected Australian adults. The proportion of respondents saying they read their superannuation statements had declined six points since the previous survey in 2008, to 69%. This result seems to be due to avoidance of news of somewhat

disappointing returns over the past few years. Around a third of the respondents continued to report that they found their superannuation statements difficult to understand.

### 3.2 Competence, information processing and choice

The ability of individuals to make investment choices is a contentious issue in Australia as the superannuation regulatory environment and retirement planning industry —predicated on the assumption that individuals want choice— implicitly assumes the capacity of individuals to make reasonable decisions about their future retirement plans. This implies that individuals have the ability to garner a level of understanding of the choices available and make optimum selections to match their retirement needs. As Bateman, Eckert, Louviere, Thorp and Satchell (2012) state:

“Retirement savings that outsource government provision to private financial institutions and individuals depend on ordinary people possessing the skills needed to manage their financial responsibilities well. Evidence is mounting that many households in both the developed world and the developing world do not. ... Australians exhibit uneven financial competence and a poor understanding of risk management, investment and superannuation”. (Bateman et al., 2012, p.39)

In other markets, such as the U.S. and the U.K. similar assumptions are made in developing the retirement wealth management markets. This assumption of individuals’ capacity to make such decisions is the subject of much interest. This is evident in studies which examine, inter alia, the seminal work of Kahneman and Tversky regarding the ability of individuals to make decisions under uncertainty (Kahneman and Tversky, 1979) as well as others such as Benartzi (2001) who finds that individuals make suboptimal choices to match their needs; and Madrian and Shea (2001) and Choi et al. (2002), noted previously, who find that individuals take the path of least resistance in making investment choices with respect to their cognitive abilities resulting in suboptimal choices. These psychological theories may explain the inertia associated with the exercise of member choice in superannuation.

To explore possible explanations for investors making suboptimal choices, it is necessary to consider the characteristics associated with the investor retirement decision. The analysis of

investor choice needs to consider initial choices made and subsequent choices in a temporal context. Firstly, it is necessary to understand how information is obtained and processed by investors in making such choices. In other words is this choice made: based on a rational search for information available; or using heuristics involving convenience or simplicity? Secondly, does the approach taken by investors in making such choices vary according to their knowledge, skill-set or understanding of these choices? Alternatively, the likelihood of investors' choice may be made due to other predispositions such as the propensity to plan for the future with respect to anticipated or unanticipated needs including basing their decisions on heuristics or reference to mimicking others.

### 3.3 Financial literacy and investor retirement decisions

A potential explanation for member choice inertia may have to do with lack of financial education. The ability of individuals to make savings and investment decisions influences likely success of retirement income systems and this is particularly relevant in Australia, which relies increasingly on DC type structures. Measuring this ability has most commonly been described as an individuals' financial literacy. Financial literacy has been defined as a "combination of awareness, knowledge, skills, attitude, and behaviours necessary, to make sound financial decisions and ultimately achieve individual financial wellbeing" (OECD INFE, 2011).

International and national benchmark surveys of financial literacy present worryingly low levels of financial literacy: "financial literacy is very low around the world, irrespective of the level of financial market development and the type of pension provision" (Lusardi and Mitchell, 2011, p.506).

While a range of characteristics have been associated with levels of financial literacy, gender and age have been persistently associated with low levels. Not only do "women uniformly know less – [and] they know they know less ... low levels of financial knowledge in older populations also suggest that these groups may be particularly vulnerable" (Lusardi and Mitchell, 2011, p.506).

In a similar vein, Clark, Caerlewy-Smith and Marshall (2009) following Lusardi and Mitchell (2007; 2008), investigate the extent to which individuals in the UK give importance to their planning ability and their understanding of how accumulated savings can be converted in to an annuity stream. They find that attributes such as age, risk tolerance, income and whether their spouses are in employer provided pension plans, are all positively correlated with perceived importance of pension planning. They also find that the source of information, whether from generic or other national sources, as well as knowledge of annuities are of less perceived value than information received from specialist advisers, and their advice.

Worthington (2008) investigates basic superannuation literacy in Australia. He utilises data from a national survey which asks a series of questions relating to fundamental superannuation understanding and analyses responses according to demographics. He finds that if you are a female migrant with little education, then your understanding of superannuation is relatively poor compared to a professional aged over 40 with university education. Interestingly, the vast majority of respondents understood that the government would no longer fund a retirement funding gap.<sup>2</sup> This acknowledgement of, but ultimately indifference to the government's message that individuals will bare the responsibility for retirement savings, is supported in recent survey findings by Croy, Gerrans and Speelman (2012).

Perhaps, the combination of financial illiteracy and superannuation choice 'overload' are responsible for the observed member choice inertia? Fund or plan level relationships between financial literacy and retirement savings outcomes have also been investigated. Agnew and Szykman (2005) use experimental evidence from Australia to link financial literacy and information overload and default "selection". More financially literate individuals, reported less overload. The authors highlight that knowledge has a strong mediation effect on a sense of overload as only high knowledge individuals experience a reduction in information overload when the number of options available reduced. They find that the default option plays a greater role for low knowledge individuals than high knowledge individuals and explain this behaviour as the choice of the path of least resistance.

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<sup>2</sup> Worthington's findings on gender-based differences in understanding finance are confirmed in ANZ financial literacy survey (ANZ, 2011) in that females were more likely to have lower levels of financial literacy.

In a related Australian study, Gallery, Gallery, Brown, Furneaux and Palm (2011) investigate financial literacy variability using a comprehensive survey dataset from a large group of public sector superannuation fund members. Three measures of financial literacy were employed: general financial literacy, general investment literacy and specific investment knowledge. They also measure individuals' perceived versus actual financial literacy and report that the ability of investors to make optimal investment choices depends on the levels of financial literacy. In general, they find that although investor financial literacy is at a reasonable level, specific investment literacy was low. Wealth and household income are also identified as being positively related to investment knowledge. In addition, they conclude that those who self-rated their financial literacy as high generally achieved low scores on objective tests for investment literacy suggesting overconfidence in their skills in making more advanced investment decisions. They highlight the importance of improving financial literacy through the use of education programs to prevent uninformed decisions that lead to unexpected and undesirable financial outcomes. This is critical given the propensity of super funds to increase choices of investments offered to superannuation fund members. Recent survey results (ANZ, 2011) also seem to show that lack of financial literacy is responsible for a third of the respondents who reported difficulty in understanding their superannuation statements.

Financial literacy is therefore clearly an important contributing factor to investor ability in making appropriate superannuation saving and investment decisions.

### 3.4 The role of demographics in individual retirement decisions

So far, we have considered psychology and financial literacy in explaining inertia in members exercising choice. However, demographic factors may also be an explanatory or associated factor. How demographics relates to differences in retirement savings decisions (amount of savings, investment type) and decision making (those consulted, resources used) has attracted considerable attention.

In terms of the decision making process, Clark-Murphy and Gerrans (2001) identify that female fund members are less likely to consult work colleagues but are more likely to consult a finance professional and partner when making retirement savings decisions. In

relation to the role of demographic characteristics in retirement decisions, Clark and Strauss (2008) examine a random sample of the British adult population to explore the significance of socio-demographic characteristics for pension-related risk attitudes. The attitudes towards risk is reflected by respondents' answer to the question of whether they "aim to get best possible growth ... even if that means taking some risks" (i.e. financial risk tolerance) or whether they prefer "safe and secure savings and investments" with the cost of foregoing potential growth (i.e. financial risk aversion). They document no difference in the risk propensities among respondents by retirement savings plan type (personal plan, employer-sponsored plan, or both) or types of employer-sponsored pension plans (defined benefit, defined contribution, or both). In regards to respondents' socio-demographic characteristics, Clark and Strauss (2008) show that respondents' age, income, gender, marital status, and spouse's pension are all related to their risk propensity. More specifically, middle-aged respondents tend to be more risk averse while no difference in risk propensity is observed for young and old respondents. No difference is found in risk propensities of those with low and medium income but they observe that respondents with high income tend to be less risk averse. Similar to prior research [see, for example, Clark, Caerlewy-Smith and Marshall, 2007; Bajtelsmit, Bernasek and Jianakoplos (1999) and Papke (1998)], Clark and Strauss (2008) find that men are more risk tolerant than women. The authors find no difference in the risk propensity for married and unmarried individuals but they do observe that respondents whose spouses also have pension entitlements tend to be less risk averse.

Males have generally been identified as more likely to make investment switches and to make riskier choices (i.e. higher growth assets, equity). Agnew et al. (2003) and Mitchell et al. (2006) report this in the US, for example. Gerrans and Yap (2013) identify the lower propensity to trade by women in Australia. In the U.K., Byrne, Blake and Mannion (2009) did not find a gender difference in investment activity. In terms of risk levels, Gerrans and Clark-Murphy (2004) confirm lower risk investment choices by female fund members in Australia and confirm this is prevalent among young female members as well.

Mitchell et al. (2006) find men are positively associated with activity: they are more likely to trade (40 per cent more likely); they are more likely to be active traders (approximately 150 per cent more likely); with more trades (91 per cent more); and higher turnover (41-55 per

cent higher). Mitchell et al. (2006) emphasise that while relative likelihood varies by gender, and other characteristics discussed below, the larger result is that the overall level of non-traders is 76 per cent for men against 83 per cent for females and the proportion of active traders (six or more trades) is only 2.2 per cent. Gerrans (2012) examined superannuation *investment* choice both pre- and post-GFC and also found significant inertia with some spike in activity during late 2008 and early 2009.

Some suggest that the occupational basis of superannuation in Australia has a clear gendered effect (Jefferson, 2012). That is, the percentage of women who have no superannuation (33.7%) is substantially higher than that of men (24.3%). This varies considerably with age, with older individuals being most likely to have no superannuation. However, even at younger ages, more men have super than women. The average super account balance is also much lower for women when compared to men (52,000 vs. 88,000). In fact, the ABS (2009) suggests women have only about 60% of the accumulated super funds of men. Preston and Jefferson (2005) suggest this is likely due to their lower average earnings and less time spent in employment due to (mainly) family responsibilities.

So, clearly gender is associated with superannuation choice. Men exercise choice more often than women and also accumulate more super and therefore have a stronger incentive to exercise choice.

The life-cycle hypothesis of Modigliani and Brumberg (1954; 1990) suggests that individuals plan their consumption and savings over the lifecycle. In this vein, Gerrans et al. (2010) analyse the superannuation investment strategy of Australian workers to highlight how actual investment strategy and asset allocation choices of members change with age. They aim to investigate whether individual risky (conservative) asset class allocations decline (increase) consistently with age. Their study is motivated by the conflicting predictions and findings in prior theoretical and empirical studies on this issue. Gerrans et al. (2010) collect data on asset allocation decisions of members of three large Australian retirement savings funds. They model the joint-decision of whether to allocate to equity/property/cash/fixed interest and how much to allocate to these assets. They document a humped shape age-profile for aggressive asset class allocations and a 'U-shaped' age-profile for defensive asset class allocations. More specifically, there is a humped equity and age profile with allocations



peaking at 34. Allocations to property also show a humped profile, but the result is weaker compared to equity. In contrast, allocations to cash have a 'U-shaped' age profile, with comparable allocations for the lowest (greater than 53) and highest (less than 30) age quintiles. Allocations to fixed interest generally increase with age. They also document that the fund the member belongs to, the year the allocation decision was made and member characteristics, such as gender, wealth proxy, can also explain the differences in asset allocation. This result is consistent with that in Agnew et al. (2003) for the US.

Consistent with the life-cycle hypothesis of savings, age therefore appears an important consideration in how superannuation decisions are made. Parrish and Delpachitra (2012) focus on younger individuals in particular and acknowledge that despite the importance of superannuation for retirement, many Australians are disengaged from their superannuation plans and unaware of how their funds are performing. Their survey of students, to examine which factors influence young Australians in their choice of superannuation fund and investment options, aim to uncover the best ways to present financial information to help young Australians make optimal decisions regarding their superannuation. The authors focus on young investors since these investors mostly have lower level of financial literacy and knowledge than older individuals (Lusardi et al., 2010), and thus are more vulnerable to factors leading them away from optimal choices. Their survey presents information on returns, fees and risk of four hypothetical funds, but differs in the way the information is presented to participants. Respondents were asked to rank the funds in the order from most preferred to least preferred and to provide the reasons for their rankings. Parrish and Delpachitra (2012) document that the way information is presented to investors is important in affecting their superannuation choice. They show that the display of fee information affects both the choice of funds and the frequency in which respondents cite fees as the reason for their investment option. Respondents also rely more on risk labels such as "medium risk" or "high risk" than risk expressed as years of negative returns (risk probabilities). Employers appear to be highly influential in fund selection with the majority (82 per cent) of respondents choose the funds selected by their employer while age and gender do not have significant effect on the fund or investment option selection. Overall, the findings of the paper highlight the importance of the presentation of information for

superannuation decisions and the impact this has on the investment choices of younger individuals.

### 3.5 Other influences on member choices: Income, Wealth, Internet and Advice

Aside from gender and age, income and wealth have generally been positively related to the likelihood of choice (Mitchell et al., 2006; Gerrans, 2012). Registering for internet access has a clear association with trading activity. For example Choi, Laibson and Metrick (2000) report that trading frequency doubles and turnover increases by 50 per cent. An unresolved issue is the direction of causality, that is are more active traders more likely to register? Those with a greater number of investment options are more likely to subsequently trade whereas those initially invested in index funds are less likely to trade

Given that members exhibit considerable inertia in the exercise of choice in the context of superannuation, to what extent does professional financial advice overcome this inertia? How many members seek financial advice? What is the quality of the advice provided? How does this advice influence member behaviour and ultimately choice?

Australian Securities and Investment Commission (ASIC) conducted its latest shadow shopping study of retirement study in 2011 using 64 examples of retirement advice for analysis and the relevant report was published in March 2012. It finds, while the majority of advice examples reviewed (58%) were adequate, 39% of the advice examples were poor, and two examples were good quality advice (3%). In 16 of the advice examples, the investigation of the client's personal circumstances was poor. And in 15 of these 16 examples (94%), the overall quality of advice was also rated as poor. In 78% of the advice examples, the adviser was remunerated through product commissions or fees that were based on a percentage of the client's assets or investments under advice giving rise to a conflict of interest situation. In similar vein, distrust of financial advisors is also evident from an ANZ (2011) survey in that 4 in 10 respondents disagreed with the proposition "*I would trust financial professionals and accept what they recommend*".

In a survey of 1001 full-time working Australians aged 25-65, Mercer (2011) documents that only 10% of respondents made changes to their superannuation investment strategy from growth to conservative option or vice versa in the preceding 3 months. Four in five had not

made any changes while among those who made changes to their superannuation investment strategy 47% did not seek any advice prior to doing so. Only 30% sought advice from a financial adviser while others (16%) approached family and friends.

Another recent survey conducted by CHOICE in July 2010 found that Retail Super fund members have a noticeable dissatisfaction with fees, investment performance, customer service and, ironically, financial advice provided by the fund. About one in 10 of all respondents are considering switching their super fund, with the potential for churn highest among retail fund members, at 23% (compared to 9% of corporate fund members, 7% of industry fund respondents and 4% of those in public sector funds).

Thus members' poor attitude towards superannuation coupled with substantial reluctance to seek professional advice from financial advisors (with evidence of questionable advice) compound the issue of investment switching behaviour in superannuation. This is an aspect of superannuation, which warrants further investigation.

### 3.6 Behavioural influences on investor retirement decisions

Behavioural and psychological factors can influence investor retirement decisions. A growing body of research is choosing to look beyond demographic predictors of behaviour and focus on the complexities of human behaviour and the psyche. The hope is that directly understanding behaviour will lead to a better understanding of member choice and that demographics has merely provided a coarse characterization of such behaviour. This section reviews some of this research.

Investment choices can be strongly influenced by the way in which information is presented or 'framed' to individuals (Benartzi and Thaler, 1999). For instance Benartzi and Thaler (1999) found that by aggregating one year returns into 30-year equivalents then this increased the attractiveness of the stocks. Therefore when individuals are presented with explicit multi-year distributions, in comparison to one year return distributions, then they are willing accept more risks. An implication of this is in instances where employers are required to provide information about investment alternatives to their employees but are not allowed to offer advice about investment choice, then the very way in which they

provide the information can have a strong impact on investment choice (Benartzi and Thaler, 1999).

An individuals' aversion to loss can also impact on their retirement decisions. When an individual has a loss aversion then they weigh reductions in wealth much more heavily than increases in wealth, where losses are roughly weighed around twice as much as gains (Benartzi and Thaler, 1999). This is an example of 'narrow framing' (Kahneman and Lovallo, 1993) when, for instance, individuals' are thinking about gambles they are considered one at a time rather than being aggregated into a portfolio. Benartzi and Thaler (1999) found that by providing individuals with the explicit distribution of potential outcomes, then aversion to short terms losses can be overcome. They conclude that by aggregating and plotting results, individuals can be helped to appreciate the effects of statistical aggregation.

In the context of superannuation, this is vital: after all the key to good choice is appreciating that long run retirement goals require long run strategies. In particular, it is crucial to understand that increased risk exposure leads to increased **expected** returns. This means that increased returns may not be realised in the short run due to variability in short run returns, however in the long run such increased risk exposures will almost certainly lead to increased returns.

Psychological variables also play a role in influencing investor retirement decisions. A recent survey of 300 working Malaysians revealed that goal clarity, attitude towards retirement and potential conflict in retirement, were all significantly related to retirement planning behaviour (Moorthy, Chelliah, Sien, Leong, Kai, Rhu and Teng, 2012). Behavioural tendencies have also been found to impact on retirement planning. For instance, a survey on 911 American households revealed that individuals who were more likely to use more financial information sources (for instance, engage financial advisors, conduct internet research etc.), those who started investing early in life and those who had been active investors in the past 12 months were more likely to own an IRA (individual retirement account) (Hira, Whitney, and Loibl, 2009). Moreover, individuals who engage in ex ante research (researching information before speaking with an individual), who review information received in the mail, who start investing early in life and holding the belief that it is important to set up automatic deposits, are all more likely to maximise their retirement contributions (Hira et

al., 2009). Their study highlights the importance of creating opportunities for young people to learn about investments and to start investing as early as possible. They also advocate the need to explore ways to help people build a strong internal locus of control (locus of control was found to be very strong for the youngest age group only, significantly associated with those who maximised their contributions). Jacobs-Lawson and Hershey (2005) explore three psychological variables and their relationship to an individuals' tendency to save for retirement. They found that by having a future time perspective (the extent to which individuals' focus on the future), knowledge of financial planning for retirement, and risk tolerance were all significant predictors of retirement savings decisions (more aggressive savings profiles). A significant three-way interaction between these psychological variables was found. They conclude by advocating the importance of looking beyond main effects and incorporating interaction effects into empirical analysis.

Psychological bias can also impact on investor retirement decisions. Familiarity bias, for instance, is where investors prefer to invest in certain stocks because they are familiar to them. The problem associated with this is that investors tend to believe that because of this familiarity, their stock is less risky than other company stocks (Bailey, Nofsinger, and O'Neill, 2003). Representative and status quo biases are other psychological biases that may be relevant for investor retirement decisions. Representative bias can lead to the incorrect assumption that a good company, that is one with a good work force, management etc., is also a good investment in terms of possessing stocks that increase in value, where in fact this is not always the case (Bailey et al., 2003; Shefrin, 2000). Status quo bias refers to preferring the default choice and this can occur when investors are presented with many choices (Samuelson and Zeckhauser, 1988; Bailey et al., 2003). Many employees do not take an active ongoing role in their retirement funds, rather once they have made their initial investment decisions; they maintain the status quo thereafter (Bailey et al., 2003). This has implications for the amount of offerings from superannuation funds where more investment options may actually lead to poorer individual outcomes due to the status quo effect where investors are overwhelmed by such choices and therefore decide to do nothing instead. Information also has the potential of being misinterpreted, for instance if a company is offering employees stock, then employees, due to their trust in the company, may view this

as a signal that the stock is 'safe', this can be particularly the case when the company matches with its stock (Benartzi, 2001).

Behavioural and psychological factors also have the potential to impact on investor switching behaviours. Tetlock (2007) examines the relationship between investor sentiment and stock returns using content analysis of a daily Wall Street Journal article "Abreast of the Market" over an extended period of time (1984-1999). Specifically, Tetlock (2007) investigates the relationship between pessimism and short and "long"-term returns as well as market trading volume. A quantitative content analysis program is employed to investigate the daily variation in a single media factor, produced from a principal components analysis of the 77 categories in the General Inquirer software program, which is strongly related to pessimism. Alternative measures related to pessimism ("Negative" and "Weak" words) are also investigated to examine robustness of findings. In Tetlock (2007, p.1141) investor sentiment is defined as "the level of noise traders' beliefs relative to Bayesian beliefs as investor sentiment" following the distinction between "noise traders who hold random beliefs about future dividends and rational arbitrageurs who hold Bayesian beliefs". Three hypotheses are investigated focussed on the timing of pessimism in the media. The first is that pessimism forecasts investor sentiment; a second has pessimism reflecting past investment sentiment; and a third has a mixture of the two. If the latter, sentiment theory, is the case, a pattern of low market returns followed by high pessimism which forecasts lower returns over short horizons and higher returns, reversals, over longer horizons. A remaining, information theory, hypothesis suggests media pessimism reflects new fundamental price information not currently reflected in prices. This also predicts lower returns in the short run with no impact on long-run returns. Aside from association with returns, the sentiment theory predicts high and low pessimism is also predicted to be associated with increased trading volumes.

In Tetlock (2007), media content, high pessimism specifically, is associated with a decline in prices the following day which is reversed within a week. Moreover, unusual levels of pessimism (high or low) result in temporarily high trading volumes. Both are consistent with noise trader and liquidity trader models of DeLong, Shleifer, Summers and Waldmann (1990) and Campbell, Grossman and Wang (1993) respectively. The price decline is larger

and slower to reverse for smaller stocks, which further corroborates the link between pessimism and individual investor behaviour.

The status quo bias can also be applied to the superannuation environment as a potential explanation for investor myopia. In one of the most important papers published in the field of economics and decision-making, Samuelson and Zeckhauser (1988) make a distinction between “rational choice” and the ways in which people conceptualise and implement decision-making. As they note, conventional models posit that the theory of rational choice is both a prescriptive and descriptive paradigm: it would seem that many economists believe that people should and actually do act in accordance with the axioms of rational choice. Samuelson and Zeckhauser (1988) contend that rational choice is not an adequate description of how people make decisions, illustrating their argument by reference to status quo bias.

Importantly, Samuelson and Zeckhauser (1988, p.10) do not run an argument which juxtaposes rationality with irrationality; rather, they suggest that “status quo bias is best viewed as a deeply rooted decision-making practice stemming partly from a mental illusion and partly from psychological inclination”. Throughout, they are at pains to suggest that status quo bias is a characteristic of human behaviour and should be recognised as such, rather than dismissed as an aberration. So, for example, they contend that “status quo bias is not a mistake”; even when people are made aware that they act in such a manner, they find it hard to act so as to mediate their psychological predisposition. Elsewhere, Zeckhauser amongst a number of other economists and psychologists have suggested that people can be educated and trained so as to dampen the effects of such predispositions. Indeed, setting and following rules applicable to situations which lend themselves to status quo bias (amongst other kinds of biases) are entirely possible, even desirable (Doherty, 2003). However, psychologists including Kahneman (2003) are not so confident as to the power of education and following rules.

Samuelson and Zeckhauser (1988) use a series of decision-making experiments combined with the analysis of two datasets to demonstrate that status quo bias can be seen in the choices made by individuals about enrolment in health care plans and the allocation of assets between various options in defined contribution pension plans. As such, this paper

has had an enormous impact in pension research, especially as regards the conceptualisation and analysis of patterns of decision-making. Nonetheless, the authors found it necessary to defend the use of experiments to illustrate the nature and significance of status quo bias. They note that critics of their paper suggested that when people are faced with “real” decisions with “real resources at stake” experimental results will fade into the background in the face of the imperatives of real life. The authors defend themselves against this argument suggesting, in fact, that people are more likely prone to status quo bias in “real” situations than in experimental settings. So-called real situations are often not fully specified in terms of the available options, information is in short supply, and there is some urgency in making a decision. As a consequence, people are more likely to default to customary practice (status quo bias) than in experimental situations.

The results of their experiments are compelling, even though experimental design and implementation have obviously moved on over the past 25 years (Baron, 2008). In any event, this aspect of their paper is often passed over in favour of their analysis of the patterns of status quo bias evident in the behaviour of participants in Harvard’s health plan (1986–1987) and in the TIAA-CREF pension system (1981–1986). They show that health plan choices and TIAA-CREF asset allocations can be reasonably explained by status quo bias. Another of their findings is that the initial asset allocations between equities and bonds made by new participants in TIAA-CREF hold for many years, and typically centre on a 50-50 split between the two asset classes. Much has been made about these findings, and there has been considerable research done on the effects of framing choice and the setting of options for subsequent behaviour. So, for example, if choice is set between just two asset classes it is inevitable, it appears, that many people simply distribute evenly the available assets between those choices.

This issue has been addressed in some detail by Benartzi and Thaler (2001) and is conceptualised *as the 1/n problem* such that investors invest evenly across the menu of options available. However, little evidence of this form of naïve diversification is reported elsewhere. Huberman and Jiang (2006) use a *conditional 1/n* heuristic where individuals allocate evenly across options conditional on the subset of options they use, not the total options offered. However they note that this behaviour is not inconsistent with decision rationality. Gerrans and Yap (2013) report similar conditional 1/n heuristic use in Australia



but also do not find evidence that investment menu size is associated with asset allocations. However, Clark et al. (2009) show that the strength of this effect may be mediated by the salience of the issue (age-related) and the significance of the assets relative to participants' overall wealth.

Benartzi and Thaler (2001) also show that there are differences in status quo bias between new and old participants by age. In this respect, the authors (p.33) contend that "it is difficult to characterise retention of the status quo allocation as a rational operating rule of thumb". They also note that those who changed their asset allocation, did so for a specific reason (for example primarily because of stock market performance) rather than a strategic understanding of the nature and scope of retirement saving. Implied is an argument that people are either over-responsive to short-term events and/or over-confident in their ability to make effective investment decisions. Either way, this type of behaviour can be characterised as myopic.

The status-quo bias, documented by Samuel and Zeckhauser (1988) applied to investments suggests that investors are more likely to make no changes to their investments when faced with different choices. Rational choice economic theory suggests economic agents choose amongst alternatives based on their well-defined preferences. Status quo bias instead shows that investors are more likely to stick to the status quo unless they experience enough conflict to incite change. Self-perception theory is offered as a potential explanation for status quo persistence – it suggests individuals view their life as if an outsider and so draw inferences about their own underlying attitudes and preferences. One manifestation of this self-perception is to refer to past decisions as a guide for future ones – good enough for me then, must be good enough for me now.

In a related study, as discussed earlier, Agnew and Szykman (2005) investigate the extent to which the notion of the "path of least resistance" proposed by Choi et al. (2002) can account for the observable data that suggest that individuals make choices with a status quo bias. They examine the role of information overload in explaining why individuals are reluctant to make investment decisions in their defined contribution plans. There is the suggestion in the literature that investors may tend to reduce their effort in making such decisions in the face

of increasing complexity arising from the need to discriminate amongst the available choices and thus perhaps rely on heuristics or perceived safe choices.

So, it appears that at least conceptually, psychological biases such as status quo bias, familiarity bias and a conditional  $1/n$  heuristic may explain many of the member behaviors and choices observed in superannuation data. Next, we consider the single most important empirical fact associated with member choice: the fact that most members never exercise choice.

#### **4 Why investors may not be switching**

From the discussion presented above, it is clear that the decisions investors make in regards to saving for retirement, and how to do so are clearly complex. Whilst we have discussed to this point how investors make decisions about retirement savings, we have not examined the process involved in these choices or what precipitates such decisions. It appears from extant studies, however, that the vast majority of investors place themselves (or are placed by their employer upon joining) in a “default” option and that most individuals hardly ever change from this strategy (Agnew et al. 2003). We therefore examine next the extant literature attempting to explain why some investors switch whilst others do not.

Once in an investment strategy, change theory predicts investors will only alter their strategy when frustrated/experiencing conflict with their current situation (perhaps feeling aggrieved by returns earned, fees paid etc.). However, more likely than change is maintaining the status quo and as detailed before, Samuelson and Zeckhauser (1988) and others since (Agnew and Szykman, 2005) clearly document that a ‘status quo bias’ exists. That is, investors are more likely to make no changes to their investments when faced with different choices. So whilst rational choice economic theory suggests economic agents choose amongst alternatives based on their well-defined preferences, status quo bias instead shows that investors are more likely to stick to the status quo.

So how does change occur then? Festinger (1964) suggests that the decision making process consists of several phases – but that the first, the pre-decision phase will only be entered into once there is conflict – decision-motivating tension – a frustration and dissatisfaction with the status quo. The pre-decision phase involves examining and evaluating alternatives– whilst an ideal might not exist, a realistic “established alternative” will be identified. The decision maker reaches for consensus opinion. Towards the end of this phase, a partial decision can be made. The second phase (partial decision) involves eliminating the “furthest” from ideal options. The remaining options are ranked. The final decision stage – alternatives become less and less until final decision made. In the post decision stage, post decision regret sets in once dissonance has become salient. Then dissonance reduction sets in. Whilst this, in theory, is how investors should be driven to make changes in their superannuation, the large number of investors in default options (and

low percentages of investor who switch options) suggest that investors never truly reach the final stages of this decision making progress (where a decision is made and action taken).

#### 4.1 Why do some investors switch and others don't?

Given the extent of investor inactivity in their retirement savings plans, some suggest that a "life-cycle fund" is the most appropriate for such myopic investors. A life-cycle fund is a particular type of mutual fund whereby the proportion of investment in different assets classes in an investor's super portfolio are automatically adjusted from a high risk to a lower risk position as the investor ages and nears retirement. Recognising that many people are risk averse, by convention life-cycle funds tend to expose younger participants to equity market risks in the early stages of their enrolment and dampen those risks as they come closer to retirement. It is assumed that certainty of income (and indeed certainty of total accumulated assets) towards the end of ones working career is a desirable attribute of a defined contribution pension plan. This permits retirement planning with some certainty and also avoids drawdowns late in one's career when it is difficult to recoup losses due to lack of earning time and time in markets. However, there are many unresolved issues with such funds, not least of which being when the asset allocation should be adjusted, at what rate and whether the reduction in equity exposure may be counterproductive to wealth accumulation.

Basu and Drew (2009) examine this issue in a simulated environment. Recognising that many participants in DC plans tend not to vary their initial asset allocation strategies as they progress through their employment careers to retirement, one response has been to encourage participants to enrol in life-cycle funds which it is assumed that this type of fund is consistent with the long-term interests of participants in building a retirement fund appropriate to their retirement needs. These funds reduce exposure to equity with age. Notwithstanding the popularity of life-cycle funds critics such as Shiller (2005) have suggested that the design of these types of funds leave a lot to be desired. Specifically, Shiller (2005) argues that life-cycle funds ought to be exposed to equity market risk during the latter stages of participants' employment careers because earnings are so much higher due to the balance at this stage being larger than is the case in their initial stages of

employment. He suggests that this would make a significant difference to the value of the accumulated fund at retirement.

Basu and Drew (2009) test Shiller's hypothesis and show that the argument does, in fact, hold for the most likely scenarios. They do so by constructing a set of hypothetical investment strategies, including conventional lifecycle approaches and contrarian approaches in the manner suggested by Shiller. They conclude that "naive contrarian strategies which, defying conventional wisdom, switch to risky stocks from conservative assets produce far superior wealth outcomes relative to conventional life-cycle strategies in all but the most extreme cases" (Basu and Drew, 2009, p.70) .

This is an inventive and compelling argument, made plausible by the assumptions underpinning the analysis and the four different asset allocation strategies used to assess the case for and against Shiller's argument. However, as suggested by Pfau (2010) there are (at least) two caveats to the scope and significance of Basu and Drew's (2009) conclusion. First, it is arguable that those affected by the extreme case would pay a heavy price if, in fact, they were subject to the "impact of severe market downturns" as they entered the final phase of their employment careers. There is, therefore, a trade-off to be made between return maximisation and insuring planned future income. As indicated by Pfau (2010) people may be willing to forfeit the upside potential in exchange for certainty.

Second, Basu and Drew (2009) do not take seriously the possibility that a plan participant, or indeed a whole generation of plan participants, may be so unlucky as to encounter a series of market downturns such that their continued exposure to market volatility radically discounts their future incomes. Granted, taking risk off-the-table after one event may lock-in losses should there be no subsequent downturn. However, simulations based upon US nominal returns data over the past century may be misleading in regards to current circumstances and the possibility of systemic shifts in the nature and incidence of financial crises in Western markets (Barro, 2006).

Missing in Basu and Drew (2009), but hinted at by Pfau (2010), is the consideration of the likely impact of other types of wealth, including housing, on the optimal saving strategies

and risk appetite of DC plan participants. The authors share similar assumptions about income, employment histories, and the like. Nonetheless, it is apparent that those who earn more also tend to acquire high levels of housing wealth and other forms of household assets. As has been shown in a study of UK DC plan participants in a London-based investment bank, the older the participant and the higher their income the more diverse are their savings instruments. As a consequence, certain types of plan participants may be quite willing to assume a high level of risk in their DC asset allocations through to retirement because these risks are, in a sense, covered by their other savings instruments with much lower downside risks (Clark, Strauss and Know-Hayes, 2012).

However, there are likely to be older participants with lower incomes and few options, if any, available to discount the risks assumed by an aggressive asset allocation formula carried through to retirement. Should they be affected by an extreme event or, worse, a sequence of extreme events, their future retirement incomes are likely to be much lower than if they had assumed a lower risk strategy some years prior to retirement. This does not mean that the risks assumed are switched on or off. Assuming a retirement age of 65, one could imagine a life-cycle fund that gradually reduces the risk exposure of participants from about 50 years of age onwards. It is arguable, in fact, that the regulators of life-cycle funds are likely to err on the side of securing an adequate retirement income rather than facilitating the maximisation of returns on accumulated funds. The adverse consequences of extreme events could shift lower income DC participants back into the public pension system. Implicit in Basu and Drew, though again hinted at by Pfau, is an assumption that the welfare consequences of extreme events are insured by governments rather than plan sponsors or the individuals concerned. In fact, there is a moral hazard problem when people assume (explicitly or implicitly) that the adverse consequences of taking risk up until point of retirement will be borne by some other entity than themselves.

Fry, Heaney and McKeown(2007) use “Prospect theory” to explain superannuation fund choice in relation to superannuation guarantee contributions. They suggest that given loss aversion the expected benefit/cost ratio needs to be substantial to encourage a change which is further magnified as “superannuation profits cannot be realised until retirement” (Fry et al., 2007). Their key point of departure is the reliance on behavioural theory of

Kahneman and Tversky (1979, 1984) and Tversky and Kahneman (1992) which focuses on gains or losses, as distinct from total wealth. Specifically the status quo effect whereby those already assigned to a default investment option, or fund in this case, will require substantial expected benefits to be encouraged to move from their current reference point, which is their current fund. Fry et al. (2007) utilise survey data from a FinaMetrica survey completed by “Personal Investor” magazine readers. Only 9.5 per cent reported they were very likely to change superannuation fund and a further 9.3 per cent answering that they were fairly likely to do so. These rates are in line with those reported elsewhere for intentions to change superannuation fund reported elsewhere at the same time (Fear and Pace, 2008: p.16) but overstate the actual rates observed which have been in the range of three to six per cent (Fear and Pace, 2008: p.15) and primarily due to change of employment or the employer changing the default fund.

Results show that those self-reporting with better superannuation knowledge were less likely to change fund (Fry et al. 2007). Those reporting an awareness of an alternative fund preferred to their current fund were more likely to change as were those comparing their current fund poorly to the best available fund. The latter two results are suggested as indication of a change in reference point to the new fund. Croy, Gerrans and Speelman (2010a, 2010b) are further examples of applications of broader psychological models to investment choice in the use of Theory of Planned Behaviour (TPB). The focus of TPB is on attitudes, social norms and behavioural control to explain retirement savings decision intention and behaviour, namely investment strategy switch.

The popularity of life-cycle funds in the U.S. is interesting to consider when reviewing the evidence of Australian fund member investment choice. Fund trustees appear not to share the same view of asset allocation as their U.S. counterparts when faced with a majority of members who remain in the default option. Whilst loss aversion and the status quo bias might explain some of the evidence of limited switching behaviour observed in the Australian setting there may be reason to propose a misunderstanding of the default “balanced” fund. Superannuation members may assume an investment in a balanced option to be a fairly risk-averse option. At an aggregate level there is not compelling evidence that Australian funds are rebalancing their default strategies as their membership ages. The

average balanced fund in Australia contains some 65% in growth assets (shares and property) and up to 17% in 'other' investments such as hedge funds. Such an option, with approximately 82% exposure to risky assets is unlikely to be appropriate for an investor nearing retirement. The lack of rebalancing of "balanced default options" is suggested as a shortcoming of the current Australian super system (Ingles, 2009).



## **5 Preliminary Analysis of the Mercer Database**

To complete this report we present selected preliminary analysis of a new database of member investment behaviour constructed from members of the Mercer Super Trust, Corporate Division. The Mercer Database includes approximately 200 employer sub-plans with approximately 400,000 employees. These members can be tracked between 2003 and 2012 as they enter, receive employer superannuation contributions and make investment strategy changes. The data includes both active and exited members.

Three different types of investment activity is observable. The first is a contributions investment change (CIC) which changes the investment strategy for future contributions. The second is a balance investment change (BIC) which changes the investment strategy of the accumulated balance. A third combines the BIC and CIC at the same time. These are treated as separate investment change events for purpose of the analysis here.

The Mercer Super Trust is a corporate master trust where the majority of members are employees and where the employer has normally selected the super fund. The data is therefore noteworthy as it allows a contrast with the Australian empirical findings, discussed elsewhere in this report, which primarily rely on Industry fund data.

The results presented should be reviewed as preliminary and will be subject to further review but provide some empirical evidence to complement the previous discussion.

### **5.1 Gender**

A breakdown of investment activity by gender in Figure 1 indicates a greater likelihood of investment activity, of each type, by males. The overall proportion with any switching activity is 24% (with males 26% and females 21%). Figure 2 provides a breakdown of activity over time, split by gender. It reveals that men consistently make greater changes in their investments than women between 2003 and 2012. There are two exceptions in: 2003 and 2006. The 2006 result is possibly influenced by the timing of individual sub-plans entering and is subject to robustness checks. Similarly the relatively high proportions in 2003 may be an artefact of the total number of sub-plans observed in the database at the time. It is worth noting that these changes appear to be declining for both men and women over the time period.

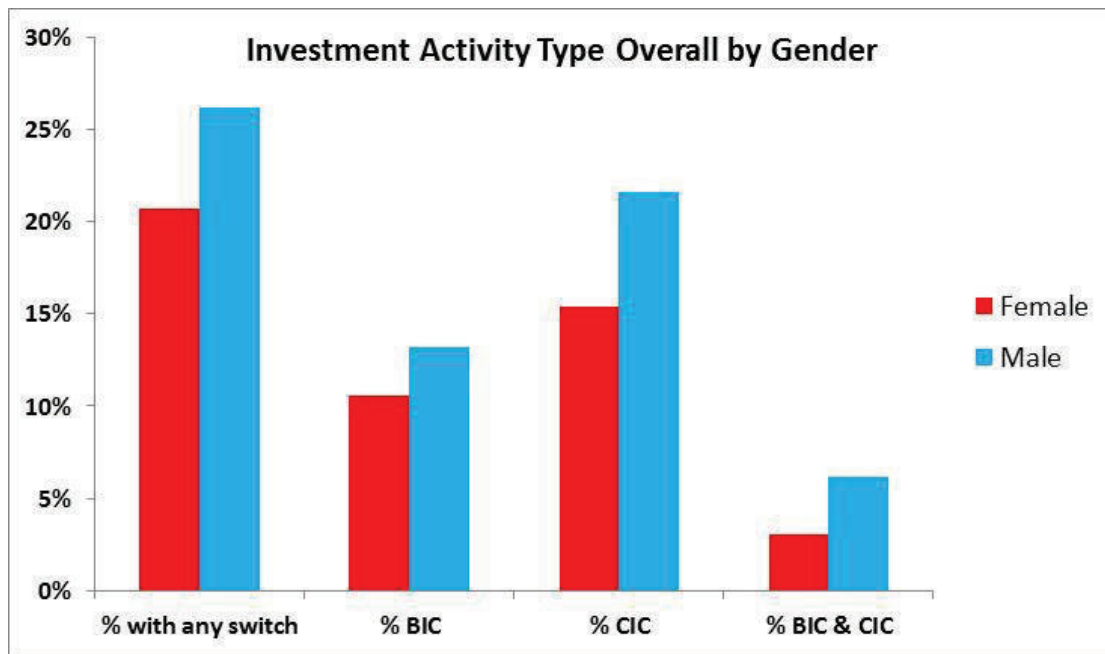


Figure 1 Overall Investment Activity by Gender

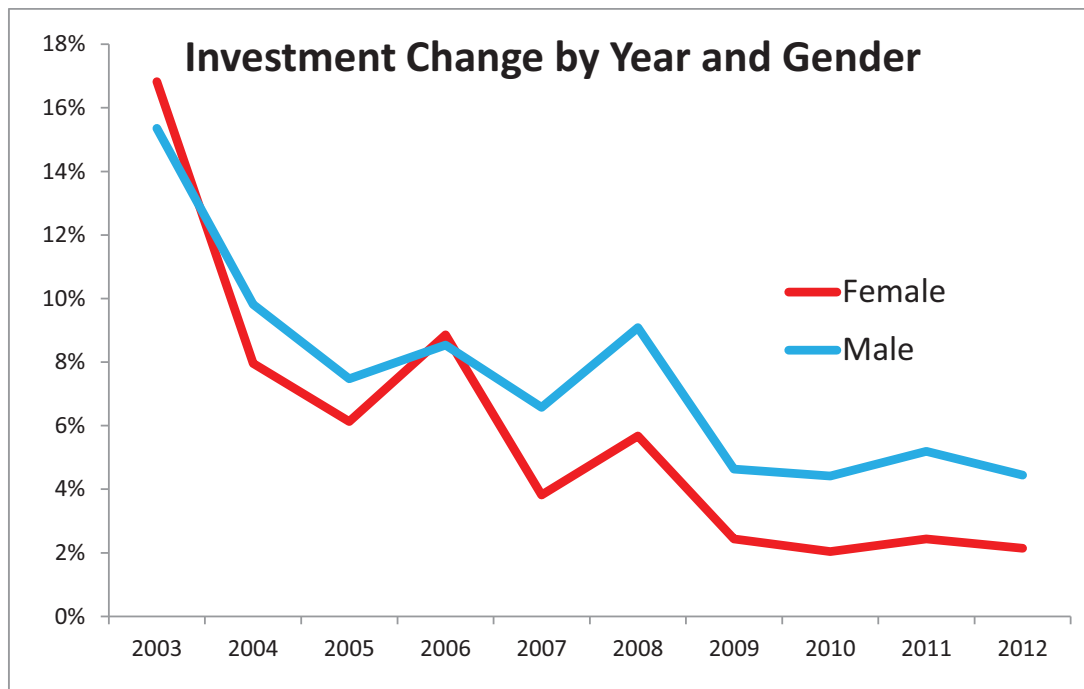


Figure 2 Investment Activity Over Time by Gender

## 5.2 Investment Activity by Age, Balance and Salary

**Figure 3** provides a breakdown of investment activity by age. Note that the age breakdown is for age at the time the activity was observed and hence a member may appear across two age cohorts given the timespan of the data. A consistent ordering of activity by age is observed from the oldest (red) to youngest (dark blue) over the entire time period. The oldest members are more likely to make changes to their portfolio. Note the spikes in 2003, 2006 and 2008. Consistent with Figure 1 the overall investment change appears to decline over time.

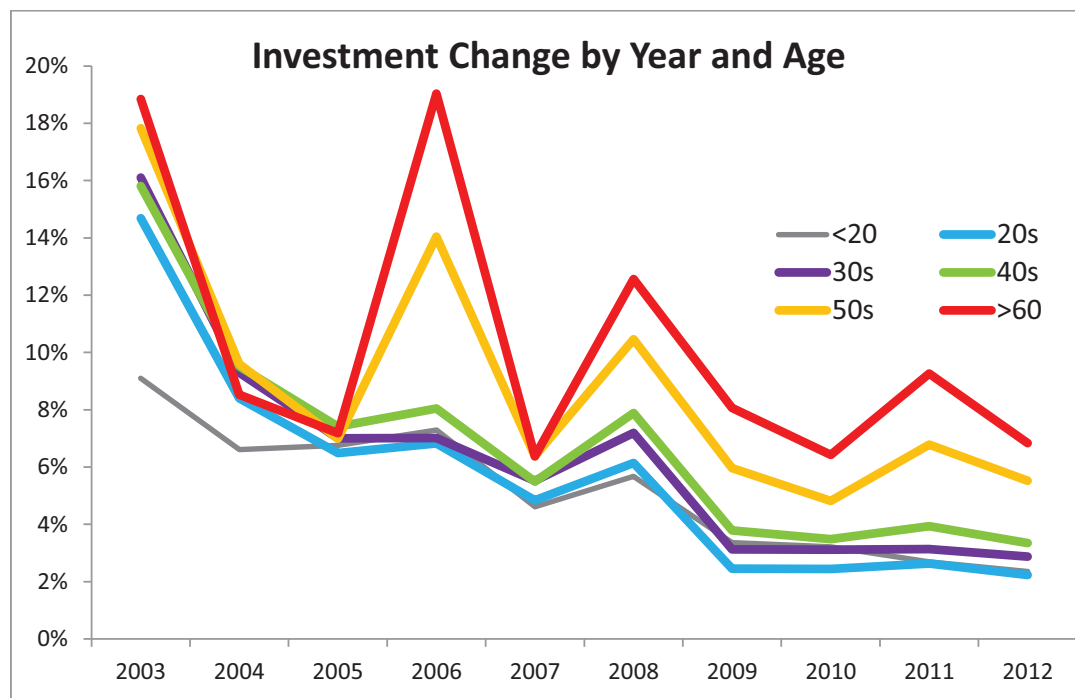


Figure 3 Investment Activity by Age

A complement to the age analysis is presented in Figure 4. Here activity is broken down by length of membership. This breakdown provides a clear difference by length of membership. For example, 49 percent of those with 10 years or more of membership have made an investment switch compared with 13 percent of those with one year.

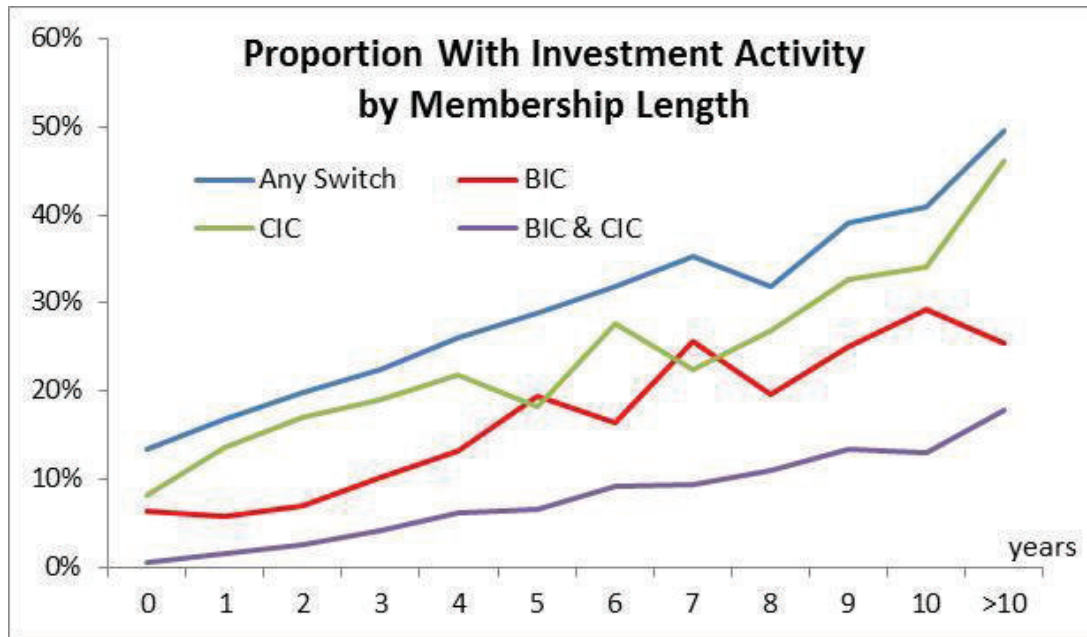


Figure 4 Investment Activity by Membership Length

Figure 5 shows investment change by balance quintile from 2003 to 2012. The balance quintile is determined for each year. A U-shape pattern in activity by balance quintile is observed. The largest balance members consistently make the largest change to their investments (and this is particularly true of the latter years). The lowest balance quintile make the second largest change, however their changes are smaller and probably due to initial information and set-up. This suggests that new members may be over-represented in investment activity, but consistent with Figure 3, the age of new members is across the age distribution, that is they are not necessarily the youngest.

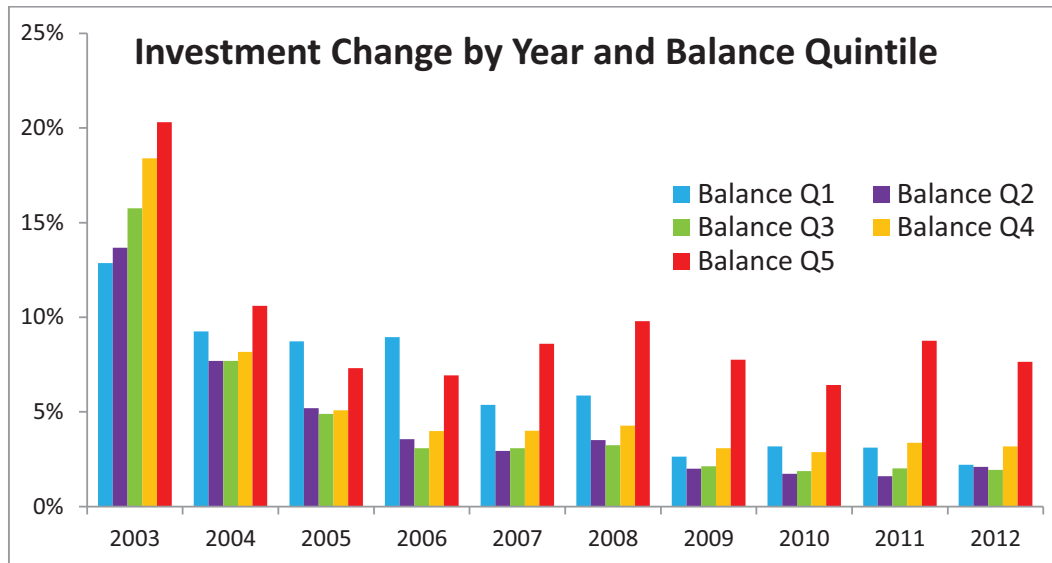


Figure 5 Investment Activity by Balance Quintile

A breakdown of investment activity by salary is presented in Figure 6. A distinct profile is reflected with those in higher salary quintiles more likely to have investment activity. The highest salary quintile is disproportionately larger. The results for age, salary and balance activity suggest interactions between each variable which will be further explored.

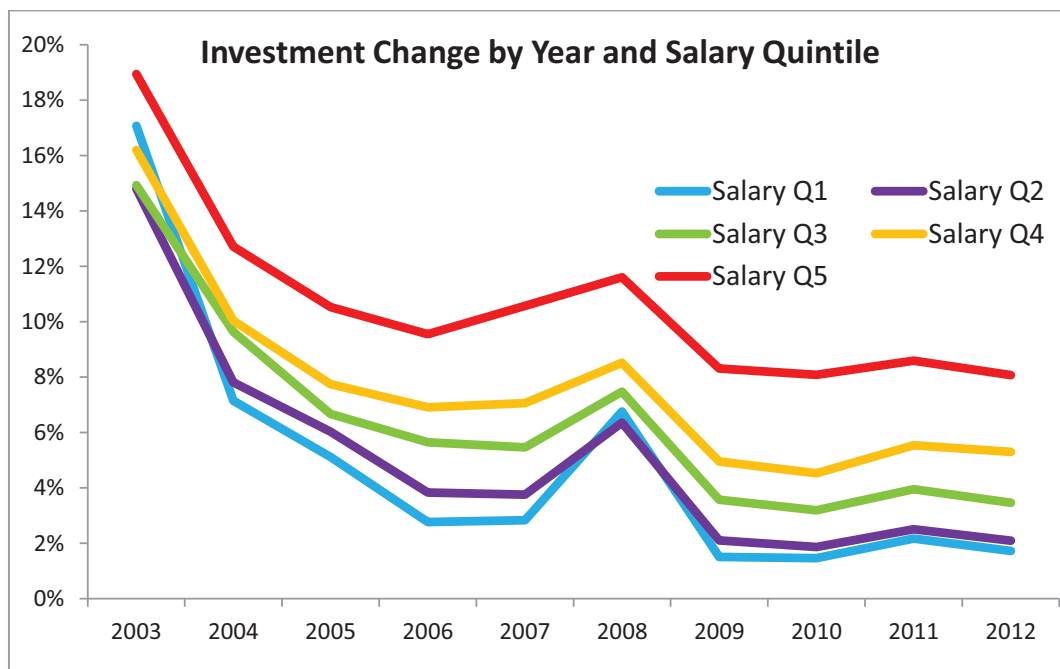


Figure 6 Investment Activity by Salary Quintile

At present the analysis does not reveal what the nature of the investment change is. That is, what are the asset allocation or risk changes produced. Further, we do not assess whether some members are observed across time or just observed once. Further analysis will reveal this.

## **6 Summary**

The Australian retirement income system continues to mature as it enters its twenties. As per any young adult, significant changes are being encountered. Significant structural changes to the institutional environment, through SuperStream, as well as the investment product environment through MySuper will influence the retirement income wellbeing of Australian workers.

This report has presented an overview of the extant literature relating to retirement savings investment choices, the determinants of investment activity and switch behaviour with preliminary results from a new database of members notably drawn from the retail sector. The report placed a particular focus on the Australian superannuation system.

From this review, it is clear that our knowledge of investor behaviour and particularly their decisions regarding investment savings and changes in their retirement savings can be improved. There appears to be some key demographic factors (gender, age, balance, income) associated with behaviour. Other factors such as financial literacy and internet access have also been found to explain investment activity. The most compelling finding is the lack of activity. The majority of members do not make changes even over considerable periods of time. Our understanding of why is improving but further reconciliation with available empirical facts is needed. Ideally this would utilise both revealed behaviour, as from the Mercer database, and attitudinal data collected via survey from the member when the investment is (and is not) undertaken.

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# Understanding superannuation contribution decisions: Theory and evidence

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**Jun Feng, Monash University**

**Paul Gerrans, The University of Western Australia\***

**Gordon Clark, Monash University/Oxford University**

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## **Preliminary Draft**

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\* Corresponding author, [paul.gerrans@uwa.edu.au](mailto:paul.gerrans@uwa.edu.au)

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## 1 Introduction

Though the Australian superannuation system can trace antecedents to the 19<sup>th</sup> century, the modern phase emerged only as recently as the 1980s through the industry wide employment agreements (Awards) and cemented through the Superannuation Guarantee Act of 1992. The modern system is built around compulsion which currently results in 9.25 percent of salary being contributed to a complying superannuation fund by employers on behalf of employees. The rate is legislated to increase in increments to 12 percent by 2019<sup>1</sup>. The compulsory employment based system complements the means-tested government age pension and the voluntary savings of individuals. This paper is focused on the latter third “pillar” of the retirement income system; in particular, the voluntary savings undertaken and managed within the superannuation system.

The assets under management in the superannuation sector have grown substantially to \$1.75 trillion (APRA 2013). This reflects the individual experience where superannuation has become the largest asset outside the family home, largely due the mandatory superannuation contributions from employers. Despite the total superannuation asset values exceeding annual GDP, concerns remain as to the adequacy of retirement savings with some analysis suggesting the retirement savings gap of \$836 billion (Rice Warner Actuaries 2012). Debate remains as to the appropriate superannuation guarantee rate with the Review of Australia’s Future Tax System (Commonwealth of Australia 2009) suggested a further tax concession of 7.5%.

In addition to the mandatory component of the superannuation, various mechanisms are in place to promote voluntary retirement savings via superannuation. Unlike the Superannuation Guarantee (SG) component, which has resulted in greater than 90% coverage among employees (ABS 2009), voluntary contributions have been less successful. This pattern is not unique internationally.

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<sup>1</sup> Though the current federal government has suggested a deferral in the timing of these increases.



The coverage of private (voluntary) retirement saving system is only 60% in countries that have relied on voluntary systems such as the U.S., U.K., and Canada (Antolin & Whitehouse 2009). Comparisons are difficult between compulsory and voluntary based systems, however, the participation rate in Australia is still lower (below 30%), which can be attributed to reliance on the compulsory component of the superannuation system.

Participation in voluntary contribution requires people to have a certain level of involvement in retirement planning, knowledge of the system, and interaction with their employer, superannuation fund or both. Surveys (Roy Morgan Research, 2003, 2005, 2008) have suggested knowledge is not high with only one-third reporting having considered how much they needed to save for retirement.

The direction of recent reviews, most recently the Super System review (Commonwealth of Australia 2010) and subsequent policy changes (MySuper), previously Simpler Super (Commonwealth Treasury 2006) and the Review of Australia's Future Tax System (Commonwealth of Australia 2009) reflect a direct challenge to the assumption of an informed and engaged membership of funds. As the Super System Review bluntly assessed it "many consumers do not have the interest, information or expertise required to make informed choices" (Commonwealth of Australia 2010, p.5).

In light of such evidence, this paper provides a review of individual retirement savings decisions with a focus on the contributions or savings behaviours. In particular, the paper examines lessons learned from international retirement saving systems and the limited number of studies examining the Australian superannuation system in order to provide a better picture of who and why people do or do not make voluntary contributions. We start with a brief introduction of the regulations governing voluntary contribution to superannuation and incentives offered. Then, the international literature is reviewed to examine the modelling of contribution behaviours. Particular attention is given to the role of demographics, plan specific features as well as tax incentives. We also provide evidence from the study of several publicly available micro-level databases in Australia. The final contribution is

a preliminary analysis of member contribution behaviours using a new database provided by Mercer Australia.

## 2 Contribution choices in superannuation

The current superannuation system has evolved sporadically from the modest beginnings of the 1980s, as previously noted. The Superannuation Guarantee Act in 1992 was pivotal legislation which resulted in widespread coverage, and was designed, in part, to reduce reliance on the means-tested age pension. Though efforts are made to reduce people's reliance on the age pension, a majority of retirees will still be eligible for the age pension at some stage through their retirement. Hence, it is important to recognise the influence of the means-test criteria on individual choices in contributions decisions.

Members of a superannuation fund have a number of channels that allow them to make further contributions into their superannuation account to boost their account balance. The fundamental motivation through superannuation rather than a non-superannuation asset is the relative tax concessions contributions it enjoys, albeit at changing levels and subject to financial year limits.

### 2.1 Voluntary Contributions Types

The first type of voluntary contribution is salary sacrifice. Salary sacrifice is a pre-arrangement with the employer where fund member forgoes part of their pre-tax salary in exchange for employer making the equivalent amount of employer contribution into the superannuation account. The salary sacrifice contribution is taxed concessional at 15% as the funds enter superannuation. For taxpayers facing higher marginal tax rates, salary sacrifice therefore offers a direct tax advantage for retirement savings though this option is bounded by several limitations. First, salary sacrifice into superannuation is not offered by all employers, and may not be available for all employees within the same employer. There are, unfortunately, no official data to shed light on the level of actual level of offering of salary sacrifice offering. Secondly, maximum concessional contribution limits are in place which limit the amount that can be salary sacrificed.

The second type of voluntary contribution is personal contributions. These contributions can be periodically deducted from after-tax salary or made on an irregular basis directly to the superannuation fund. Tax treatment differs depending

on the employment status of the contributor. For employees, the contributions do not attract the 15% contributions tax, but the investment return on the contributions, as with salary sacrifice, is taxed at 15%<sup>2</sup>. For the self-employed, tax concessions can be claimed and therefore the voluntary contribution is effectively treated as a pre-tax contribution. In addition to tax concessions on contributions and investment returns, the government makes co-contributions on eligible personal contributions made by low income earners under the *Superannuation (Government Co-contribution for Low Income Earners) Act 2003*. At present a maximum \$500 government co-contribution may be received by an individual earning \$33,516 or less and making a \$1,000 personal contribution.

A third type of voluntary contribution is spousal contributions, where contributions are made on behalf of the spouse into a spouse's account. Aside from tax benefit on investment returns, this option offers a tax rebate of 18% on the first \$3,000 spouse contributions for low income earners. Reflecting the modest incentive, in absolute size, the take up rate for this option is extremely small, and is not separately reported in the official statistics published by ABS (2009).

In this paper, the first two types of voluntary contributions are reviewed given the small participation rate of the third. Much of the literature examined in this paper focuses on the employee population as they comprise a large proportion of the work force. It is important to note that savings for retirement can be achieved outside of superannuation structures. However in this paper we focus only on savings within superannuation. It is also important to emphasise that along with the tax concessions to save within superannuation are constraints on accessing the savings when "inside". Superannuation savings can be withdrawn once the individual reaches preservation age, which at present ranges from 55 (born on or before 1 June 1960) to 60 (born after 30 June 1964).

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<sup>2</sup> The effective tax rate on investment returns is lower than 15% due to imputation credits and discounted capital gains. Yoo & de Serres (2004) estimated that the effective tax rate is 7.1%.

## 2.2 Predictors of contribution decisions

In universal public pension schemes and defined benefit plans, individuals do not have to make as many decisions about retirement savings. At the least, investment strategy is the plan sponsor's choice. Participation or enrolment may be automatic for an individual and contribution rates may also be predetermined. The question of adequacy, however, remains. For the majority of Australians, superannuation funds are primarily defined contribution (DC) funds, where choices and responsibility are completely left to the fund members. The types of choices available to superannuation members in the Australian system include voluntary contribution decisions, choice of fund, roll-over/consolidation of fund balances, choice of investment strategies, commencement of a transition to retirement scheme, and choice of lump sum or income stream in withdrawal.<sup>3</sup> Given so many choices available to fund members, it is somewhat surprising to see so little active choices made.

Focussing here on the contributions choice, is there a pattern that can be identified to predict who is saving more for retirement? Further, what are the characteristics the participants exhibit? In this section, we will review evidence from the international literature to address these questions.

## 2.3 Contributions, demographic and socio-economic factors

When thinking about the characteristics that can help identify the potential contributors to superannuation funds, demographic and socio-economic factors are the most available and can be readily used in the modelling of contribution behaviours. The most frequently studied personal characteristics include age, gender, income (salary), education and family composition.

Among the personal characteristics studied, analysis of age and income has consistently led to the same conclusion that older and higher income earners participate more and contribute more via retirement saving accounts. Such a

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<sup>3</sup> The choice of lump sum or income stream may also be faced by defined benefit fund members.

relationship has been established by a number of studies in the US (e.g., Poterba *et al.* 1995; Bassett *et al.* 1998; Poterba *et al.* 1998; Springstead & Wilson 2000; Purcell 2009; Copeland 2010) that have examined the distribution of participants in retirement saving schemes from various population surveys (e.g., CPS, SIPP, SCF, EBRI databases). Guariglia and Markose (2000) examine British personal pension plans, and also find that older, higher paid British citizens are more likely to be involved in schemes. In Germany, pension plan ownership is also related to age and income (Dummann 2008). Along the same lines, Munnell *et al.* (2001) look at the influence of homeownership and show that homeowners are more likely to become plan participants.

The life-cycle hypothesis of Modigliani and Brumberg (1954) is the most common model employed to explain the correlation between plan participation, age and income. The model suggests that forward-looking individuals plan their consumption and savings over the lifecycle, and savings behaviours are more likely to occur as one ages prior to retirement

Research on the correlation between gender, education and voluntary contributions is inconclusive. Although males are often associated with actively managing retirement savings (e.g., Hardy & Shuey 2000; Purcell 2005; Mitchell *et al.* 2006), some research (e.g., Papke 2004; Huberman *et al.* 2007) suggests that women have a higher probability of participation. A majority of the literature finds a positive connection between higher education and savings scheme participation, though a few (e.g., Munnell *et al.* 2001; Papke 2004) find no impact, and even a slightly negative effect. Despite the differences, many suggest that educational qualification can be good indicators of financial and scheme specific knowledge (Bassett *et al.* 1998), as well as income levels and job opportunities when these are unknown (Even & Macpherson 2000).

In addition to the above mentioned characteristics, family composition is also found to have some influence on participation. Married individuals are found to have a higher probability of participation in pension plans, suggesting a joint decision and coordination between family members (Shuey 2004). The presence of children, on

the other hand, reduces the chance of participation, especially for women (Joulfaian & Richardson 2001; Shuey & O'Rand 2006).

#### 2.4 The association with member job characteristics

Another area investigated of the determinants of voluntary retirement savings participation are employee job characteristics including job tenure, occupation, industry, and firm size. Job characteristics can reveal several aspects of individual needs and preferences, as well as characteristics of the position itself.

Firstly, job characteristics may reveal individual risk preference where risk averse individuals choose a more stable job. Even and Macpherson (2005) suggest that having part-time or casual employment reduces the probability of participation and Shuey (2004) finds that being in a large firm increases the probability.

Second, job characteristics are associated with income certainty which is an important factor in the savings decisions. Benito (2006) identifies that job security reduces the need for emergency savings, leaving higher potential for retirement savings.

Third, differences in employer offerings are often captured through job characteristics. For example, Even and Macpherson (2005) and Huberman *et al.* (2007) document that longer job tenure is positively associated with program participation, which in turn reflects the matching requirement set by the 401(k) programs. Shuey (2004) also records differences in participation rates by industry and occupation. In more detail, Chatterjee and Zahirovic-Herbert (2009) and Chatterjee (2010) demonstrate that participation is higher in the public sector than in the private sector, and suggest that this is likely due to the compulsory participation. They also show that public employees are more likely to be covered in a DB than a DC plan.

Despite the explanatory power of job characteristics, they are not commonly included in the modelling of voluntary contributions primarily due to the availability of the data. However, differences in the practices between sectors and industry are worth exploring to provide a better picture of the voluntary saving behaviours. This aspect will be explored with the Mercer database to be discussed in section 4.

## 2.5 The influence of plan/fund features

Plan or fund specific features are other areas that have attracted attention in the US thanks to the efforts made by plans to promote participation in retirement saving vehicles, particularly 401(k)s. Choi *et al.* (2001) summarise such features as including: matching contributions; education on plan features; automatic enrolment; automatic increase in contribution rates; automatic cash distribution at termination; as well as investment and borrowing options.

The automatic enrolment with opt out mechanism has substantially promoted both participation and contribution such as in the public sector saving plans (Thaler & Benartzi 2004; Beshears *et al.* 2009), largely attributed to the wide prevalence of inertia. Chetty *et al.* (2012) estimate that 85% of the population are passive decision makers. This behaviour is also observed in the Australian superannuation funds. For example, civil and military service industry members have a much higher participation rate in voluntary contributions due to its design of the plan (Bateman & Piggott 2011). Concerns remain in the US that while participation rates are improved through the auto-enrolment feature, it may have lowered contribution rates for those who would otherwise have opted in (Choi *et al.* 2001; Madrian & Shea 2001).

Although the association of individual education level and participation is inconclusive, education on plan features has a positive influence on retirement savings. Evidence from both the employee's side (Bernheim & Garrett 2003) and the employer's side (Bayer *et al.* 2009) show a positive link between retirement savings and employer-based education, particularly for low and middle income earners. Further, Duflo and Saez (2002; 2003) illustrate a significant peer effect on 401(k) and 403(b) participation where knowledge of the plan was passed among the peers.

Improvement in plan flexibility is also shown to increase plan participation. Holden and VanDerhei (2001) show that the availability of options to borrow against fund balances encourages plan participation, even though only a small number of participants apply for a loan and the debt ratio is often low. Offering investment choice within a fund was found to increase participation by 36% (Papke 2003). However, the number of choices should be limited with Mitchell *et al.* (2007) suggesting that when investment choices are over 30, the participation rate falls.



Matching as an incentive to stimulate retirement saving has been used widely in the US. A similar version of this in Australia is the government co-contribution for the low income earners. Such measures are believed to be an effective way of stimulating participation. However, debate on the extent to which matching has promoted retirement savings has shown large disparity. Research is in agreement on the positive relationship between participation and the offer of matching (Even & Macpherson 2005), but the effect is estimated to vary from very small (Smith *et al.* 2004; Mitchell *et al.* 2007) to very large (Duflo *et al.* 2006). Papke and Poterba (1995) find a substantial increase in contribution levels when matching is available while Engelhardt and Kumar (2007) conclude that the response of contribution level to matching is rather inelastic.

There are parallels between the features of many Australian superannuation funds when compared with US plans. The Superannuation Guarantee can be considered as an extreme case of an auto-enrolment plan. Investment choice offerings vary widely by fund, and some employers offer matched offerings. The opportunity to borrow and availability of company stocks, in the case of the US, are two notable differences

## 2.6 The role of tax incentives

The major benefit of participation in retirement saving account is its tax benefit. The decision to commit contributions to a retirement savings account, such as superannuation, is constrained by many factors including, time to retirement, uncertainty, budget constraint, and rule changes. The effect of the tax incentive on retirement saving decisions is often hard to measure due to the fact that it is correlated with income, which itself is positively associated with the likelihood of making or increasing contributions.

Within the limited literature available, a positive relationship between participation and tax incentives has been found; however, there is less than full agreement on the magnitude of the effect of tax incentives. Venti and Wise (1988) model IRA contributor status and contribution levels jointly accounting for contribution limits. The results show a substantial rise in the probability to participate, along with incentive, but no effect on the contribution rate. Attanasio *et al.* (2004) and Disney

*et al.* (2010) examine tax-exempt saving vehicles in the UK and Engelhardt (1996) and Milligan (2003) investigate Registered Retirement/Homeownership Saving Plans in Canada. Their evidence suggests an increase in participation after the products were first introduced or when the contribution limit was increased.

Research also argues that the impact of tax deductions is not large in terms of retirement savings. Collins and Wyckoff (1988) estimate the elasticity of savings in IRA participation to be 0.24. Power and Rider (2002) find the semi-elasticity to be 0.25 among the self-employed in the US Keogh/SEP program. Both papers conclude that the marginal tax rate has a limited impact on retirement saving decisions. In addition, Eaton (2002) explored a panel dataset and examined three aspects of the tax effect: the change in the tax price of contributions; the change in gross income; and the change in taxable income. This attempts to disentangle the effect of the tax incentives from the effect of income. Eaton (2002) finds a substantial impact from the change in taxable income with only a small influence from the change in gross income and no change due to tax price. This suggests that the true effect of tax incentive is not significant. This is particularly relevant in the Australian context given the current discussion of the cost, equity and necessity of providing tax incentives to encourage superannuation savings. The tax expenditure estimate for the concessional taxation of employer contributions in 2013/14 is \$16 billion (Commonwealth Treasury 2014) and forecast to reach \$20.7 billion in 2016/17, though there are contested views as to the suitability of the methodology employed in these estimates.

### 3 What do we know about Australian superannuation member contribution decisions?

The Superannuation Guarantee Act has resulted in the near universal coverage of Australian workers with superannuation entitlements. The coverage rate has steadily increased to its current level of over 90% (ABS 2000-2013). In contrast, the participation rate in voluntary contributions, on the other hand, has fallen steadily at a rate of 2.5% per year from half of employees making voluntary contributions in 1993, to a little less than a quarter in 2007. The trend is observed in all age groups except the 55 and older, where the decline in participation slowed down between 2000 and 2007 (ABS 1994-1995, 2001, 2009).

In the same period, the rules governing voluntary contributions have experienced substantial changes. A useful chronology of changes to 2010 is provided by Nielson and Harris (2010). The Government co-contribution scheme was first introduced in 2003 to replace the tax offset for low income earners. Age-based concessional contribution limits were abolished in 2007 and replaced with a uniform contribution cap with a transitional period for people over 50. Contribution limits have progressively reduced but from an individual planning perspective there have been continued adjustments announced and implemented as well as being announced and not implemented. This has had the effect of introducing uncertainty around rule changes and prospects of future changes which needs to be considered when reviewing individual decisions. The taxation regime has changed from taxation on entry and on earnings with concessional tax applied to withdrawals (TTt), to concessional taxation on entry and on earnings with no tax on withdrawal (provided at age 60) (ttE) in 2007.

Questions of interest relating to contributions include:

- What determinants of voluntary contributions emerge when considering the rule changes in the last decade?
- Are the patterns observed in the US and elsewhere observed in Australia notwithstanding differences in the retirement system design?

- What unique patterns are evident that relate to the design of Australian retirement system?

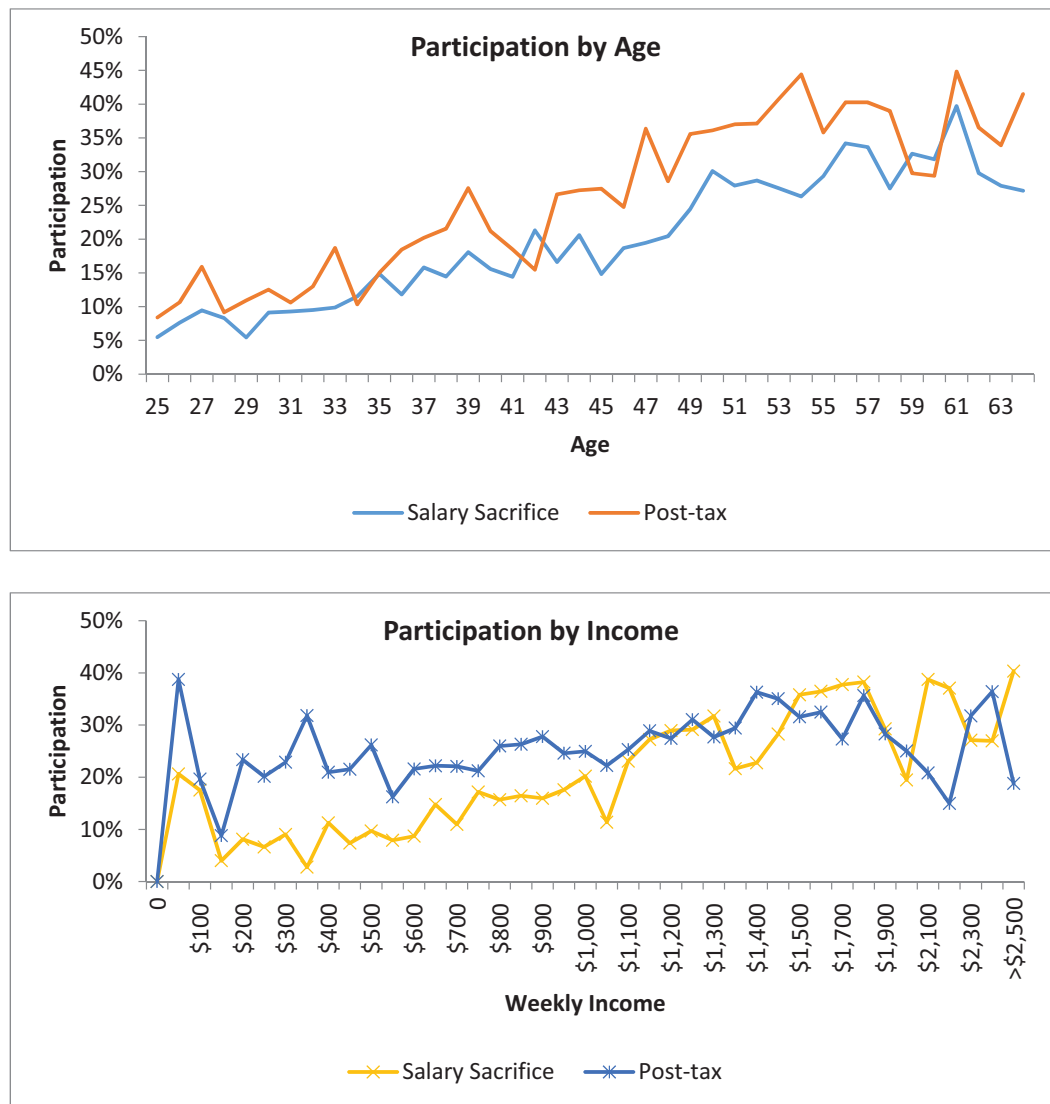
In this section, we will begin to address these questions based on Australian evidence.

### 3.1 What do we know from population surveys?

Micro-level data on voluntary superannuation contribution decisions are limited. The Australian Bureau of Statistics (ABS) produces a survey of employment, retirement and superannuation (SEARS) which has been undertaken in 2000 and 2007. These surveys provide comprehensive information on contribution decisions, demographics, socio-economic and employment factors. The survey of income and housing (SIH) undertaken biannually by the ABS also has similar factors to those explored by international studies. But, only information on salary sacrifice decisions are elicited. The longitudinal dataset HILDA, in recent waves (from wave 10), started to collect information on salary sacrifice decisions as well.

In these datasets, salary sacrifice participation for superannuation is estimated to be approximately 10 percent of the employee population, while participation in post-tax contributions is approximately 20 percent. As illustrated from the summary statistics from SEARS 2007 survey in Figure 1, there is a clear pattern of increased participation rate with both age and income levels.

**Figure 1 Participation rate for voluntary contributions (SEARS 2007, job tenure over 2 years)**



Feng (2013) utilises these datasets to examine the determinants of salary sacrifice and post-tax contribution decisions utilising a bivariate probit model. Five sets of factors (demographic, socio-economic factors, housing, job attributes and other factors) are explored that are suggested to predict contribution behaviours based on international literature and special features of the Australian retirement system design.

The results confirm the well documented pattern that age and income are the strongest predictors of voluntary contribution participation. Education level acts as a proxy for income and employment characteristics and can be a good predictor when

information is not available. Gender and family composition (marital status and number of children) were surprisingly found to have no significant relationship with the decision to make further contributions, which is a different result to that previously documented internationally. Job attributes, on the other hand, have shown to have significant predictive power, where individuals in more stable jobs (such as in permanent employment or working in large firms) are more likely to contribute in both types of voluntary contributions.

Feng (2013) also explores some of the features of the Australian retirement system. The treatment of the family home within the means-tested Age Pension is of particular note. The value of the family home is exempt from the assets test although the threshold for the asset test is lower for homeowners. Feng (2013) documents a negative relationship between homeownership and voluntary contributions participation, with those with mortgages and renting less likely to participate after controlling for income and demographic factors. This suggests a definite savings ordering with voluntary retirement savings second after property ownership.

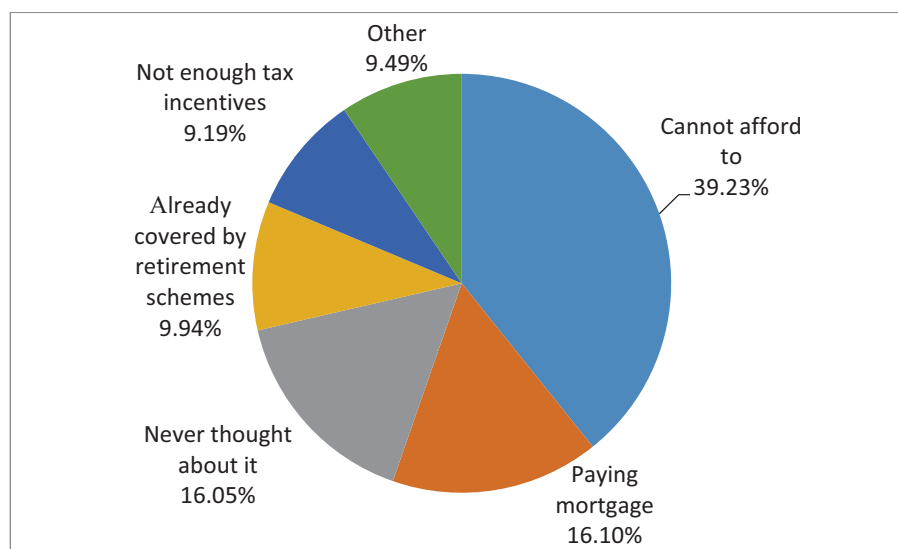
Another aspect of voluntary contribution decisions examined is the response to tax concessions offered through salary sacrifice. The evidence suggests no strong change in individual behaviour when individuals are faced with various levels of tax concessions, consistent with international evidence. It must be noted, however, that the influence of income in predicting participation interacts with the eligibility for tax concessions as noted previously.

### 3.2 What reasons could explain the lack of participation?

The above discussion provides us with a model that could help predict the participation in voluntary contributions to superannuation. However, many of the characteristics that predict participation are not amenable to change (e.g., family composition) to induce higher level of participation. Recent academic literature has focused on aspects that could help us understand the mechanism(s) behind the complex decision process. We explore some of the theories and empirical evidence that help explain the lack of participation.

In the SEARS 2007 survey, respondents were asked why they did not make any voluntary contributions. The main reasons are summarised in Figure 2. The largest proportion (39%) nominated unaffordability as the main reason, reflecting household budget constraints. Analysis of HILDA data also suggests that a significant indicator of non-participation is budgetary constraints reflected in the ability to raise emergency funds within a short period of time. Together with the respondents who nominate paying mortgages as the main reason, over half of the respondents nominate their financial situation as the main reason.

**Figure 2 Main reasons for not making any voluntary contributions (SEARS 2007)**



The second biggest reason (“never thought about it”) can be associated with the retirement planning perspective, and has also been identified in more detailed studies as a key explanatory variable of non-participation. Agnew *et al.* (2013b) surveyed people close to retirement and report over half do not have any plans for retirement. Further, Croy *et al.* (2010a, b, 2012) based on survey results from members of four superannuation fund established a strong association between planning and voluntary contributions.

The third reason (“already covered by retirement schemes”) is nominated because people consider that they are well covered by the mandatory employer contributions. This behaviour can be related to the status quo bias often reported in other areas of behaviour. Status quo bias and procrastination are often cited as

reasons for people to delay an action. The massive increase in participation rates after automatic enrolment is one example (Bailey *et al.* 2003) of methods to overcome this. Shuey and O'Rand (2006), Enis (2010) and Kusko *et al.* (1994) all find persistence in plan participation even when there is substantial change in the benefit of participation. Bateman *et al.* (2014a) further highlight that having an interest in superannuation is not readily transferred to active engagement in retirement saving decision making.

Other reasons not examined in these surveys, but increasingly examined elsewhere, is the level of financial literacy which may prevent individuals from making complex choices such as retirement saving decisions. Lusardi and Mitchell (2011) found low financial literacy among particular groups including young, low-educated women and report a positive relationship between financial literacy and the likelihood of retirement planning. A number of papers (e.g., Bateman *et al.* 2012; Agnew *et al.* 2013a; Agnew *et al.* 2013c; Bateman *et al.* 2014b) examine the financial competency of Australians and their results suggest a wide dispersion in financial literacy which compares poorly internationally. In addition, the knowledge of superannuation system specifically is limited, which impacts individuals willingness/ability in developing retirement saving plans.



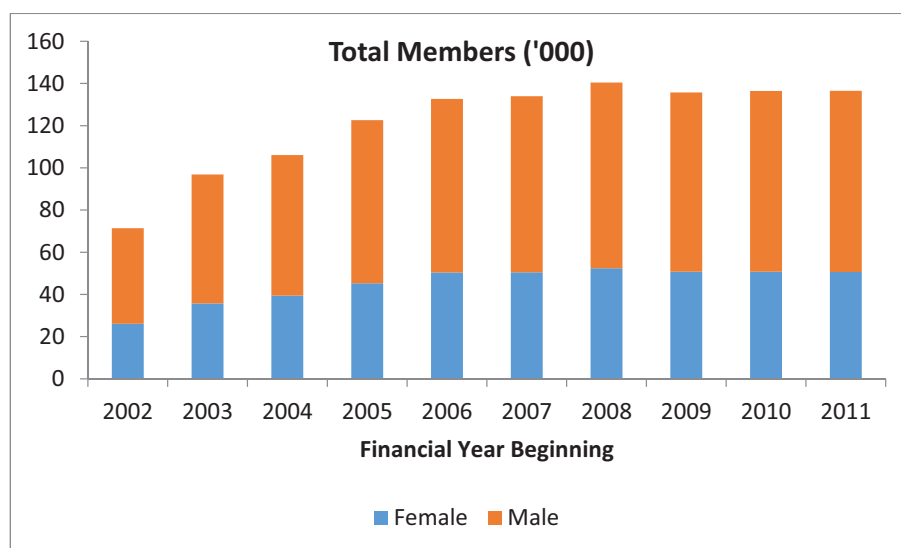
#### 4 Preliminary results from Mercer database

Many of the current studies on Australian superannuation contributions behaviour described so far are based on population surveys which often suffer from a reporting bias, especially when knowledge of the superannuation system is poor. It is not readily observable the extent to which respondents are correctly distinguishing between post-tax and salary sacrifice arrangements, for example. Further, time series information is limited and data is primarily cross-sectional which only provides a snapshot of savings behaviour, without any analysis available of trends in retirement savings. This is true both in an aggregate sense as well as at the micro-level.

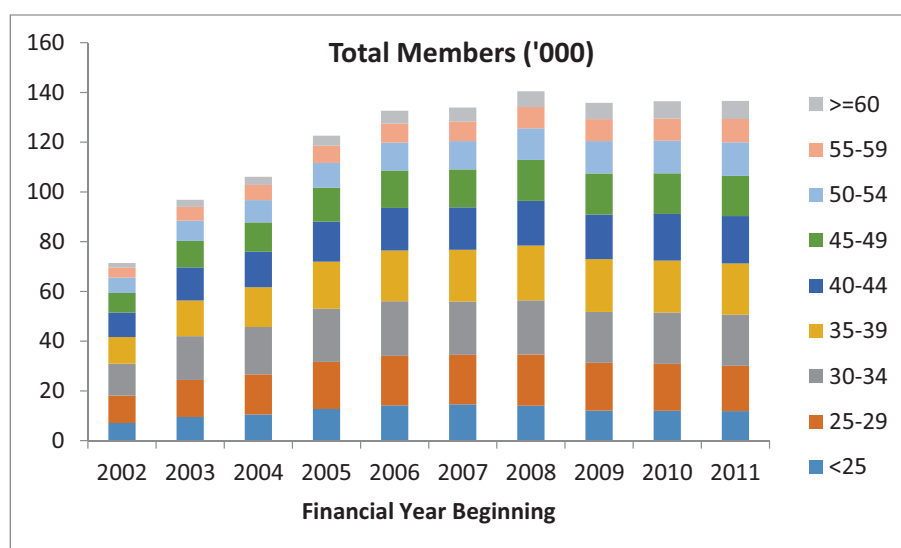
To further investigate the analysis of contributions, we now investigate individual records drawn from the Mercer Super Trust, Corporate Division. The Trust includes details of 187 sub-plans from many different employers drawn from a wide cross-section of Australian industry. Members of these sub-plans are therefore drawn from a wide cross-section of employees – full and part-time, junior level to executive, active and exited members

This preliminary analysis includes members with at least one financial year contributions record and a balance record for a financial year. This produces 162,605 members for 2002/03 to 2011/12 as described in Figure 3 and Figure 4. This time period allows an analysis covering different external conditions, notably including the global financial crisis, and incorporating periods where the rules governing contributions have changed significantly. The results presented should be viewed as preliminary and will be subject to further analysis at a more refined level. However, the results are a useful complement to the previous discussion.

**Figure 3 Sample Breakdown by Gender and Financial Year ('000 s)**



**Figure 4 Sample Breakdown by Age and Financial Year ('000 s)**



#### 4.1 Contribution participation rate

We first examine the incidence of salary sacrificed contributions and post-tax contributions. For inclusion in the estimations, a member required an employer contribution in the financial year. Receipt of an employer contribution signals an ability to make salary sacrifice, that is, it indicates earnings from an employer and hence the option to sacrifice (if available). However, receipt of employer contributions is not needed to be able to make a post-tax contribution to the fund. As a result the post-tax rate may overstate the true rate. However, because

continued employment is a requirement for continued fund membership we don't believe this to result in a significant difference. Future analysis will more closely examine those with broken contributions histories, suggesting broken employment history, and attempt to track these members as they are transferred to the Personal Super Division of the Trust.

Overall, there is a declining pattern evident for both salary sacrifice (SS) and post-tax (PT) contribution participation between 2002/03 and 2011/12 as indicated in Figure 5. Rates are relatively stable to 2007/08 but from 2008/09 through 2011/12 a drop is observed in both salary sacrifice and post-tax contributions. Figure 6 identifies that the only age group which does not experience the declining trend is the oldest age group, those 60 years and above.

A breakdown of participation by gender identifies clear differences but consistent trends. There is a substantially greater likelihood of salary sacrifice contributions by males. The participation rate is over five percentage points in all financial years. In contrast, females are more likely to make post-tax contributions, though the difference in participation rates is of a much smaller magnitude.

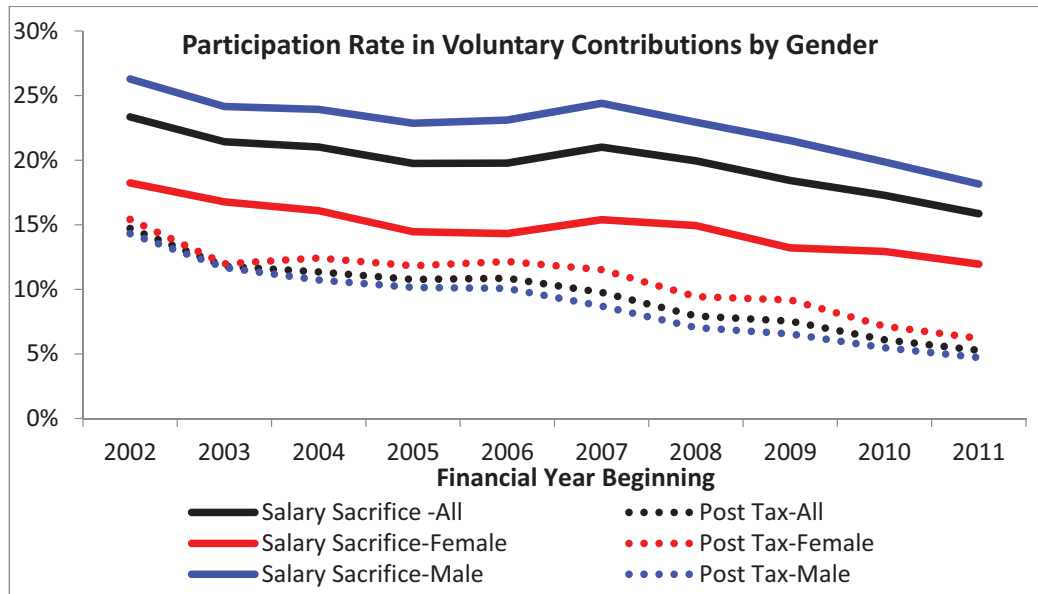
The breakdown of participation by age, shown in Figure 6 and Figure 7 indicates a clear positive relationship between voluntary contribution decisions and age.<sup>4</sup> Across age groups, however the general pattern for both salary sacrifice and post-tax contributions is a reduction in participation rates. This pattern is more distinct with post-tax contributions.

In contrast to the population surveys discussed previously, the participation rate is almost always higher (except for the very young) in salary sacrifice. The rate of decline on the other hand is very similar.

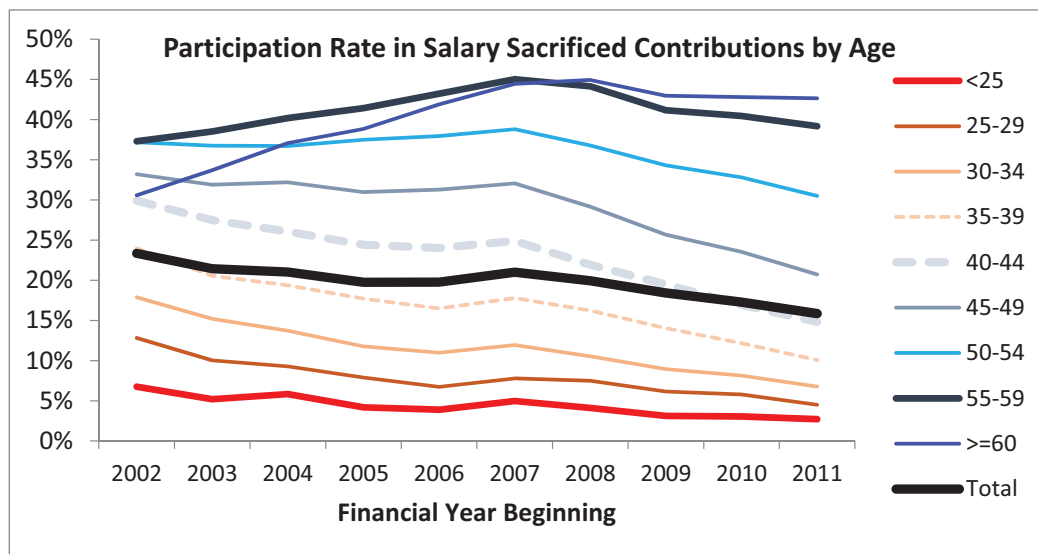
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<sup>4</sup> Note that the age breakdown is for age as at the corresponding financial year and hence a member may appear across two cohorts through the timespan of the data.

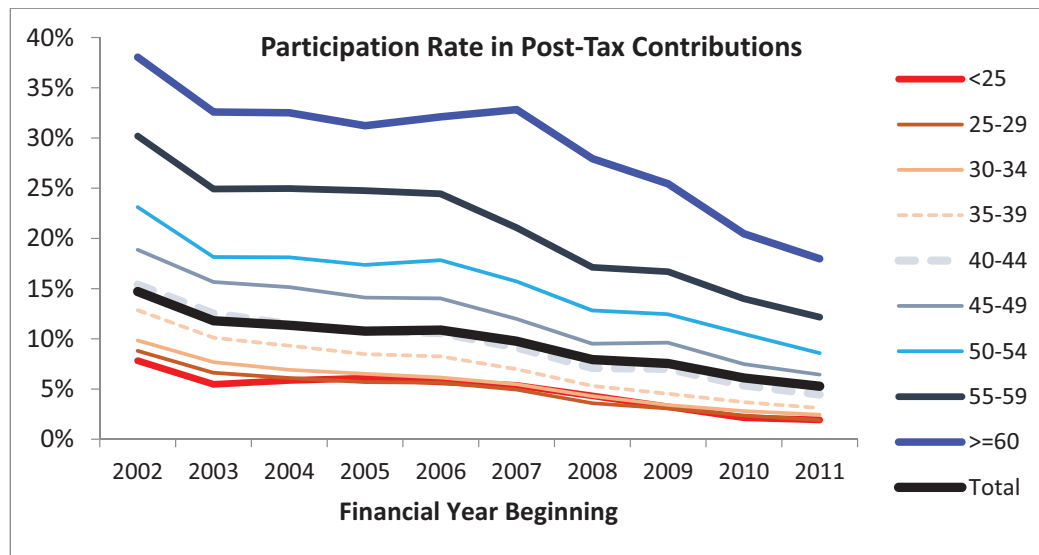
**Figure 5 Participation Rate in Voluntary Contributions by Gender and Financial Year**



**Figure 6 Participation Rate in Salary Sacrifice Contributions by Age and Financial Year**



**Figure 7 Participation Rate in Salary Sacrifice Contributions by Age and Financial Year**



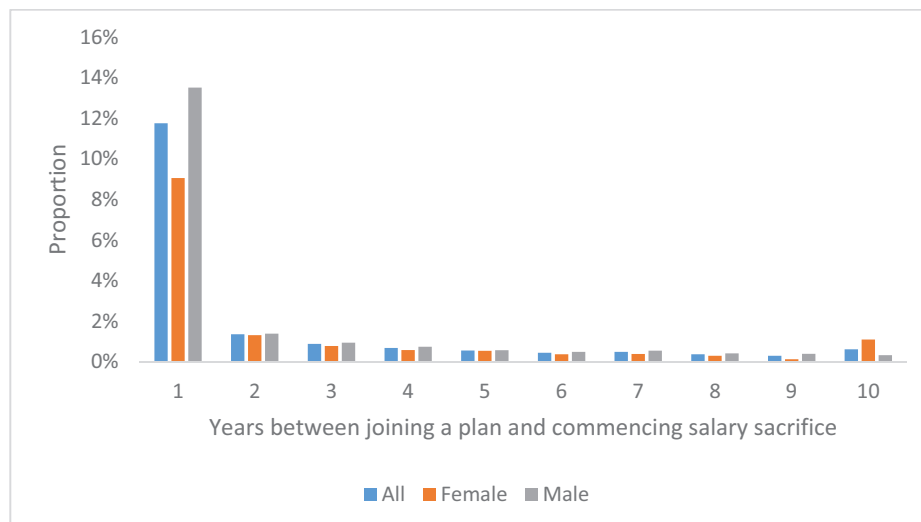
#### 4.2 Timing of the start of the contributions

The longitudinal nature of the data allows us to explore the commencement of voluntary contributions following the member commencing with the fund. Figure 8 to Figure 11 provide a breakdown of how long before a member commences a salary sacrifice or post-tax contribution arrangement after commencing with the fund. Analysis here is restricted to those joining during or after the 2001/02 financial year.

Figure 8 provides a breakdown for salary sacrifice contributions by gender. What is noticeable is that the previously identified gender difference is largely related to the first financial year since the member joins the fund. That is, a larger proportion of males choose to enter a salary sacrifice arrangement in the first year of fund membership. After the first year the gender difference reduces. Figure 9 also highlights that the age differences in commencement of salary sacrifice arrangements are most pronounced in the first year of membership. The salience of opportunities to salary sacrifice is heightened in the first year of employment as employees first arrange salary payments and are made aware of contribution options. This is suggestive that revisiting the initial communications provided when a member joins a fund may be a means of increasing further participation in voluntary contributions arrangements. It is worthwhile noting however that time effects may confound the above conclusion. That is, the regulatory changes that occurred from

2007/08 to contributions limits are difficult to separate from patterns related to membership length.

**Figure 8 Time Before Commencing Salary Sacrifice (by Gender)**



**Figure 9 Time Before Commencing Salary Sacrifice (by Age)**

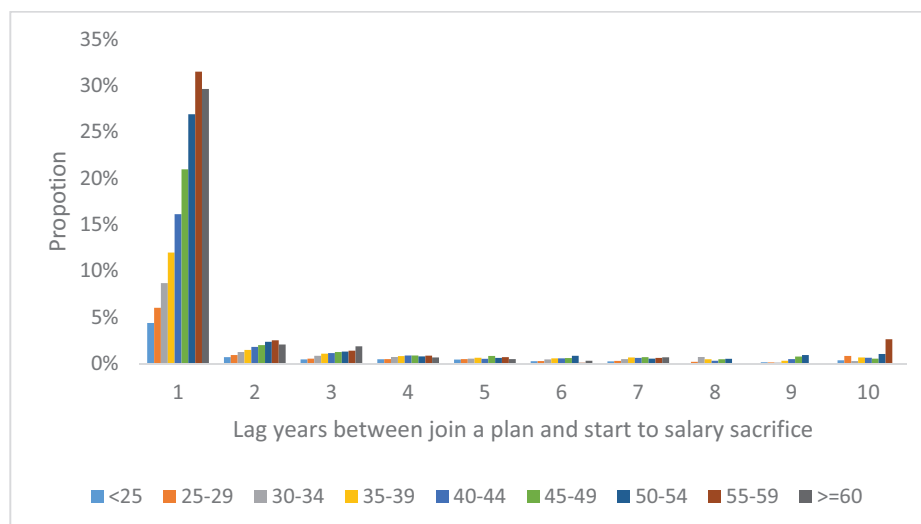


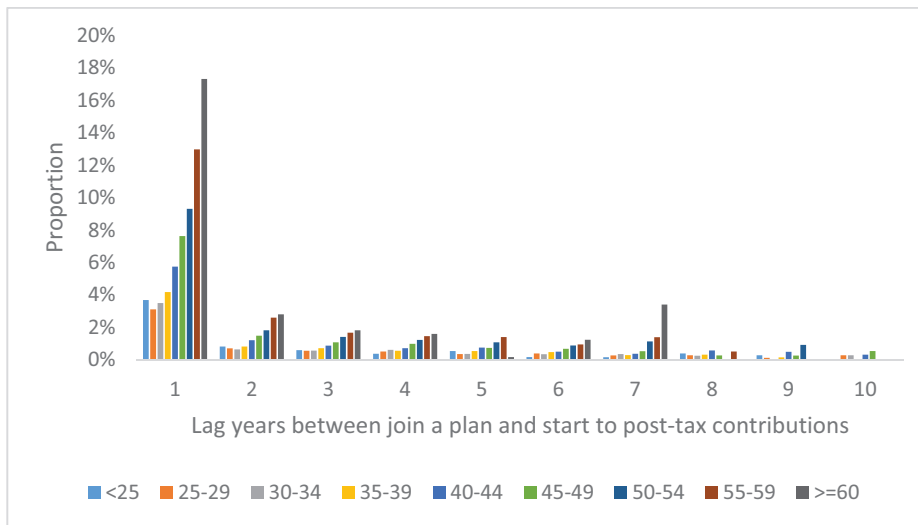
Figure 10 presents a profile of participation in post-tax contributions arrangements by the time before the arrangement is commenced, broken down by gender. As noted previously, the gender profile for post-tax contributions is the reverse of salary sacrifice arrangements. The absolute gender difference in participation in post-tax contributions, however, is not as large as for salary sacrifice arrangements. The net effect of which is that men are more likely to participate in voluntary contributions. The quick decline in the proportion of people who commence post-tax

contributions after the first year of membership is also evident. This pattern is consistent by gender and across age groups. Figure 11 highlights the age pattern as prevalent in salary sacrifice arrangements. Older members are more likely to participate in post-tax contributions.

**Figure 10 Time Before Commencing Post-Tax (by Gender)**



**Figure 11 Time Before Commencing Post-Tax (by Age)**



## 5 Conclusion

The modern phase of Australia's superannuation system now extends into its third decade. While this is now close to an individual's expected working lifespan, the history is marked by frequent rule changes impacting contribution rates, contribution limits, and taxation. Recent policy changes have entrenched the "libertarian paternalistic" design of the system. The system is based on compulsion which requires individuals to save for their retirement though this contribution is made by the employer on the employee's behalf. A belief that the compulsory rate is inadequate has seen the compulsory rate increased alongside policies to encourage more voluntary retirement savings through tax incentives and provision of options within superannuation funds. Despite these efforts, participation in voluntary retirement savings appears to be declining.

This paper has presented an overview of international literature relating to the determinants of voluntary retirement saving participation, with a focus on available Australian evidence. From this review, a number of key socio-economic and demographic factors, as well as job characteristics are identified to be important predictor of participation. Other factors such as retirement planning, financial literacy, status quo bias can also explain the lack of voluntary contributions.

A preliminary analysis of a new, large database made available by Mercer Australia provides a valuable addition to this literature by allowing a view from within a superannuation fund instead of the population surveys currently available. The longitudinal nature of the database allows a better understanding of trends, impact of external events, and persistence in actions.

Future analysis of this database will continue to add to our understanding of member behaviour in relation to voluntary contributions. In view of the preliminary evidence suggesting a decline in those making voluntary contributions, future work will examine who this applies to. For example, is this due to those who were previously contributing ceasing to do so, but otherwise continuing to receive employer contributions, or is it because those who were previously contributing are leaving the fund (retiring from their employer) and new younger members are not



choosing to contribute? Additionally, what has happen to the amount that has been contributed? How has this changed over time and how significant have rule changes been in changing the amount contributed? We will address these issues in future work.

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# The sequencing risk threat to retirement adequacy from increased superannuation contributions

Pieter Stoltz<sup>1</sup>, Michael E. Drew<sup>1</sup>, Adam N. Walk<sup>1</sup> and Jason M. West<sup>1,2</sup>

## Abstract

The Commonwealth Government of Australia has embarked on a policy of increasing the legislated minimum and compulsory provision of retirement savings for employees (known as the Superannuation Guarantee, SG) from 9% to 12% of salary. Using a simulation approach, we find that retirement adequacy generally improves under the increased SG provision, particularly if a relatively favorable sequence of returns is experienced over the plan member's working life. However, the increased SG fails to ameliorate low income replacement ratios for those who experience an unfavorable sequence of returns. Using a variety of default option designs, we show that increasing the contributions of workers without appropriately altering the asset allocation strategy of such investments may expose workers to greater sequencing risk, potentially undermining the objectives of the contribution increase. We find that a combination of increased SG and a dynamic lifecycle approach to default design achieves superior retirement outcomes for plan members.

**Keywords:** superannuation, DC plans, retirement adequacy, sequencing risk, contributions, asset allocation

**JEL Codes:** G11, G23, G28

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<sup>1</sup> Griffith Business School, Griffith University, Brisbane, Australia. 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.

<sup>2</sup> Corresponding author: Associate Professor Jason West, Department of Accounting, Finance & Economics, Griffith University, 170 Kessels Rd, Nathan, Qld, Australia, 4111, Email: [j.west@griffith.edu.au](mailto:j.west@griffith.edu.au)

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### **Abstract**

The Commonwealth Government of Australia has embarked on a policy of increasing the legislated minimum and compulsory provision of retirement savings for employees (known as the Superannuation Guarantee, SG) from 9% to 12% of salary. Using a simulation approach, we find that retirement adequacy generally improves under the increased SG provision, particularly if a relatively favorable sequence of returns is experienced over the plan member's working life. However, the increased SG fails to ameliorate low income replacement ratios for those who experience an unfavorable sequence of returns. Using a variety of default option designs, we show that increasing the contributions of workers without appropriately altering the asset allocation strategy of such investments may expose workers to greater sequencing risk, potentially undermining the objectives of the contribution increase. We find that a combination of increased SG and a dynamic lifecycle approach to default design achieves superior retirement outcomes for plan members.

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## 1. Introduction

In 1992 the Commonwealth Government of Australia introduced a mandated system of retirement savings based on hard compulsion, known as the Superannuation Guarantee (SG). Under the SG, employers are required to make tax-deductible superannuation contributions for their employees. Despite being a relatively inclusive and comprehensive retirement savings system, serious concerns over the retirement adequacy of Australian workers remain. In an effort to combat the pension liability of an ageing population, exacerbated by increased life expectancy and rising health care costs, in 2012 the Commonwealth Government of Australia proposed to gradually increase the SG from 9% to 12% over a 10-year period. This is expected to result in a greater proportion of workers in the future exiting the workforce with adequate financial resources to fund their retirement.

While simply increasing the compulsory level of savings may seem like a straightforward solution to improving retirement adequacy, added contributions are not costless. The major risk facing workers is an unfavorable sequence of returns in the years immediately prior to retirement. Unfavorable path dependency of portfolio returns, known as ‘sequencing risk,’ has its origins in constant proportion portfolio insurance (CPPI) theory (Black and Perold, 1992) and has become recognized as the key risk facing the retirement portfolios of workers. The effect of sequencing risk increases with the size of the retirement savings portfolio and for most workers this risk is greatest in the decade immediately prior to retirement. Coupled with a suboptimal asset allocation strategy, the sequencing risk exposure of a larger portfolio represents a significant risk to the retirement portfolio of most workers. In this study we show that increasing the SG provision is not a straightforward solution to improving retirement adequacy.

We use long horizon historical returns data from various asset classes to simulate retirement adequacy outcomes of workers investing in typical asset allocation strategies. In contrast to using a single rate of return on retirement savings to model a single wealth outcome at retirement (Bateman and Piggot, 1993), we use Monte Carlo, bootstrap simulation and stationary bootstrap simulation techniques to model accumulation paths based on historical returns to derive a distribution of terminal wealth outcomes. We

consider the success (or otherwise) under the revised SG provisions using the retirement wealth ratio (RWR) and the associated income replacement rate (RR).

The simulation results show that increasing the contributions of workers without appropriately altering the asset allocation strategy of such investments will expose workers to greater sequencing risk, and potentially undermine the objectives of the pension increase. In particular, asset allocation strategies with a higher proportion of stocks are shown to be more suitable for achieving adequate retirement outcomes for workers invested in the ‘default’ superannuation asset allocation option, which is thus an extension of the findings of Samuelson (1994). To counter the increased sequencing risk experienced by workers contributing a greater proportion to superannuation under revised SG provisions, we examine the effectiveness of competing asset allocation styles within the default option to offset sequencing risk. Despite the higher volatility experienced in the portfolio, we find that increasing the allocation to stocks actually reduces the risk of workers experiencing adverse retirement outcomes in the accumulation phase of defined contribution (DC) superannuation plans.

## **2. Retirement adequacy and superannuation policy**

Retirement policy in Australia was designed as a three-pillar system; the age pension, the SG and voluntary retirement savings (Piggott et al., 2001). For the majority of workers, mandatory contributions under the second pillar are seen as the critical component aimed at reducing the government dependency of future retirement benefits. Under the superannuation reforms in Australia in 2011/12, collectively known as the Stronger Super reforms, employers must only pay mandated contributions to low management expense ratio (MER) products with a single investment option. These low cost default funds are officially authorized as ‘MySuper’ products. The majority of workers do not deviate from the employer default fund (Commonwealth Treasury, 2013) and, although the reforms acknowledge the importance of the default asset allocation strategy, the SG does not mandate a retirement income scheme, only an accumulation profile. Superannuation funds are not directly rewarded for maximizing the terminal wealth of their members or ensuring that the level of wealth is ‘adequate’ for retirement.

Defining a level of wealth that is deemed ‘adequate’ is not simple. Since the retirement adequacy for most retirees depends on their desired lifestyle during retirement, a number of criteria need to be met. To better define adequacy, some scholars employ a preference-based calibration approach that uses constant relative risk aversion utility or constant absolute risk aversion utility to define retirement adequacy (Hurd and Rohwedder, 2003; Scholz et al., 2004; Poterba, et al. 2006). These have had very limited success.

A number of competing measures of retirement adequacy are based on terminal wealth. Terminal wealth is easy to operationalize and it enables analysis of retirement outcomes using a range of evaluation criteria. More importantly, it also represents the single most important objective that workers seek to maximize before converting terminal wealth into an annual retirement income. An alternative but related measure of retirement adequacy is the income replacement rate (RR). The RR provides a target that is expressed as the annuity equivalent value as a fraction of a person’s salary in their final year of employment. This measure is popular in the literature because it is very likely that people’s post-retirement expectations are closely linked to their pre-retirement income (Palmer, 1994; Moore and Mitchell, 1997). An income replacement rate of 65-75% is commonly assumed for Australian workers (Cooper, 2010) and is comparable to international rates (Binswanger and Schunk, 2012). Also derived from terminal wealth is the retirement wealth ratio (RWR) which is a useful measure of adequacy because it frames the retirement target as the multiple of terminal wealth to final annual salary (Booth and Yakoubov, 2000). These benchmarks are accessible to the individual because they more easily relate their retirement savings to their standard of living.

### ***2.1 Portfolio size effect, sequencing risk and asset allocation***

Of great concern among workers in the accumulation phase of DC superannuation plans prior to retirement is the portfolio size effect and the related phenomenon of sequencing risk. In the early years of workers’ retirement savings plan, contributions account for the majority of the portfolio. However, as the returns on past contributions accumulate to become the main driver of terminal wealth, incremental contributions become less important. The relationship between contributions and returns over time is the source of the portfolio size effect which has been explored in Basu and Drew (2009a).

Sequencing risk is the risk of experiencing returns in an unfavorable order during periods in which there are capital changes to the portfolio (Basu et al., 2012). Conversely, a favorable sequence of returns can result in ‘good’ sequencing risk (Frank and Blanchett, 2010; Frank et al. 2011; Doran et al. 2012). Sequencing risk is highly relevant to the issue of retirement adequacy because a large market downturn occurring close to retirement could deplete workers’ retirement nest-egg to the point where it may never recover (Doran et al. 2012).

Modern portfolio theory (MPT) assumes that wealth is a function of a series of time-weighted returns (Markowitz, 1952). This only holds in the rare case of an initial endowment with no subsequent changes in capital. The presence of continual contributions and withdrawals to and from a retirement savings plan is a major determinant of workers’ wealth. This forms a set of dollar-weighted returns which can be equated with the investment’s internal rate of return (IRR). Dollar-weighted returns are intuitive to many workers but the concept rarely appears as a performance objective in portfolio management. MPT ignores the sequence of returns which can substantially affect the terminal wealth of a retirement portfolio (Basu et al., 2012). The ability of superannuation portfolios to achieve a dollar-weighted return target relies heavily on both the allocation of assets within the portfolio and changes in asset allocation through workers’ lives.

## ***2.2 Default asset allocation plans***

Default investment options that maintain a constant proportion of asset classes, known as target risk funds (TRF), assume that workers have an infinite investment horizon and maintain complete flexibility over their retirement date. Target risk funds (TRFs) maintain the same level of risk through time by holding a constant proportion of growth and defensive assets. TRFs are commonly employed in MySuper products at varying proportions of growth and defensive assets. TRF strategies can range from 100% stocks to 100% cash strategy. In addition to these two extremes, in this study we consider growth/defensive asset splits of 50/50 (moderate TRF portfolio), 60/40 (default option average (DOA) TRF portfolio) and 70/30 (balanced TRF portfolio).

Since workers generally have a finite investment horizon, target date funds (TDF) have since emerged. TDFs switch from growth to defensive assets according to a pre-determined glide-path as a worker approaches retirement. TDFs reduce the proportion of growth assets in the retirement portfolio as the worker approaches a retirement date using deterministic switching rules. TDFs have become a core product for investors saving for retirement, particularly in the US (Estrada, 2013). But while lifecycle strategies implied in TDFs attempt to address the issue of a finite investment horizon, they are unable to appropriately position workers' retirement investments towards a defined adequacy target (Basu et al., 2011). In the case of deterministic asset allocation strategies such as TRFs and TDFs, the asset allocation strategy may become inconsistent with the investment objective over time without corrective action.

Portfolio adequacy based on a defined terminal wealth target however can be better achieved by using target-driven asset allocation strategies such as a dynamic lifecycle strategy (DLC) strategy. The DLC strategy increases the allocation to riskier asset classes when workers' portfolio wealth is less than a defined adequacy target. The glide-path of a DLC strategy is not pre-determined because the asset allocation policy is not only dependent on a worker's retirement date but also on the performance of the portfolio relative to a retirement target. When the portfolio wealth is greater than an adequacy target the allocation shifts towards more defensive assets, and when wealth falls below the target the portfolio shifts its weight towards growth assets. The DLC strategy is a flexible approach that preserves terminal wealth as the primary objective, particularly in the presence of sequencing risk. This approach is in sharp contrast to the static and deterministic allocation strategies of TRFs and TDFs that subordinate terminal wealth to a secondary aim behind maintaining a pre-determined policy portfolio.

We propose that simply increasing the SG provision alone may not improve retirement adequacy for DC plan members. But increasing the SG contribution rate, coupled with a flexible asset allocation mechanism that maintains a terminal wealth target as its objective, can adequately overcome sequencing risk exposure. Using a suite of robust simulation approaches we consider the practical implications of an increase in the SG contribution rate and its impact on retirement adequacy.

### 3. Methodology and data

The model used to generate terminal wealth outcomes is

$$TW = k \sum_{t=0}^{n-1} S_t (1 + r_t) \prod_{u=t+1}^{n-1} (1 + r_u), \quad (1)$$

where  $TW$  is the terminal value of retirement wealth,  $k$  is the plan contribution rate,  $r_t$  is the nominal rate of investment return earned in year  $t$  and  $r_u$  is the nominal rate of return in year  $t - 1$ ,  $n$  is the number of years before retirement and  $S_t$  is the annual salary in year  $t$  and is given by  $S_t = S_0(1 + g)^{t-1}$  where  $S_0$  is the starting salary and  $g$  is the nominal salary growth rate. From (1) it is clear that the contribution rate, investment horizon and asset allocation are the three main factors affecting retirement adequacy. While the investment horizon critically impacts on a worker's retirement adequacy, we exclude its impact in this analysis because few workers have much flexibility in choosing their retirement date. Analyzing the effect of investment horizon on portfolio outcomes has been considered in other analyses (Hickman, et al. 2001) but for model tractability we maintain a constant investment horizon.

For the simulation we use a monthly contribution model in line with the SG provisions that mandate at least a quarterly contribution frequency. We examine two competing SG contribution rate scenarios: the old minimum rate of 9% and the new minimum rate of 12%. These rates are kept constant over the entire investment horizon so as to compare outcomes under each contribution regime. We also assume that the employee is fully employed during the entire investment horizon and hence contributions will be a constant percentage of salary over time. Table 2 outlines the basic simulation model inputs.

Table 1 here

We examine seven asset allocations: the five target risk funds (TRFs) outlined earlier; one target date fund (TDF); and, one dynamic lifecycle fund (DLF). The following asset allocation assumptions were made. A 5% allocation to Australian T-bills is always maintained if an asset allocation strategy is invested in defensive assets, except for the 100% cash strategy. The remaining proportion of any allocation to defensive



assets is made to Australian bonds. Where an asset allocation strategy is invested in growth assets, half of the proportion of growth assets is allocated to Australian stocks and half is allocated to U.S. stocks.

TDFs have deterministic glidepaths. The asset class proportions depend only on the worker's retirement age and the glide-path algorithm. We consider one TDF strategy that invests 80% in growth assets and 20% in defensive assets for the first 20 years of the investment period. In the 21<sup>st</sup> year the strategy commences a linear switch from growth to defensive assets so that by the end of the 40-year investment horizon the portfolio has invested 56% in growth assets and 44% in defensive assets. This glide-path is a reasonable representation of the TDF strategies employed by funds.

The DLC strategy is partitioned into three investment periods. For the first 30 years the strategy invests in growth assets only so that Australian stocks and U.S. stocks each comprise half of the portfolio. The rationale for the initial allocation to growth assets only is that the objective of the worker is to maximize wealth over the first 30 years of their investment horizon. Consistent with lifecycle theory, the worker should have sufficient time to recover wealth in the final ten years if stock market performances have been unfavorable. The remaining two partitions are each five years in length and have slightly different asset allocation rules. For both partitions, the below-target portfolio is 100% in growth assets. The above-target portfolio in the second partition is 80% in growth assets and 20% in defensive assets. The above-target portfolio in the third and final partition is 60% in growth assets and 40% in defensive assets. The rationale for the decreasing proportion of growth assets in the above-target portfolios in each of the final two partitions is to reduce risk when the worker approaches retirement, so long as the worker remains above this target. Unlike the TDF strategy, the DLC strategy uses performance feedback to control the asset allocation at any point in time.

### ***3.1 Data***

We use monthly return data of four asset classes obtained from the Global Financial Database. Nominal returns, including periodic cash flows such as dividends, for Australian Stocks, U.S. Stocks, Australian Bonds and Australian T-bills from October 1882 to February 2013 are used as the basis for the simulation.

The Global Financial Database adjusts returns data for survivorship bias. The use of monthly returns in this study replicates the monthly contribution frequency typical for most workers who contribute to a superannuation plan. We recognize the issue of the purchasing power of a plan member's retirement savings through the use of the retirement wealth ratio (RWR), which anchors terminal wealth to the price level of the year in which the plan member receives their final salary. We use Australian stocks and U.S. stocks as proxies for growth assets and Australian bonds and Australian T-bills as proxies for defensive assets. While an international fixed interest asset class may comprise a portion retirement products in practice, we exclude them based on the reasoning that the majority of bond investments in MySuper products are domestic (Morningstar, 2013). Descriptive statistics of the returns data for each of the four asset classes used in this study are presented in Table 2.

Table 2 here

### ***3.2 Simulation***

We model using both parametric and non-parametric simulation methods to generate 10,000 accumulation paths for each asset allocation from historical data. We selected three simulation methods to test for the robustness of results – Monte Carlo, standard bootstrap and stationary bootstrap.

First, the Monte Carlo simulation draws returns from a normal distribution with a mean and standard deviation calibrated to the historical data. Although the Monte Carlo method is a versatile simulation technique, it assumes returns are Gaussian, it departs from the time characteristics of the historical data, and it fails to maintain cross-correlation between asset classes.

Second, the standard bootstrap process randomly resamples row vectors with replacement (Efron, 1979). This process generates 10,000 simulated 480-month long return paths from the underlying data series. This approach does not impose distributional assumptions and maintains historical cross-correlations between asset classes. It does not however preserve the time series characteristics of the data.

Third, we use the stationary bootstrap proposed by Politis and Romano (1994). This is similar to the Efron (1979) bootstrap in the sense that it does not impose distributional assumptions on the data. It also retains

cross-correlations between the returns of different asset classes and incorporates the time series characteristics of the data by resampling blocks of returns. The block length is randomly sampled from a geometric distribution and is based on the original block bootstrap method introduced by Kunsch (1989). In the absence of a random block length this method requires the arbitrary specification of a fixed block length in practical settings (Bühlmann, 2002). This simulation method is stationary because, by statistical inference, a moving block length permits the synthetic time series to be stationary however this is conditional on the underlying data being stationary as well. This feature allows the simulation to retain some of the serial dependence in the data while still generating the synthetic time series needed for our analysis.

### 3.3 Terminal wealth evaluation criteria

We set the investment objective RWR target ( $RWR_{\text{target}}$ ) based on a nominal return target of 7% per annum. This is based on a typical superannuation fund objective of the average inflation rate (represented by the consumer price index (CPI)) plus 400bps. Target returns that are too high or too low are unsuitable for use in DLC strategies because the dynamic switching capability is compromised. Under the 9% contribution profile, the  $RWR_{\text{target}}$  that is equivalent to the compounded accumulation of a fund achieving a 7% annual return over the investment horizon is 6.95 times final salary. Under the 12% contribution profile, the  $RWR_{\text{target}}$  is 9.27 times final salary. The use of a common return target adjusts for different expected levels of terminal wealth because of different contribution levels.

While standard deviation is a useful measure of variability, for RWR we use the lower partial moment (LPM) which represents downside risk for different levels of risk aversion (Bawa, 1975; Fishburn, 1977).

The LPM is given by:

$$LPM_{\lambda} = \frac{1}{n} \sum_{t=1}^n \text{Max}[0, (RWR_{\text{target}} - RWR_t)]^{\lambda}, \quad (2)$$

where  $RWR_{\text{target}}$  is the target outcome (determined above),  $RWR_t$  is the outcome for the  $t$ -th observation,  $n$  is the number of observed RWR model outcomes and  $\lambda$  is a parameter representing the order of the LPM, which can be calibrated to the risk aversion of the participant. The three LPM orders considered in this

analysis are the probability of falling short of the  $RWR_{target}$  ( $LPM_{FS}$ ), the magnitude of the shortfall below  $RWR_{target}$  ( $LPM_{MS}$ ) and the below- $RWR_{target}$  semi-variance ( $LPM_{SV}$ ).

We also use the Sortino ratio which is a reward-to-risk measure that does not penalize performance for volatility above the target outcome (Sortino and Price, 1994). The Sortino ratio is given by:

$$Sortino\ Ratio = \frac{\overline{RWR}_T - RWR_{target}}{[LPM_2]^{1/2}}, \quad (3)$$

where  $\overline{RWR}_T$  is the mean RWR,  $RWR_{target}$  is the target outcome and  $LPM_2$  is the second lower partial moment as defined above. An extension of this measure is the upside potential ratio ( $UPR$ ) which combines upside potential and downside risk (Sortino et al. 1999) and is given by:

$$UPR = \frac{\frac{1}{n} \sum_{t=1}^n \text{Max}[0, (RWR_T - RWR_{target})]}{[LPM_2]^{1/2}}. \quad (4)$$

The numerator is the first upper partial moment and the denominator is the second lower partial moment using  $RWR_{target}$ . This measure allows us to consider the above- $RWR_{target}$  outcomes adjusted for downside risk.

## 4. Results

We conducted the simulations using all three methods as discussed above. However in the following results we focus only on the stationary bootstrap method for brevity. Of the three methods, we select the stationary bootstrap because Politis and Romano (1994) show that this technique, where the block size is random, is less sensitive to block size misspecification when compared to competing methods. The full set of results for all simulations is presented at the Appendix.

### 4.1 RWR distributions

The distribution of retirement outcomes must be considered when investigating retirement adequacy, not just average outcomes. Table 3 presents the distributional statistics of the RWR for a 9% and 12% SG contribution rate. The median adequacy shows that, as expected, increasing contributions by one-third

results in a one-third increase in the median RWR. This is equivalent to an additional nominal AEV of \$211,000. Terminal wealth has increased by 4.15 times final salary which equates to about \$1.124m in nominal terms. Considering those outcomes in the tails of the RWR distributions, in addition to the central outcomes, provide more insight into what increasing the SG provision means for plan members in terms of potential retirement outcomes. These results are in line with those of Bateman and Piggot (1993).

Increasing the SG contribution rate increases the mean, median and range of the RWR distribution. While there is a substantial increase in the maximum RWR in absolute terms, the impact of the increasing contribution rate is less substantial. For RWR outcomes on the lower end of the distribution, the absolute increase in retirement outcomes is more modest. Using an RWR of 10 (the 65% RR equivalent) as a benchmark is useful for comparison, it is evident that the 25<sup>th</sup> percentile has been shifted above this level. Overall it appears that increasing the SG contribution rate is effective in boosting many plan members above this adequacy threshold. Based on this finding, we reject the hypothesis that increasing the contribution rate from 9% to 12% has no impact upon the retirement adequacy of workers' solely contributing to a superannuation fund. Note that, theoretically, the results in the following tables should differ by a scale factor of 1.33 (12% / 9%). However the pseudo-time series generated by the stationary bootstrap approach will generate a minor divergence from the theoretical scale due to sampling from the resulting approximated geometric distribution.

Table 3 here

Table 4 shows that the one-third increase in the contribution rate is accompanied by a corresponding increase in the standard deviation of retirement outcomes. This equates with the expected outcome. However raising the SG contribution rate, without appropriately adjusting asset allocation, also magnifies the exposure to sequencing risk. To understand the real exposure to sequencing risk Table 4 presents the lower partial moments for the 9% and 12% contribution rates using a balanced asset allocation.

Table 4 here

Table 4 shows that the increased risk associated with increasing the SG contribution rate is very relevant to the issue of retirement adequacy. Each measure of downside risk, relative to the appropriate targets, has increased as a result of increasing the contribution rate. Workers are 5% more likely to fall short of the retirement target, albeit a higher target, and the expected value of this shortfall has increased by 44%. The below target semi-variance has doubled indicating that workers are twice as exposed to downside sequencing risk. The increased risk relative to the retirement target is not entirely offset by the upside risk. The *UPR* has declined by 10% under the higher contribution rate which confirms that simply increasing the SG contribution rate does not necessarily improve the retirement adequacy of workers.

It appears that the improvements in retirement adequacy come at the cost of increased sequencing risk borne by workers. So the asset allocation becomes of even greater importance to workers' retirement portfolios. Workers who contribute 12% invest significantly more over the accumulation phase and any gains made to the portfolio largely evaporate during the critical last decade before retirement. But if returns on the retirement portfolio dwarf the value of additional contributions, then perhaps the asset allocation that governs those returns can be altered to achieve retirement adequacy?

#### ***4.2 Changing the asset allocation***

Table 5 shows that different asset allocations can produce widely different median retirement outcomes. The asset allocation of the default option has a substantial impact on retirement adequacy in regards to median outcomes. Asset allocations with a higher proportion of growth assets result in higher adequacy measures on average.

Table 5 here

Like increasing the SG contribution rate, median retirement outcomes improve where workers' retirement portfolios are comprised of a higher proportion of stocks. This suggests that TRFs tilted toward stocks may lead to more adequate retirement outcomes. The TDF strategy results in a similar median retirement outcome to the balanced TRF indicating that a deterministic glidepath does not materially improve retirement outcomes. The DLC strategy, however, is more successful. The DLC strategy produces the

highest median adequacy measures with a median RWR and RR of 15.26 times and 97% respectively indicating that a higher allocation to stocks combined with dynamic switching rules offers a significant improvement. The distributional statistics of the RWR retirement outcomes are presented in Table 6 for the seven asset allocations.

Table 6 here

Figure 1 here

The boxplot in Figure 1 shows that the TDF strategy has a very similar RWR distribution to the balanced TRF. This supports the conclusion that deterministic switching rules on their own fail to improve retirement adequacy metrics. Besides the 100% stocks strategy, the DLC strategy has the highest maximum, 75<sup>th</sup> percentile, median and 25<sup>th</sup> percentile outcomes. The minimum outcomes for the 100% stocks and the DLC strategy are the lowest of the seven strategies, except for the 100% cash strategy but the difference between minimums when compared to more conservative strategies appears negligible. The minimum outcomes are so far below the adequacy guideline of a RWR of 10 that this small improvement from implementing a more defensive strategy is not worth the limited upside.

We further found that TRFs tilted toward growth assets naturally achieve better retirement outcomes. But the higher allocation of growth assets also exposes the plan member to greater volatility. Table 7 shows that the standard deviation is higher for strategies with a higher growth asset allocation but this is contrasted with the LPM metrics that appropriately account for downside risk. There is a clear inverse relationship between the LPM results and the allocation to growth assets. The terminal wealth outcomes for the balanced TRF and the TDF asset allocation are not substantially different. Both asset allocations have similar accumulation paths for the first 20 years of the investment horizon where contributions are still a major part of the total portfolio. Although the TDF begins to switch toward defensive assets after this point, it is not until age 55 that the balanced TRF and the TDF hold the exact same proportion of growth and defensive assets. This is also the point where the portfolio size effect means that contributions are accounting for about one-fifth of the total portfolio value.

Table 7 here

However the higher returns associated with growth assets mean that the returns are compounding faster using a DLC asset allocation strategy. While the higher proportion of growth assets results in improved performance for the DLC strategy dynamic switching rules also play their part. Table 7 shows that the DLC strategy experiences a higher standard deviation but that LPM measures are substantially better. The shortfall probability ( $LPM_{FS}$ ) is less than 4% for the DLC strategy which is the lowest shortfall probability of all seven asset allocations. The DLC strategy also has the lowest magnitude of shortfall and below-target semi-variance of all seven asset allocations and is superior to the balanced TRF when comparing the Sortino ratio and  $UPR$ .

## 5. Discussion

### 5.1 Heat maps of the retirement risk zone

We examine the simulation results in the final decade of the accumulation phase using heat maps. For ease of interpretation, we use granular shading to examine the monthly RWR relative to the adequacy target  $RWR_{target}$  of 6.95. Figure 2 depicts the heat map for the balanced TRF (70/30), Figure 3 depicts the heat map for the TDF and Figure 4 depicts the heat map for the DLC strategy.

The diagrams show how each asset allocation strategy pilots the superannuation portfolio towards the retirement date. The retirement risk zone (RRZ) represents the decade immediately prior to retirement. In the RRZ returns account for about 80% of the portfolio value. Figure 2 shows that the balanced TRF strategy achieves the adequacy target in four out of 49 paths prior to the RRZ. But overall, the majority of paths eventually achieve adequacy at retirement.

Despite it taking longer for some paths to achieve adequacy, the TDF strategy in Figure 3 demonstrates similar adequacy outcomes. The TDF strategy has eight paths that have achieved adequacy upon entering the RRZ however, there seems to be a larger proportion of paths below the adequacy target during the initial months. A common attribute of both the balanced TRF and the TDF strategies is that the retirement savings



plans suddenly achieve (or fall behind) the adequacy target. It is not uncommon for a yellow cell to turn into a green cell (or vice versa) within a single month.

Figure 2 here

Figure 3 here

Figure 4 here

But the transition from inadequate savings to adequate savings is much smoother under the DLC strategy as shown in Figure 4. Unlike the balanced TRF and TDF strategies, the results show that it is very unlikely that a path will fall behind the adequacy target once it has been achieved. Moreover, a higher proportion of paths are already above the adequacy target upon entering the RRZ, attributable to the higher allocation to stocks in the earlier years of the accumulation phase. Figure 4 also shows that the dynamic switching rules assist several paths in achieving the adequacy during the critical RRZ.

## ***5.2 Scenario analysis – left tail outcomes***

The value at risk (VaR) and expected tail loss (ETL) retirement outcomes for each asset allocation strategy under the 9% and 12% SG provision are given in Table 8. As expected, increasing the SG provision produces a commensurate increase in the tail related risk measures for each asset allocation strategy. But both the VaR and ETL measures are higher for equity driven strategies including the 100% stocks TRF and the DLC strategy. This result challenges the traditional notion that suggests stocks may achieve adverse outcomes due to the higher observed volatility. An equity driven strategy actually reduces the risk of workers' experiencing a lower adverse retirement outcome.

Table 8 here

The VaR measures for the 9% and 12% SG contribution rate highlight the importance of the asset allocation strategy used in the default option. For instance, the VaR for a 9% SG contribution using a DLC strategy is similar to the VaR for 12% SG contribution rate using a TRF strategy. Increasing the SG provision may not

be of much benefit to some workers if the asset allocation strategy chosen by the default option is inefficient.

To highlight this effect we examine two scenarios that both experience an unfortunate sequence of returns over the investment period. Scenario 1 uses a DLC asset allocation strategy with a 9% SG contribution rate. Scenario 2 uses a TRF asset allocation strategy with a 12% SG contribution rate. These are retirement outcomes on the left tails of the two RWR distributions. Figure 5 presents the accumulation paths.

Both scenarios experience similar retirement outcomes. The additional contributions made in Scenario 2 did not create more wealth for retirement compared to Scenario 1. The moderate TRF coasts toward the retirement outcome without any consideration of a retirement target of 9.37 times final salary. This results in a substantial shortfall. In two instances, the dynamic switching rules of the DLC strategy assisted in its pursuit of its lower retirement target of 6.95 times by maintaining or increasing the exposure to growth assets. The first occurs directly after the worker turns 55 years of age and the second occurs after a market downturn shortly before retirement. Recall that the appropriate retirement target is lower for a 9% SG provision than a 12% SG provision because less contributions are invested resulting a lower expected target. The worker is thus able to achieve the appropriate retirement target associated with a 9% contribution rate. While the use of only two sample paths in this example does not prove our hypothesis, it does demonstrate how a dynamic strategy successfully aims for a target wealth outcome while more static strategies may comply with their asset allocation objectives yet underperform intended wealth outcomes.

Figure 5 here

An appropriate measure for evaluating investment outcomes with multiple cash flows, such as those associated with defined contribution plans (DC plans), is the dollar-weighted return or internal rate of return (IRR) (Dichev and Yu, 2011). Table 9 presents the IRR outputs from the above scenario analysis alongside the geometric return and average return for comparison. Being time-weighted, both the geometric return and the arithmetic average return are inappropriate for evaluating terminal wealth outcomes in the presence of cash flows such as contributions (Basu et al., 2012) because they overstate the return associated with each

accumulation path. The sequence of returns was worse for the worker in Scenario 1 as the difference between the IRR and geometric return is larger.

Table 9 here

Table 9 shows that both scenarios accumulated similar levels of wealth during the worker's life and both produce the same terminal RWR. But the IRR for Scenario 1 is significantly higher than Scenario 2. Scenario 1 outperforms Scenario 2 for workers who experience unfavorable market conditions during the accumulation phase, but at a higher risk as measured by the standard deviation. Standard deviation (as a variability metric) is a poor measure of retirement risk because the worker in Scenario 2 has contributed an additional \$160,000 to simply experience a smoother accumulation path.

## **6. Concluding remarks**

Using a simulation methodology, we find that the impact of increasing the SG from 9% to 12% for defined contribution plans is to increase retirement adequacy in expectation only. A large proportion of modelled retirement outcomes exceed the retirement adequacy threshold. Increasing the mandatory contribution rate has a positive impact on the retirement adequacy of workers. But retirement outcomes from increased contributions observed in the left tail of the distribution make no substantial difference in absolute terms. The full distribution of potential retirement outcomes should thus be considered rather than central measures only.

Increasing the SG provision is therefore not a straightforward solution to improving retirement adequacy. An increase in contributions translates into workers being exposed to greater sequencing risk as the size of their superannuation portfolio grows, particularly when coupled with a static asset allocation strategy. Indeed the downside risk relative to a target appropriate for the level of contributions nearly doubles.

Using a stationary bootstrap simulation method, we find that the impact on retirement adequacy of changes in the portfolio asset allocation depends largely on the proportion of growth assets in the portfolio. TRFs with a higher proportion of stocks produce significantly better retirement outcomes and also experience less retirement inadequacy retirement exposures despite the higher risk associated with stocks.

Target date funds (TDF) and dynamic lifecycle (DLC) strategies that change the proportion of growth and defensive assets during the investment horizon also support this result. A TDF strategy with exposure to stocks in a similar proportion to the balanced TRF produces similar retirement outcomes. The DLC strategy with a higher proportion of stocks produced substantially better retirement outcomes than the balanced TRF, mainly due to the capacity to dynamically switch allocations during the accumulation phase. We also showed that the downside risk relative to an adequacy target was lower for the DLC strategy than for any other strategy. We have shown that increasing the contribution rate for a portfolio with a static asset allocation strategy merely generates a smoother profile towards an adequacy target. The same result may be achieved at a lower contribution rate coupled with a dynamic strategy that accounts for sequencing risk exposure during the accumulation phase. The results demonstrate that generating adequate income for workers in retirement should be the key motivation behind designing retirement savings solutions, instead of using simple performance targets pegged to annual returns and portfolio standard deviation.

We acknowledge that there are several limitations to this study. First, retirement adequacy can be partially or fully met by the age pension and voluntary superannuation savings. Our analysis is confined to retirement adequacy under the SG regime only. Second, workers' retirement wealth ratio (RWR) may be different from those computed here due to wealth external to the superannuation system. Third, we assumed a constant investment horizon of 40 years and clearly a different investment horizon may yield different outcomes. A shorter investment horizon may require a different default investment option to the ones we considered which might be more effective in meeting retirement adequacy. Finally, we abstracted from taxes and inflation in this analysis, both of which are important factors affecting retirement adequacy.

There is scope for further research on variations of this DLC strategy. Further refinements, including more flexible switching rules, could make the strategy more applicable for retirement savings in practice. More sophisticated dynamic strategy algorithms are also an obvious area for future research.

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## Tables

Input	Value
Starting balance	\$0
Age entering workforce	25
Age at retirement	65
Investment horizon	40
Starting salary	\$55,000
Salary growth rate	4%

**Table 1:** The hypothetical worker wage profile and investment period.

	Australian Stocks	U.S. Stocks	Australian Bonds	Australian T-bills
Median (%)	1.11 (13.2)	0.86 (10.32)	0.36 (4.32)	0.28 (3.36)
Mean (%)	1.02 (12.24)	0.88 (10.56)	0.50 (6.00)	0.35 (4.20)
Standard Deviation (%)	3.77 (45.24)	5.10 (61.2)	2.28 (27.36)	0.29 (3.48)
Skewness	-0.84	1.01	0.59	1.77
Kurtosis	13.98	11.67	13.65	3.14
Range (%)	65.30	72.16	34.93	1.55
Minimum (%)	-42.13	-23.63	-13.47	0.06
Maximum (%)	23.16	48.53	21.47	1.62
Jarque-Bera test statistic	1,2837	9,080	12,160	1,459

**Table 2:** Descriptive statistics of monthly returns data for the Australian stocks, U.S. stocks, Australian bonds and Australian T-bills. The median, mean and standard deviation include annualised figures in brackets.

SG	Min	P25	Median	Mean	P75	Max	IQRR
9%	2.81	9.19	12.32	14.60	17.50	126.52	0.67
12%	3.60	12.14	16.47	19.32	22.94	156.68	0.66

**Table 3:** Distributional statistics for changes to the Superannuation Guarantee (SG) from a 9% contribution rate to a 12% contribution rate using a balanced TRF asset allocation. The IQRR refers to the interquartile range ratio using a stationary bootstrap simulation.

Contribution Rate	$\sigma$ (RWR)	$LPM_{FS}$	$LPM_{MS}$	$LPM_{SV}$	UPR
9%	8.32	0.0792	0.0779	0.1219	22.1447
12%	11.10	0.0835	0.1123	0.2426	20.6258
<b>Percentage Increase</b>	<b>33%</b>	<b>5%</b>	<b>44%</b>	<b>99%</b>	<b>-7%</b>

**Table 4:** Standard deviation of RWR, lower partial moments and upside potential ratio for the 9% SG contribution rate and the 12% SG contribution rate using a stationary bootstrap simulation.



Asset Allocation	Median RWR	Median RR
100% Cash	3.59	23%
Moderate	9.41	60%
DOA	10.78	68%
Balanced	12.32	78%
100% Stocks	18.71	119%
TDF	12.55	80%
DLC	15.26	97%

**Table 5:** Median RWR and RR results for each asset allocation under a 9% SG provision using a stationary bootstrap simulation.

Asset Allocation Strategy	Min	Median	Mean	P25	P75	Max	IQRR
100% Cash	2.12	3.59	4.14	2.99	4.73	20.42	0.48
Moderate	3.14	9.41	11.02	7.33	12.88	70.81	0.59
DOA	2.98	10.79	12.67	8.24	15.06	94.89	0.63
Balanced	2.81	12.32	14.60	9.19	17.50	126.52	0.67
100% Stocks	2.29	18.71	23.29	12.48	28.65	291.74	0.86
TDF	2.84	12.55	15.00	9.34	17.91	126.06	0.68
DLC	2.29	15.26	18.69	10.78	22.63	182.81	0.78

**Table 6:** Distribution statistics for each asset allocation strategy in RWR units using a stationary bootstrap simulation.

Asset Allocation	$\sigma$ (RWR)	$LPM_{FS}$	$LPM_{MS}$	$LPM_{SV}$	Sortino Ratio	UPR
100% Cash	1.75	0.9300	2.9423	10.3964	-0.87	0.04
Moderate	5.60	0.1962	0.1795	0.2580	8.01	8.36
Default Option Average	6.77	0.1165	0.1090	0.1605	14.27	14.54
Balanced	8.32	0.0792	0.0779	0.1219	21.92	22.14
100% Stocks	16.94	0.0400	0.0493	0.0992	51.86	52.02
TDF	8.7294	0.0726	0.0691	0.1066	24.65	24.86
DLC	12.21	0.0338	0.0418	0.0865	39.92	40.06

**Table 7:** Path volatility measures for the accumulation paths under each of the seven asset allocations (TRF, TDF and DLC) using a stationary bootstrap simulation. Each LPM is a measure of downside risk relative to a  $RWR_{\text{target}}$  of 6.95.  $LPM_{FS}$  represents the probability of falling short of the retirement target,  $LPM_{MS}$  represents the expected shortfall below this target and  $LPM_{SV}$  represents the below target semi-variance. The Sortino ratio and the UPR evaluate the performance of each TRF relative to an  $RWR_{\text{target}}$  of 6.95.

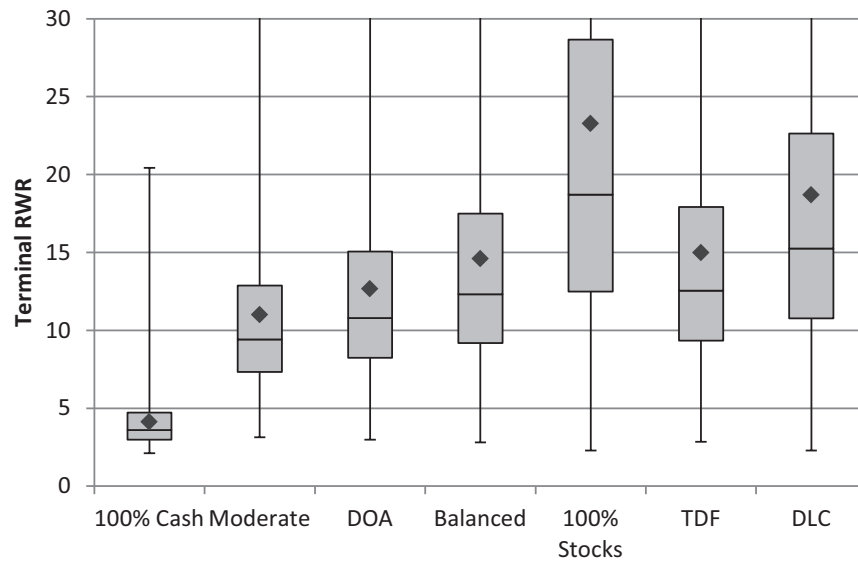
<b>Asset Allocation Strategy</b>	<b>VaR (RWR)</b>	<b>ETL (RWR)</b>
<b>9% contribution Rate</b>		
100% Cash	2.51	2.40
Moderate	5.61	5.07
Default Option Average	6.02	5.35
Balanced	6.35	5.56
100% Stocks	7.29	6.00
Lifecycle	6.52	5.66
Dynamic Lifecycle	7.31	6.18
<b>12% contribution Rate</b>		
100% Cash	3.38	3.22
Moderate	7.46	6.71
Default Option Average	7.96	7.05
Balanced	8.43	7.29
100% Stocks	9.55	7.73
Lifecycle	8.57	7.43
Dynamic Lifecycle	9.63	7.98

**Table 8:** Tail related risk measures using a stationary bootstrap simulation.

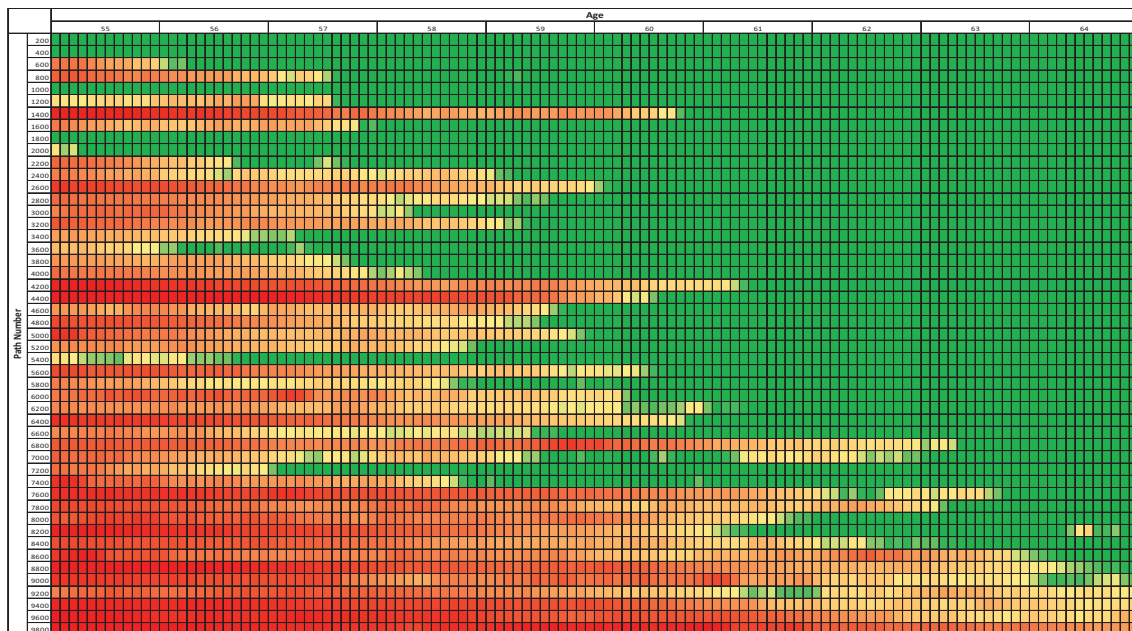
<b>Scenario</b>	<b>IRR</b>	<b>Geometric return</b>	<b>Average Return</b>	<b>Total Contributions</b>	<b>RWR</b>	<b>TW</b>	<b>IRR</b>	<b><math>\sigma</math></b>
(1) 9%DLC	7.50%	8.45%	9.26%	\$487,559	7.41	\$2,007,839	7.50%	41.73%
(2) 12% Moderate	6.19%	6.70%	6.97%	\$650,079	7.41	\$2,006,480	6.19%	25.04%

**Table 9:** Total contributions, terminal RWR, terminal wealth, IRR and standard deviation of returns (annualized) for sample paths of the 9% SG DLC strategy and the 12% SG TRF moderate strategy.

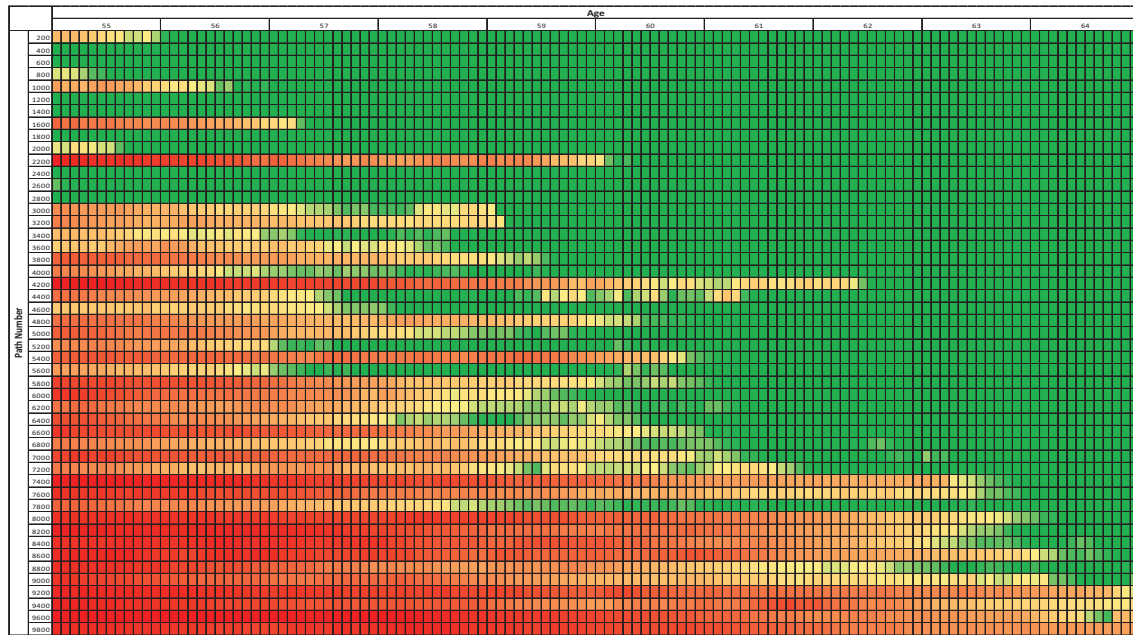
## Figures



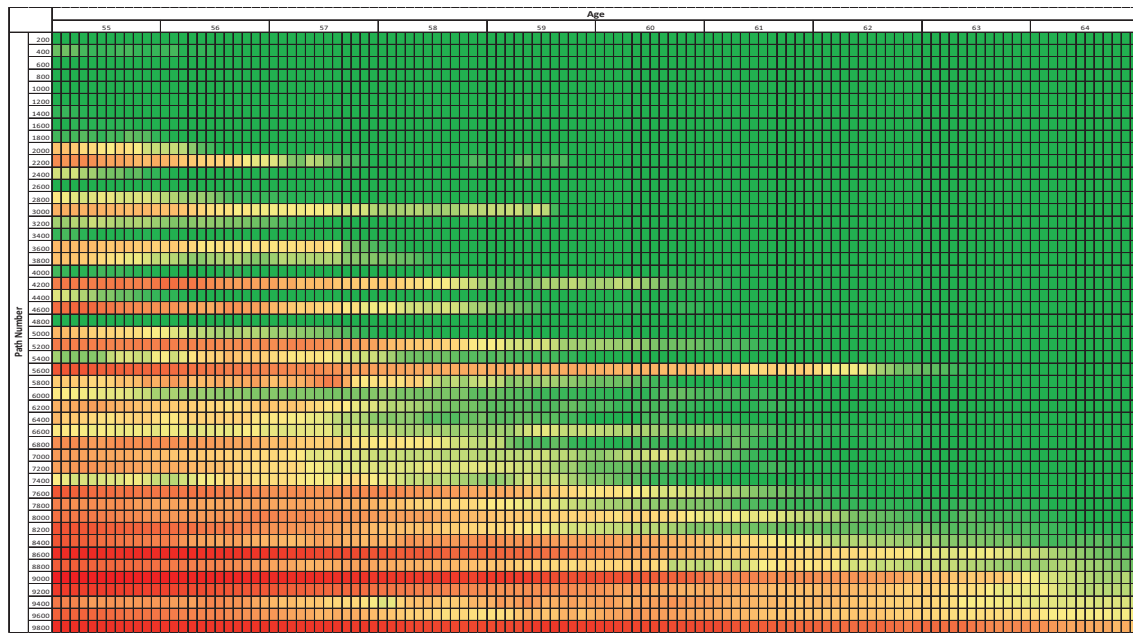
**Figure 1:** Comparative box-and-whisker plots for each of the seven asset allocations using a stationary bootstrap simulation. RWR scale set to a maximum of 30.



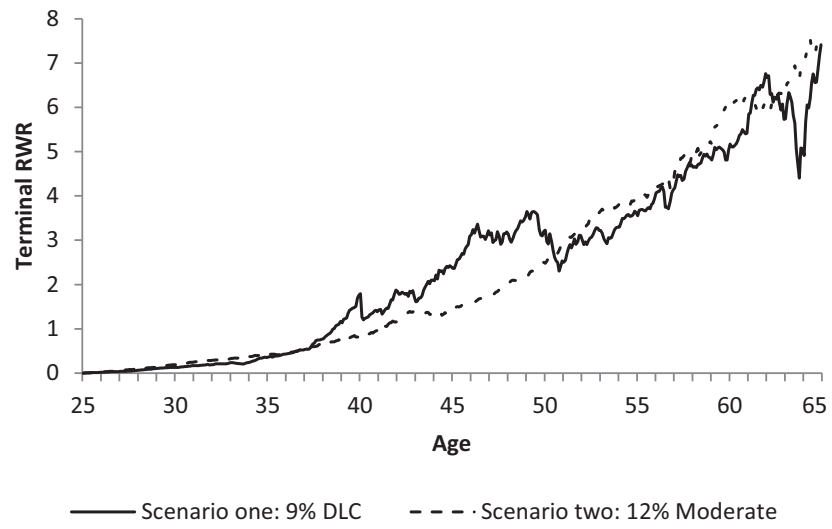
**Figure 2:** Balanced TRF heat map in the retirement risk zone using a stationary bootstrap simulation. RWR sequence for every 200th path, ordered best to worst, for the balanced TRF strategy in the last decade before retirement.



**Figure 3:** TDF heat map in the retirement risk zone using a stationary bootstrap simulation. RWR sequence for every 200th path, ordered best to worst, for the TDF strategy in the last decade before retirement.



**Figure 4:** DLC heat map in the retirement risk zone using a stationary bootstrap simulation. RWR sequence for every 200th path, ordered best to worst, for the DLC strategy in the last decade before retirement.



**Figure 5:** Accumulation paths for a 9% SG DLC strategy and 12% SG TRF moderate strategy.

## Appendix

Asset Allocation Strategy	Min	P25	Median	Mean	P75	Max	IQRR	Std Dev
<b>9 % Contribution Rate</b>								
100% Cash	3.22	3.70	3.79	3.80	3.89	4.37	0.05	0.14
Moderate	3.47	7.96	9.78	10.36	12.13	31.78	0.43	3.38
DOA	3.34	8.78	11.13	11.92	14.18	47.78	0.49	4.41
Balanced	3.30	9.71	12.72	13.86	16.66	69.01	0.55	5.82
100% Stocks	2.77	12.79	18.47	21.95	27.03	166.75	0.77	13.64
TDF	3.21	9.88	13.02	14.19	17.05	72.57	0.55	6.09
DLC	2.85	11.57	16.24	19.00	23.21	143.25	0.72	10.94
<b>12% Contribution Rate</b>								
100% Cash	4.43	4.93	5.06	5.06	5.19	5.86	0.05	0.19
Moderate	3.98	10.59	13.02	13.77	16.15	52.78	0.43	4.49
DOA	4.60	11.77	14.92	15.98	18.87	75.19	0.48	6.00
Balanced	3.87	12.89	16.81	18.38	22.20	91.32	0.55	7.82
100% Stocks	3.45	17.02	24.69	29.59	36.26	325.87	0.78	19.10
TDF	4.29	13.06	17.26	18.80	22.65	88.89	0.56	8.07
DLC	2.98	15.55	21.84	25.08	30.62	191.45	0.69	13.93

**Table A1:** Extended summary statistics of Monte Carlo simulation of RWR distributions for seven asset allocation strategies.

Asset Allocation Strategy	Min	P25	Median	Mean	P75	Max	IQRR	Std Dev
<b>9% Contribution Rate</b>								
100% Cash	3.20	3.70	3.79	3.80	3.89	4.51	0.05	0.15
Moderate	3.37	7.93	9.80	10.35	12.16	39.58	0.43	3.43
DOA	3.36	8.78	11.12	11.90	14.13	55.26	0.48	4.44
Balanced	3.04	9.65	12.58	13.72	16.51	77.30	0.55	5.86
100% Stocks	2.31	12.69	18.48	21.94	27.06	222.33	0.78	14.21
TDF	2.91	9.79	12.82	14.09	16.96	81.09	0.56	6.19
DLC	2.31	10.92	15.35	17.67	21.50	127.42	0.69	9.94
<b>12% Contribution Rate</b>								
100% Cash	4.38	4.94	5.05	5.06	5.18	5.86	0.05	0.19
Moderate	4.52	10.67	13.09	13.88	16.28	52.74	0.43	4.56
DOA	4.41	11.83	14.87	15.95	18.98	69.53	0.48	5.90
Balanced	4.21	13.01	16.83	18.40	22.11	91.41	0.54	7.74
100% Stocks	3.35	17.16	24.72	29.43	36.38	232.79	0.78	18.58
TDF	4.55	13.23	17.15	18.88	22.64	88.85	0.55	8.13
DLC	3.35	14.80	20.44	23.66	28.80	143.03	0.68	13.02

**Table A2:** Extended summary statistics of Efron (1979) bootstrap simulation of RWR distributions for seven asset allocation strategies.

<b>Asset Allocation Strategy</b>	<b>Min</b>	<b>P25</b>	<b>Median</b>	<b>Mean</b>	<b>P75</b>	<b>Max</b>	<b>IQRR</b>	<b>Std Dev</b>
<b><i>9% Contribution Rate</i></b>								
100% Cash	2.12	2.99	3.59	4.14	4.73	20.42	0.48	1.75
Moderate	3.14	7.33	9.41	11.02	12.88	70.81	0.59	5.60
Default Option Average	2.98	8.24	10.79	12.67	15.06	94.89	0.63	6.77
Balanced	2.81	9.19	12.32	14.60	17.50	126.52	0.67	8.32
100% Stocks	2.29	12.48	18.71	23.29	28.65	291.74	0.86	16.94
TDF	2.84	9.34	12.55	15.00	17.91	126.06	0.68	8.73
DLC	2.29	10.78	15.26	18.69	22.63	182.81	0.78	12.21
<b><i>12% Contribution Rate</i></b>								
100% Cash	2.82	4.03	4.79	5.53	6.26	45.22	0.47	2.37
Moderate	4.20	9.81	12.49	14.65	17.05	136.09	0.58	7.68
DOA	3.90	10.97	14.37	16.80	19.67	146.65	0.61	9.15
Balanced	3.60	12.14	16.47	19.32	22.94	156.68	0.66	11.10
100% Stocks	2.82	16.42	24.77	30.56	37.57	333.13	0.85	21.97
TDF	3.74	12.38	16.78	19.84	23.63	171.56	0.67	11.65
DLC	2.28	14.18	20.43	24.66	29.84	252.16	0.77	16.14

**Table A3:** Extended summary statistics of stationary bootstrap simulation of RWR distributions for seven asset allocation strategies.